Minerals yearbook: Area reports: domestic 1983. Year 1983, Volume 2 1983

Bureau of Mines
Washington, D. C.: Bureau of Mines : United States Government Printing Office, 1983

Minerals Yearbook

1983

Volume II

AREA REPORTS: DOMESTIC

Prepared by staff of the

BUREAU OF MINES

UNITED STATES DEPARTMENT OF THE INTERIOR • Donald Paul Hodel, Secretary

BUREAU OF MINES • Robert C. Horton, Director

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities to protect and conserve our land and water, energy and minerals, fish and wildlife, and park and recreation areas, and for the wise use of all those resources. The Department also has a major responsibility for American Indian reservation communities and for the people who live in Island Territories under U.S. administration.

U.S. GOVERNMENT PRINTING OFFICE

WASHINGTON : 1985

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

1983

Foreword

2 This edition of the Minerals Yearbook discusses the performance of the worldwide mineral industry during 1983 and provides background information to assist in interpreting developments during the year being reviewed. Content of the individual volumes follows:

Volume I, Metals and Minerals, contains chapters on virtually all metallic and nonmetallic mineral commodities important to the U.S. economy. In addition, it includes a statistical summary chapter, a chapter on mining and quarrying trends, and a chapter discussing the statistical surveying methods used by the Bureau of Mines.

Volume II, Area Reports: Domestic, contains chapters on the mineral industry of each of the 50 States, the U.S. island possessions in the Pacific Ocean and the Caribbean Sea, and the Commonwealth of Puerto Rico. This volume also has a statistical summary.

Volume III, Area Reports: International, contains the latest available mineral data on more than 130 foreign countries and discusses the importance of minerals to the economies of these nations. A separate chapter reviews the international mineral industry in general and its relationship to the world economy.

The Bureau of Mines continually strives to improve the value of its publications to its users. Therefore, the constructive comments and suggestions of readers of the Yearbook will be welcomed.

Robert C. Horton, *Director*

Acknowledgments

The chapters of this volume were written by the State Liaison Officers of the Bureau of Mines, located throughout the country.

The Statistical Summary chapter and the tabular material covering total State mineral production, value of mineral production by county, and economic indicators were prepared in the Office of the Assistant Director, Minerals Information. The Division of Publication reviewed the manuscripts upon which this volume was based to ensure statistical consistency among the tables, figures, and text between this volume and Volume I, and between this volume and those of former years.

Compilations contained in this volume were based largely on statistics and other data provided by the mineral industries. The Bureau gratefully acknowledges the willing contribution of these essential data by both companies and individuals.

In the collection of statistical and other mineral-industry information, the Bureau of Mines was also assisted by various State agencies through cooperative agreements. Many of the chapters in Volume II were reviewed by staff members of these agencies; in some instances the staff members collaborated in preparing the chapters and are shown as coauthors. Our sincere appreciation for this assistance is extended to the following cooperating organizations:

Alabama: Geological Survey of Alabama.
Alaska: Division of Geological and Geophysical Surveys, Alaska Department of Natural Resources.
Arizona: Arizona Department of Mineral Resources.
Arkansas: Arkansas Geological Commission.
California: Division of Mines and Geology, California Department of Conservation.
Colorado: Colorado Geological Survey.
Connecticut: Geological and Natural History Survey of Connecticut, Department of Environmental Protection.
Delaware: Delaware Geological Survey.
Florida: Florida Bureau of Geology.
Georgia: Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources.
Hawaii: Department of Land and Natural Resources.
Idaho: Idaho Geological Survey, University of Idaho.
Illinois: State Geological Survey Division, Illinois Department of Energy and Natural Resources.
Indiana: Geological Survey, Indiana Department of Natural Resources.
Iowa: Iowa Geological Survey.
Kansas: Kansas Geological Survey.
Kentucky: Kentucky Geological Survey.
Louisiana: Louisiana Geological Survey.
Maine: Maine Geological Survey.
Maryland: Maryland Geological Survey.
Massachusetts: Office of the State Geologist, Massachusetts Department of Environmental Quality.
Michigan: Geological Survey Division, Michigan Department of Natural Resources.
Minnesota: Mineral Resources Research Center, University of Minnesota.
Mississippi: Bureau of Geology and Energy Resources, Mississippi Department of Natural Resources.

Missouri: Division of Geology and Land Survey, Missouri Department of Natural Resources.
Montana: Montana Bureau of Mines and Geology.
Nebraska: Conservation and Survey Division of the University of Nebraska (Nebraska Geological Survey).
Nevada: Nevada Bureau of Mines and Geology.
New Hampshire: New Hampshire Department of Resources and Economic Development.
New Jersey: Geological Survey, Division of Water Resources, New Jersey Department of Environmental Protection.
New Mexico: New Mexico Bureau of Mines and Mineral Resources.
New York: New York State Education Department, Geological Survey.
North Carolina: Division of Land Resources, North Carolina Department of Natural Resources and Community Development.
North Dakota: North Dakota Geological Survey.
Oklahoma: Oklahoma Geological Survey.
Oregon: Department of Geology and Mineral Industries.
Pennsylvania: Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources.
Puerto Rico: Department of Natural Resources.
Rhode Island: Department of Environmental Management.
South Carolina: South Carolina Geological Survey, State Division of Research and Statistical Services.
South Dakota: South Dakota Geological Survey.
Tennessee: Tennessee Division of Geology.
Texas: Bureau of Economic Geology, The University of Texas at Austin.
Utah: Utah Geological and Mineral Survey.
Vermont: Office of the State Geologist, Agency of Environmental Conservation.
Virginia: Virginia Division of Mineral Resources.
Washington: Washington Division of Geology and Earth Resources.
West Virginia: West Virginia Geological and Economic Survey.
Wisconsin: Wisconsin Geological and Natural History Survey.
Wyoming: Geological Survey of Wyoming.

Albert E. Schreck, *Chief, Division of Publication*

Contents

Statistical Summary

By Rose L. Ballard[1]

This chapter summarizes data on crude nonfuel mineral production for the United States, its island possessions, and the Commonwealth of Puerto Rico. Included also are the tables that show the principal nonfuel mineral commodities exported from and imported into the United States and that compare world and U.S. mineral production. The detailed data from which these tables were derived are contained in the individual commodity chapters of Volume I and in the State chapters of Volume II of this edition of the Minerals Yearbook.

Although crude mineral production may be measured at any of several stages of extraction and processing, the stage of measurement used in this chapter is what is normally termed "mine output." It usually refers to minerals or ores in the form in which they are first extracted from the ground, but customarily includes the output from auxiliary processing at or near the mines.

Because of inadequacies in the statistics available, some series deviate from the foregoing definition. For copper, gold, lead, silver, tin, and zinc, the quantities are recorded on a mine basis (as the recoverable content of ore sold or treated). However, the values assigned to these quantities are based on the average selling price of refined metal, not the mine value. Mercury is measured as recovered metal and valued at the average New York price for the metal.

The weight or volume units shown are those customarily used in the particular industries producing the commodities. Values shown are in current dollars, with no adjustments made to compensate for changes in the purchasing power of the dollar.

[1]Statistical specialist, Minerals Information.

Table 1.—Nonfuel mineral production[1] in the United States

Mineral	1981		1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS						
Antimony ore and concentrate short tons, antimony content	646	W	503	W	838	W
Bauxite thousand metric tons, dried equivalent	1,510	$26,489	732	$12,334	679	$11,309
Copper (recoverable content of ores, etc.) metric tons	1,538,160	2,886,440	r1,146,975	r1,840,856	1,038,098	1,751,476
Gold (recoverable content of ores, etc.) troy ounces	1,379,161	633,918	r1,465,686	r550,968	1,957,379	829,929
Iron ore, usable (excluding byproduct iron sinter) thousand long tons, gross weight	72,158	2,914,689	35,751	1,491,705	44,295	1,938,496
Iron oxide pigments, crude short tons	67,214	2,285	67,294	2,702	40,023	2,368
Lead (recoverable content of ores, etc.) metric tons	445,535	358,821	r512,516	r288,579	449,038	214,623
Manganiferous ore (5% to 35% Mn) short tons, gross weight	174,760	2,889	31,509	293	33,523	216
Mercury 76-pound flasks	27,904	11,549	25,760	W	25,070	W
Molybdenum (content of concentrate) thousand pounds	118,916	945,540	r76,135	r504,089	49,163	167,164
Nickel (content of ore and concentrate) short tons	12,099	W	3,203	W	--	--
Silver (recoverable content of ores, etc.) thousand troy ounces	40,683	427,921	r40,248	r319,975	43,415	496,671
Titanium concentrate: Ilmenite short tons, gross weight	523,681	37,013	233,063	19,093	W	W
Tungsten ore and concentrate metric tons, contained W	3,545	62,231	1,575	22,062	1,016	10,528
Vanadium (recoverable in ore and concentrate) short tons	5,126	71,496	4,098	52,577	2,171	30,675
Zinc (recoverable content of ores, etc.) metric tons	312,418	306,879	r303,160	r257,116	275,294	251,204
Combined value of beryllium concentrates, magnesium chloride for magnesium metal, platinum-group metals (1981), rare-earth metal concentrate, tin, titanium concentrate (rutile), zircon concentrate, and values indicated by symbol W	XX	153,902	XX	154,917	XX	161,100
Total	XX	8,842,000	XX	r5,517,000	XX	5,866,000
NONMETALS (EXCEPT FUELS)						
Abrasive stones short tons	2,501	1,096	1,285	553	1,101	482
Asbestos metric tons	75,618	30,685	63,515	24,917	69,906	27,866
Asphalt and related bitumens, native: Bituminous limestone, sandstone, gilsonite thousand short tons	1,261	27,654	W	W	W	W
Barite do	2,849	102,439	1,845	69,522	754	29,203
Boron minerals do	1,481	435,387	1,234	384,597	1,303	439,181
Bromine thousand pounds	377,100	90,200	401,100	102,600	370,000	91,000
Calcium chloride short tons	704,691	61,692	e616,513	e61,483	W	W
Carbon dioxide, natural thousand cubic feet	1,577,053	2,607	2,067,500	3,399	--	--
Cement:						
Masonry thousand short tons	2,738	161,819	2,364	145,172	2,921	186,240
Portland do	68,197	3,515,600	61,080	3,084,439	67,183	3,315,690
Clays do	44,379	988,845	35,345	825,064	40,858	931,091
Diatomite do	687	113,010	613	107,619	619	114,279
Feldspar short tons	665,000	21,000	615,000	20,300	710,000	22,500
Fluorspar do	115,404	18,412	77,017	13,293	e61,000	e10,000
Garnet (abrasive) do	25,451	2,059	27,303	2,321	29,767	2,533
Gem stones[e]	NA	7,625	NA	7,150	NA	7,425
Gypsum thousand short tons	11,497	98,101	10,538	89,131	12,884	101,361
Helium:						
Crude million cubic feet	175	2,100	W	W	W	W
Grade-A do	1,223	31,798	31,248	342,432	31,299	345,465
Lime thousand short tons	18,856	884,197	14,075	696,207	14,867	757,611
Magnesium compounds short tons	W	W	W	W	556,113	145,084
Mica (scrap) thousand short tons	133	8,212	106	r6,398	140	6,479
Peat do	757	18,783	r769	r16,871	725	18,667
Perlite short tons	591,000	17,458	506,000	16,044	474,000	15,664
Phosphate rock thousand metric tons	53,624	1,437,986	37,414	950,326	42,573	1,020,901
Potassium salts (K_2O equivalent) do	1,908	328,900	1,784	265,600	1,513	220,800

See footnotes at end of table.

Table 1.—Nonfuel mineral production[1] in the United States —Continued

Mineral	1981		1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS (EXCEPT FUELS) — Continued						
Pumice thousand short tons	499	$4,311	416	$3,750	449	$4,486
Pyrites thousand metric tons	797	49,160	676	41,943	W	W
Salt thousand short tons	38,907	637,568	r37,894	r671,424	34,573	597,081
Sand and gravel:						
Construction do	e690,000	e1,928,000	r594,000	r1,674,000	e655,100	e1,935,000
Industrial do	29,980	332,300	r27,400	r323,800	26,620	335,200
Sodium sulfate (natural) do	608	43,186	W	W	423	39,425
Stone:[4]						
Crushed do	872,600	3,125,000	e790,030	e2,918,300	862,700	3,337,000
Dimension do	1,331	150,461	e1,330	e145,113	1,186	149,483
Sulfur, Frasch process thousand metric tons	5,910	715,683	3,598	434,660	4,111	445,131
Talc and pyrophyllite thousand short tons	1,343	31,497	1,135	r20,671	1,066	20,280
Tripoli short tons	107,330	617	112,928	653	111,020	649
Vermiculite thousand short tons	320	26,181	316	28,508	282	27,170
Combined value of aplite, emery, graphite (1982-83), iodine, kyanite, lithium minerals, magnesite, marl (greensand), olivine, sodium carbonate (natural), staurolite, wollastonite, and values indicated by symbol W	XX	r994,115	XX	r959,269	XX	868,055
Total	XX	r16,446,000	XX	r14,158,000	XX	15,268,000
Grand total	XX	r25,288,000	XX	r19,675,000	XX	21,134,000

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Grindstones, pulpstones, grinding pebbles, sharpening stones, and tube mill liners.

[3]Excludes output in New Mexico; withheld to avoid disclosing company proprietary data; included in nonmetals "Combined value" figure for 1982-83.

[4]Excludes abrasive stone and bituminous limestone and sandstone; all included elsewhere in table.

Table 2.—Nonfuel minerals produced in the United States and principal producing States in 1983

Mineral	Principal producing States, in order of quantity	Other producing States
Antimony ore and concentrate	Idaho and Mont.	
Aplite	Va.	
Asbestos	Calif. and Vt.	
Asphalt (native)	Utah.	
Barite	Nev., Ga., Mo., Mont	Tenn., Ill., Wash.
Bauxite	Ark., Ala., Ga.	
Beryllium concentrate	Utah and S. Dak.	
Boron minerals	Calif.	
Bromine	Ark. and Mich.	
Calcium chloride	Mich. and Calif.	
Cement	Tex., Calif., Pa., Mich	All other States except Alaska, Conn., Del., Mass., Minn., N.H., N.J., N. Dak., R.I., Vt.
Clays	Ga., Tex., Wyo., N.C	All other States except Alaska, Del., Hawaii, R.I., Vt., Wis.
Copper (mine)	Ariz., Utah, N. Mex., Mont	Alaska, Calif., Colo., Idaho, Mo., Nev., Oreg., Tenn.
Diatomite	Calif., Nev., Wash., Oreg.	
Emery	N.Y.	
Feldspar	N.C., Conn., Ga., Calif	Okla. and S. Dak.
Fluorspar	Ill., Nev., Tex.	
Garnet, abrasive	Idaho, Maine, N.Y.	
Gold (mine)	Nev., S. Dak., Utah, Mont	Alaska, Ariz., Calif., Colo., Idaho, N. Mex., Oreg., Wash.
Gypsum	Tex., Iowa, Okla., Calif	Ariz., Ark., Colo., Idaho, Ind., Kans., La., Mich., Mont., Nev., N. Mex., N.Y., Ohio, S. Dak., Utah, Va., Wash., Wyo.
Helium	Kans., Tex., N. Mex.	
Iodine	Okla. and Mich.	
Iron ore	Minn., Mich., Wyo., Mo	Calif., Colo., Mont., Nev., Tex., Utah.
Iron oxide pigments (crude)	Mich., Ga., Mo., Va.	
Kyanite	Va. and Ga.	
Lead (mine)	Mo., Idaho, Colo., N.Y	Alaska, Ariz., Calif., Ill., Mont., Nev., N. Mex., Oreg.
Lime	Ohio, Pa., Mo., Ky	All other States except Alaska, Del., Ga., Maine, Miss., N.H., N.J., N.C., R.I., S.C., Vt.
Lithium minerals	N.C. and Nev.	
Magnesite	Nev.	
Magnesium chloride	Tex.	
Magnesium compounds	Mich., Calif., Fla., Tex	Del., N.J., Utah.
Manganiferous ore	S.C. and Mont.	
Marl, greensand	N.J.	
Mercury	Nev.	
Mica (scrap)	N.C., S. Dak., N. Mex., S.C	Conn., Ga., Pa.
Molybdenum	Ariz., Colo., Mont., Utah	Nev. and N. Mex.
Olivine	N.C. and Wash.	
Peat	Mich., Fla., Ind., Ill	Calif., Colo., Ga., Iowa, Maine, Md., Mass., Minn., Mont., N.J., N.Y., N.C., N. Dak., Ohio, Pa., S.C., Wash., Wis.
Perlite	N. Mex., Ariz., Calif., Nev	Colo., Idaho, Utah.
Phosphate rock	Fla., Idaho, N.C., Tenn	Ala., Mont., Utah.
Potassium salts	N. Mex., Utah, Calif.	
Pumice	Oreg., N. Mex., Calif., Idaho	Ariz., Hawaii, Kans., Okla.
Pyrites, ore and concentrate	Tenn. and Ariz.	
Rare-earth metal concentrate	Calif. and Fla.	
Salt	La., Tex., N.Y., Ohio	Ala., Ariz., Calif., Kans., Mich., Nev., N. Mex., N. Dak., Okla., Utah, W. Va.
Sand and gravel:		
Construction	Calif., Tex., Alaska, Ohio	All other States.
Industrial	Ill., Mich., N.J., Calif	All other States except Alaska, Del., Hawaii, Iowa, Maine, Md., N.H., N. Mex., N. Dak., R.I., S. Dak., Vt., Wyo.
Silver (mine)	Idaho, Mont., Nev., Utah	Alaska, Ariz., Calif., Colo., Ill., Mo., N. Mex., N.Y., Oreg., S. Dak., Tenn., Wash.
Sodium carbonate (natural)	Wyo. and Calif.	
Sodium sulfate (natural)	Calif., Tex., Utah.	
Staurolite	Fla.	
Stone:		
Crushed	Tex., Fla., Pa., Ill	All other States except Del. and N. Dak.
Dimension	Ga., Ind., Vt., Va	All other States except Alaska, Del., Fla., Ky., La., Miss., Neb., Nev., N. Dak., W. Va.
Sulfur (Frasch)	Tex. and La.	
Talc and pyrophyllite	Tex., Vt., Mont., N.Y	Ark., Calif., Ga., N.C., Oreg., Va., Wash.
Tin	Alaska.	
Titanium concentrate	Fla. and N.Y.	
Tripoli	Ill., Okla., Ark.	
Tungsten ore and concentrate	Calif., Colo., Idaho.	
Vanadium	Colo., Utah, Idaho.	
Vermiculite	Mont., S.C., Va.	
Wollastonite	N.Y. and Calif.	
Zinc (mine)	Tenn., Mo., N.Y., Colo	Idaho, Ill., Ky., N.J., Pa.
Zircon concentrate	Fla.	

Table 3.—Value of nonfuel mineral production in the United States and principal nonfuel minerals produced in 1983

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
Alabama	$361,326	21	1.71	Cement, stone (crushed), lime, clays.
Alaska	122,452	36	.58	Sand and gravel (construction), gold, stone (crushed), tin.
Arizona	1,510,878	3	7.15	Copper, cement, molybdenum, sand and gravel (construction).
Arkansas	246,430	28	1.17	Bromine, cement, stone (crushed), sand and gravel (construction).
California	1,764,401	1	8.35	Boron minerals, cement, sand and gravel (construction), stone (crushed).
Colorado	337,652	22	1.60	Sand and gravel (construction), cement, molybdenum, gold.
Connecticut	71,213	43	.34	Stone (crushed), sand and gravel (construction), feldspar, sand and gravel (industrial).
Delaware	[1]3,200	50	.02	Magnesium compounds, sand and gravel (construction).
Florida	1,274,979	5	6.03	Phosphate rock, stone (crushed), cement, clays.
Georgia	850,224	7	4.02	Clays, stone (crushed), cement, stone (dimension).
Hawaii	52,411	44	.25	Stone (crushed), cement, sand and gravel (construction), lime.
Idaho	415,079	17	1.96	Silver, phosphate rock, gold, lead.
Illinois	406,907	19	1.93	Stone (crushed), cement, sand and gravel (construction), sand and gravel (industrial).
Indiana	250,542	26	1.19	Stone (crushed), cement, sand and gravel (construction), lime.
Iowa	247,360	27	1.17	Stone (crushed), cement, sand and gravel (construction), gypsum.
Kansas	267,004	25	1.26	Cement, salt, stone (crushed), helium (Grade-A).
Kentucky	224,517	31	1.06	Stone (crushed), lime, cement, sand and gravel (construction).
Louisiana	446,761	16	2.11	Sulfur (Frasch), salt, sand and gravel (construction), cement.
Maine	26,363	46	.12	Sand and gravel (construction), cement, stone (crushed), peat.
Maryland	199,409	33	.94	Stone (crushed), cement, sand and gravel (construction), clays.
Massachusetts	95,675	40	.45	Sand and gravel (construction), stone (crushed), lime, stone (dimension).
Michigan	1,160,691	6	5.49	Iron ore, cement, magnesium compounds, salt.
Minnesota	1,455,030	4	6.88	Iron ore, sand and gravel (construction), stone (crushed), sand and gravel (industrial).
Mississippi	89,705	42	.42	Sand and gravel (construction), cement, clays, stone (crushed).
Missouri	725,809	8	3.43	Lead, cement, stone (crushed), lime.
Montana	293,295	23	1.39	Gold, silver, copper, cement.
Nebraska	94,844	41	.45	Cement, stone (crushed), sand and gravel (construction), lime.
Nevada	615,785	12	2.91	Gold, silver, diatomite, cement.
New Hampshire	19,086	48	.09	Sand and gravel (construction), stone (dimension), stone (crushed), clays.
New Jersey	154,615	35	.73	Stone (crushed), sand and gravel (construction), sand and gravel (industrial), zinc.
New Mexico	517,194	13	2.45	Copper, potassium salts, gold, cement.
New York	506,644	14	2.40	Stone (crushed), cement, salt, sand and gravel (construction).
North Carolina	399,158	20	1.89	Stone (crushed), phosphate rock, lithium compounds, sand and gravel (construction).
North Dakota	25,370	47	.12	Sand and gravel (construction), lime, salt, clays.
Ohio	479,144	15	2.27	Stone (crushed), salt, lime, sand and gravel (construction).
Oklahoma	226,186	30	1.07	Cement, stone (crushed), sand and gravel (construction), sand and gravel (industrial).
Oregon	110,943	37	.52	Stone (crushed), sand and gravel (construction), cement, pumice.
Pennsylvania	635,141	10	3.01	Cement, stone (crushed), lime, sand and gravel (construction).
Rhode Island	7,930	49	.04	Stone (crushed), sand and gravel (construction), stone (dimension), gem stones.
South Carolina	230,594	29	1.09	Cement, stone (crushed), clays, sand and gravel (construction).
South Dakota	222,251	32	1.05	Gold, cement, stone (dimension), stone (crushed).
Tennessee	407,051	18	1.93	Stone (crushed), zinc, cement, pyrites.
Texas	1,568,557	2	7.42	Cement, stone (crushed), sulfur (Frasch), sand and gravel (construction).
Utah	656,579	9	3.11	Copper, gold, silver, cement.
Vermont	42,129	45	.20	Stone (dimension), asbestos, sand and gravel (construction), stone (crushed).
Virginia	289,344	24	1.37	Stone (crushed), cement, sand and gravel (construction), lime.
Washington	187,465	34	.89	Cement, sand and gravel (construction), stone (crushed), lime.

See footnotes at end of table.

Table 3.—Value of nonfuel mineral production in the United States and principal nonfuel minerals produced in 1983 —Continued

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
West Virginia	$103,973	38	.49	Stone (crushed), cement, sand and gravel (industrial), salt.
Wisconsin	101,191	39	.48	Stone (crushed), sand and gravel (construction), lime, sand and gravel (industrial).
Wyoming	629,901	11	2.98	Sodium carbonate, clays, iron ore, cement (portland).
Total	21,134,000	XX	100.00	

XX Not applicable.
[1]Incomplete total.

Table 4.—Value of nonfuel mineral production per capita and per square mile in 1983, by State

State	Area (square miles)	1983 population (thousands)	Value of mineral production				
			Total (thousands)	Per square mile		Per capita	
				Dollars	Rank	Dollars	Rank
Alabama	51,705	3,959	$361,326	6,988	23	91	20
Alaska	591,004	479	122,452	207	50	256	10
Arizona	114,000	2,963	1,510,878	13,253	9	510	3
Arkansas	53,187	2,328	246,430	4,633	31	106	17
California	158,706	25,174	1,764,401	11,117	12	70	25
Colorado	104,091	3,139	337,652	3,244	37	108	16
Connecticut	5,018	3,138	71,213	14,192	7	23	43
Delaware	2,044	606	[1]3,200	1,566	45	5	50
Florida	58,664	10,680	1,274,979	21,734	1	119	14
Georgia	58,910	5,732	850,224	14,433	6	148	11
Hawaii	6,471	1,023	52,411	8,099	17	51	33
Idaho	83,564	989	415,079	4,967	30	420	4
Illinois	56,345	11,486	406,907	7,222	21	35	40
Indiana	36,185	5,479	250,542	6,924	24	46	34
Iowa	56,275	2,905	247,360	4,396	32	85	22
Kansas	82,277	2,425	267,004	3,245	36	110	15
Kentucky	40,409	3,714	224,517	5,556	29	60	28
Louisiana	47,752	4,438	446,761	9,356	16	101	18
Maine	33,265	1,146	26,363	793	48	23	44
Maryland	10,460	4,304	199,409	19,064	4	46	35
Massachusetts	8,284	5,767	95,675	11,594	10	17	48
Michigan	58,527	9,069	1,160,691	19,832	3	128	13
Minnesota	84,402	4,144	1,455,030	17,239	5	351	8
Mississippi	47,689	2,587	89,705	1,881	43	35	41
Missouri	69,697	4,970	725,809	10,414	13	146	12
Montana	147,046	817	293,295	1,995	42	359	7
Nebraska	77,355	1,597	94,844	1,226	46	59	29
Nevada	110,561	891	615,785	5,570	28	691	2
New Hampshire	9,279	959	19,086	2,057	41	20	47
New Jersey	7,787	7,468	154,615	19,856	2	21	45
New Mexico	121,593	1,399	517,194	4,254	35	370	6
New York	49,108	17,667	506,644	10,317	14	29	42
North Carolina	52,669	6,082	399,158	7,579	19	66	27
North Dakota	70,702	680	25,370	359	49	37	39
Ohio	41,330	10,746	479,144	11,593	11	45	36
Oklahoma	69,956	3,298	226,186	3,233	38	69	26
Oregon	97,073	2,662	110,943	1,143	47	42	38
Pennsylvania	45,308	11,895	635,141	14,018	8	53	30
Rhode Island	1,212	955	7,930	6,543	25	8	49
South Carolina	31,113	3,264	230,594	7,412	20	71	24
South Dakota	77,116	700	222,251	2,882	39	318	9
Tennessee	42,144	4,685	407,051	9,659	15	87	21
Texas	266,807	15,724	1,568,557	5,879	27	100	19
Utah	84,899	1,619	656,579	7,734	18	406	5
Vermont	9,614	525	42,129	4,382	33	80	23
Virginia	40,767	5,550	289,344	7,098	22	52	32
Washington	68,139	4,300	187,465	2,751	40	44	37
West Virginia	24,231	1,965	103,973	4,291	34	53	31
Wisconsin	56,153	4,751	101,191	1,802	44	21	46
Wyoming	97,809	514	629,901	6,440	26	1,225	1
Total[2] or average	3,618,702	233,357	21,134,000	5,840	XX	91	XX

XX Not applicable.
[1]Incomplete total.
[2]Excludes Washington, DC (which has no mineral production), with an area of 69 square miles and a population of 623,000.

Table 5.—Nonfuel mineral production[1] in the United States, by State

Mineral	1981		1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ALABAMA						
Cement:						
Masonry thousand short tons	193	$10,721	150	$9,086	210	$13,417
Portland do	2,270	89,216	2,558	104,461	3,279	150,255
Clays[2] do	1,910	25,406	1,323	13,193	1,863	20,758
Gem stones	NA	1	NA	1	NA	1
Lime thousand short tons	1,219	59,454	907	42,380	981	41,149
Sand and gravel:						
Construction do	e9,503	e23,340	7,019	17,226	e8,600	e23,500
Industrial do	182	864	960	8,096	418	3,256
Stone:						
Crushed do	20,706	88,377	e21,200	e89,600	20,558	95,374
Dimension do	7	2,130	e8	e2,341	7	2,661
Combined value of asphalt (native, 1981), bauxite, clays (bentonite), phosphate rock, and salt	XX	14,288	XX	13,025	XX	10,955
Total	XX	313,797	XX	299,409	XX	361,326
ALASKA						
Gem stones	NA	$60	NA	$60	NA	$60
Gold (recoverable content of ores, etc.) troy ounces	26,531	12,195	30,513	11,470	34,702	14,714
Sand and gravel (construction) thousand short tons	e41,000	e75,600	40,832	74,895	e45,200	e97,200
Silver (recoverable content of ores, etc.) thousand troy ounces	2	25	2	17	4	47
Stone (crushed) thousand short tons	5,359	26,855	e5,100	e25,200	1,981	9,460
Tin metric tons	136	1,200	W	W	W	W
Combined value of copper (1982-83), lead, platinum-group metals (1981), tungsten ore and concentrate (1981), and values indicated by symbol W	XX	265	XX	1,269	XX	971
Total	XX	116,200	XX	112,911	XX	122,452
ARIZONA						
Clays thousand short tons	148	$1,105	143	$998	151	$1,425
Copper (recoverable content of ores, etc.) metric tons	1,040,813	1,953,142	r769,521	r1,235,055	678,216	1,144,285
Gem stones	NA	3,250	NA	2,800	NA	2,800
Gold (recoverable content of ores, etc.) troy ounces	100,339	46,120	61,050	22,949	61,991	26,284
Gypsum thousand short tons	213	2,594	175	1,205	265	1,929
Lead (recoverable content of ores, etc.) metric tons	993	800	359	202	144	69
Lime thousand short tons	538	29,913	326	17,080	340	16,700
Molybdenum (content of concentrate) thousand pounds	35,808	254,345	r20,445	r89,928	23,934	79,459
Pumice thousand short tons	1	3	1	7	2	15
Sand and gravel:						
Construction do	e20,990	e63,340	19,124	58,375	e23,200	e75,000
Industrial do	179	2,455	107	1,617	W	W
Silver (recoverable content of ores, etc.) thousand troy ounces	8,055	84,728	r6,309	r50,159	4,492	51,383
Stone:						
Crushed thousand short tons	6,315	26,263	e5,200	e22,200	4,755	24,079
Dimension do	W	578	W	e580	(3)	1
Zinc metric tons	138	135	--	--	--	--
Combined value of asbestos (1981), barite (1981), cement, perlite, pyrites, salt, tungsten ore and concentrate (1981), vanadium (1981), and value indicated by symbol W	XX	93,009	XX	79,105	XX	87,449
Total	XX	2,561,780	XX	r1,582,260	XX	1,510,878

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
ARKANSAS						
Abrasives short tons	W	W	1,085	$469	W	W
Bauxite thousand metric tons	1,242	$22,185	W	W	W	W
Clays thousand short tons	880	9,333	629	6,658	879	$9,956
Gem stones	NA	200	NA	200	NA	200
Lime thousand short tons	149	8,102	W	W	W	W
Sand and gravel:						
Construction do.	e9,146	e22,400	r6,936	r18,700	e6,900	e19,600
Industrial do.	642	8,236	r471	r5,625	386	4,796
Stone:						
Crushed do.	13,834	47,260	e13,100	e48,500	13,448	51,267
Dimension do.	7	411	e5	e290	9	573
Talc do.	W	W	13	92	7	66
Combined value of barite (1981-82), bromine, cement, gypsum, tripoli, vanadium (1981-82), and values indicated by symbol W	XX	153,721	XX	169,754	XX	159,972
Total	XX	271,848	XX	r250,288	XX	246,430
CALIFORNIA						
Boron minerals thousand short tons	1,481	$435,387	1,234	$384,597	1,303	$439,181
Cement, portland do.	7,896	518,966	6,464	401,883	7,567	420,949
Clays do.	2,309	19,118	1,762	15,642	r1,816	r18,255
Diatomite do.	W	W	340	68,139	W	W
Gem stones	NA	300	NA	250	NA	300
Gold (recoverable content of ores, etc.) troy ounces	6,271	2,882	10,547	3,965	38,443	16,300
Gypsum thousand short tons	1,456	13,948	1,088	10,614	1,213	10,668
Lime do.	472	26,834	364	23,000	358	22,994
Mercury 76-pound flasks	85	35	—	—	—	—
Peat thousand short tons	W	W	W	W	13	612
Perlite do.	36	1,044	W	W	W	W
Pumice do.	98	1,501	59	1,285	65	1,582
Sand and gravel:						
Construction do.	e107,200	e352,100	81,147	270,995	e91,000	e308,700
Industrial do.	2,150	28,269	r2,167	r27,528	2,150	34,066
Silver (recoverable content of ores, etc.) thousand troy ounces	53	560	34	271	27	308
Stone:						
Crushed thousand short tons	34,560	118,698	e28,500	e105,400	35,582	146,289
Dimension do.	29	1,909	e29	e1,895	20	2,839
Talc do.	111	5,855	85	1,699	71	1,289
Combined value of asbestos, calcium chloride, carbon dioxide (1981-82), cement (masonry, 1982-83), clays (fire clay, 1983), copper, feldspar, iron ore, lead, magnesium compounds, molybdenum (1981-82), potassium salts, pyrophyllite (1981), rare-earth metal concentrate, salt, sodium carbonate, sodium sulfate, tungsten ore and concentrate, wollastonite, zinc (1981), and values indicated by symbol W	XX	446,310	XX	r293,851	XX	340,069
Total	XX	1,973,716	XX	r1,611,014	XX	1,764,401
COLORADO						
Clays thousand short tons	276	$1,734	201	$1,124	459	$2,650
Copper (recoverable content of ores, etc.) metric tons	W	W	575	r922	W	W
Gem stones	NA	80	NA	80	NA	80
Gold (recoverable content of ores, etc.) troy ounces	51,069	23,473	64,584	24,278	63,063	26,739
Gypsum thousand short tons	203	2,346	184	1,571	W	W
Lead (recoverable content of ores, etc.) metric tons	11,431	9,207	W	W	W	W
Molybdenum thousand pounds	73,615	636,037	41,691	360,626	14,244	51,850
Peat thousand short tons	33	299	47	275	W	W
Sand and gravel:						
Construction do.	e23,500	e73,300	r18,590	r58,465	e21,200	e81,600
Industrial do.	W	W	222	3,266	212	3,233
Silver (recoverable content of ores, etc.) thousand troy ounces	3,009	31,650	1,934	15,378	2,146	24,546

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
COLORADO—Continued						
Stone:						
Crushed thousand short tons	6,969	$24,083	e6,900	e$27,800	6,790	$22,749
Dimension do.	1	64	e1	e64	1	86
Combined value of beryllium concentrate (1982), carbon dioxide (1981-82), cement, iron ore, lime, perlite, pyrites (1981-82), salt (1981-82), tin (1981-82), tungsten ore and concentrate, vanadium, zinc, and values indicated by symbol W	XX	164,493	XX	142,049	XX	124,119
Total	XX	966,766	XX	r635,898	XX	337,652
CONNECTICUT						
Clays thousand short tons	73	$391	56	$329	86	$515
Lime do.	16	1,190	8	568	5	400
Sand and gravel:						
Construction do.	e6,500	e15,400	r4,887	r16,237	e5,000	e17,900
Industrial do.	W	W	80	1,746	W	W
Stone:						
Crushed do.	6,837	36,745	e6,100	e32,700	7,692	45,890
Dimension do.	19	910	e20	e1,046	18	1,028
Combined value of feldspar, gem stones, mica (scrap), and values indicated by symbol W	XX	3,985	XX	3,299	XX	5,480
Total	XX	58,621	XX	r55,925	XX	71,213
DELAWARE						
Sand and gravel (construction) thousand short tons	e1,205	e$2,959	1,300	$3,197	e1,400	e$3,200
Total	XX	2,959	XX	3,197	XX	3,200
FLORIDA						
Cement:						
Masonry thousand short tons	288	$20,757	231	$16,267	313	$19,557
Portland do.	3,518	199,064	2,651	136,190	3,329	164,048
Clays do.	731	2r35,319	672	2r31,339	684	31,566
Gem stones	NA	6	NA	6	NA	6
Lime thousand short tons	191	11,343	103	5,828	W	13,881
Peat do.	157	2,885	120	1,575	114	1,999
Sand and gravel:						
Construction do.	e14,910	e30,600	r13,616	r30,081	e14,900	e31,500
Industrial do.	349	4,419	341	4,257	329	3,447
Stone (crushed) do.	65,067	226,192	e53,100	e182,300	57,282	235,700
Combined value of clays (kaolin, 1981-82), magnesium compounds, phosphate rock, rare-earth metal concentrate, staurolite, titanium concentrates (ilmenite and rutile), and zircon concentrates	XX	1,197,304	XX	815,155	XX	773,275
Total	XX	1,727,889	XX	r1,222,998	XX	1,274,979
GEORGIA						
Cement:						
Masonry thousand short tons	89	$4,392	W	W	W	W
Portland do.	1,150	45,423	W	W	W	W
Clays do.	8,029	553,726	6,773	$475,768	7,859	$560,005
Gem stones	NA	20	NA	20	NA	20
Sand and gravel:						
Construction thousand short tons	e3,364	e8,308	3,166	8,361	e3,800	e9,400
Industrial do.	W	W	541	6,793	539	7,298
Stone:						
Crushed do.	35,730	153,751	e34,800	e153,500	41,100	186,192
Dimension do.	268	17,894	e271	e18,510	198	21,672
Talc do.	26	182	20	141	14	101
Combined value of barite, bauxite, feldspar, iron oxide pigments (crude), kyanite, mica (scrap), peat, and values indicated by symbol W	XX	17,067	XX	54,880	XX	65,536
Total	XX	800,763	XX	717,973	XX	850,224

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
HAWAII						
Cement:						
Masonry thousand short tons	10	$807	6	$554	6	$641
Portland do.	302	23,024	227	18,122	216	20,673
Sand and gravel (construction) do.	e459	e1,198	449	1,221	e440	e1,000
Stone:						
Crushed do.	6,036	31,403	e4,500	e26,600	5,532	29,703
Dimension do.	(3)	4	e(3)	e4	(3)	3
Combined value of gem stones, lime, and pumice	XX	589	XX	388	XX	391
Total	XX	57,025	XX	46,889	XX	52,411
IDAHO						
Antimony ore and concentrate, antimony content short tons	432	W	294	W	585	W
Clays thousand short tons	26	$288	8	$101	6	$91
Copper (recoverable content of ores, etc.) metric tons	4,245	7,966	3,074	r4,933	3,556	6,000
Gem stones	NA	75	NA	75	NA	100
Lead (recoverable content of ores, etc.) metric tons	38,397	30,923	W	W	25,726	12,296
Lime thousand short tons	W	W	W	W	85	7,686
Phosphate rock thousand metric tons	5,361	108,964	W	W	W	W
Sand and gravel (construction) thousand short tons	e3,063	e7,329	2,340	6,258	e3,000	e9,800
Silver (recoverable content of ores, etc.) thousand troy ounces	16,546	174,033	14,830	117,901	17,684	202,308
Stone (crushed) thousand short tons	1,437	6,206	e1,200	e6,000	1,935	7,480
Combined value of cement, garnet (abrasives), gold, gypsum, perlite, pumice, sand and gravel (industrial), stone (dimension), tungsten ore and concentrate, vanadium, zinc, and values indicated by symbol W	XX	89,093	XX	164,810	XX	169,318
Total	XX	424,877	XX	r300,078	XX	415,079
ILLINOIS						
Cement, portland thousand short tons	1,574	$61,536	1,757	$78,444	1,857	$74,975
Clays[2] do.	322	1,540	455	2,305	717	3,360
Gem stones	NA	15	NA	15	NA	15
Peat thousand short tons	46	1,502	W	W	W	W
Sand and gravel:						
Construction do.	e25,150	e68,970	21,557	59,149	e21,100	e58,400
Industrial do.	4,646	49,186	3,989	45,665	4,060	42,871
Stone:						
Crushed do.	44,159	165,218	e42,900	e148,300	42,761	166,860
Dimension do.	2	85	e2	e98	2	71
Combined value of barite, cement (masonry), clays (fuller's earth), fluorspar, lead, lime, silver, tripoli, zinc, and values indicated by symbol W	XX	79,434	XX	55,618	XX	60,355
Total	XX	427,486	XX	389,594	XX	406,907
INDIANA						
Cement:						
Masonry thousand short tons	252	$10,972	W	W	W	W
Portland do.	1,538	59,344	1,523	$58,055	W	W
Clays do.	691	1,602	501	1,221	r558	r$1,421
Gem stones	NA	1	NA	1	NA	1
Peat thousand short tons	105	3,140	89	r2,243	81	1,973
Sand and gravel:						
Construction do.	e15,870	e41,330	13,097	34,579	e14,400	e37,900
Industrial do.	257	1,179	W	W	W	W
Stone:						
Crushed do.	25,349	79,910	e20,300	e65,500	24,051	82,782
Dimension do.	145	13,672	e135	e13,337	144	11,015

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
INDIANA—Continued						
Combined value of abrasives (natural), clays (fire clay, 1983), gypsum, lime, and values indicated by symbol W	XX	$40,212	XX	$40,199	XX	$115,450
Total	XX	251,362	XX	r215,135	XX	250,542
IOWA						
Cement:						
Masonry thousand short tons	41	$3,227	W	W	37	$3,425
Portland do	1,779	92,099	1,622	$82,225	1,644	87,836
Clays do	476	2,375	437	2,392	576	3,258
Gem stones	NA	1	NA	1	NA	1
Gypsum thousand short tons	1,383	12,706	1,177	11,345	1,612	13,518
Peat do	10	453	W	W	W	W
Sand and gravel (construction) do	e10,330	e29,080	10,064	25,618	e11,800	e32,800
Stone (crushed) do	22,424	82,891	e22,600	e88,800	24,844	101,097
Combined value of lime, sand and gravel (industrial, 1981-82), stone (dimension), and values indicated by symbol W	XX	6,559	XX	8,256	XX	5,425
Total	XX	229,391	XX	218,637	XX	247,360
KANSAS						
Cement:						
Masonry thousand short tons	51	$2,835	46	$2,628	W	W
Portland do	1,641	81,792	1,549	79,558	W	W
Clays do	915	4,756	664	3,656	718	$3,921
Gem stones	NA	1	NA	1	NA	1
Helium:						
Crude million cubic feet	W	W	--	--	188	3,572
Grade-A do	W	W	790	26,860	775	27,125
Salt[4] thousand short tons	1,410	60,148	r1,601	r72,146	1,719	67,195
Sand and gravel:						
Construction do	e10,500	e21,000	9,720	20,612	e12,400	e26,600
Industrial do	W	W	331	3,635	199	2,184
Stone:						
Crushed do	14,143	45,738	e14,400	e41,100	12,192	44,540
Dimension do	14	605	e11	e395	W	W
Combined value of gypsum, lime, pumice, salt (brine), and values indicated by symbol W	XX	32,185	XX	5,745	XX	91,866
Total	XX	249,060	XX	r256,336	XX	267,004
KENTUCKY						
Clays[2] thousand short tons	490	$2,395	579	$2,039	669	$2,142
Gem stones	NA	1	NA	1	NA	1
Sand and gravel:						
Construction thousand short tons	e6,939	e16,070	6,499	15,936	e5,500	e13,000
Industrial do	W	247	7	116	10	124
Stone (crushed) do	32,433	108,257	e29,500	e104,300	33,399	117,842
Combined value of cement, clays (ball clay, fire clay, 1983), lime, and zinc	XX	81,559	XX	84,555	XX	91,408
Total	XX	208,529	XX	206,947	XX	224,517
LOUISIANA						
Clays thousand short tons	2380	2$6,338	326	2$6,216	2505	$10,793
Gem stones	NA	1	NA	1	NA	1
Salt thousand short tons	12,565	114,476	r12,171	117,569	11,544	100,936
Sand and gravel:						
Construction do	e17,240	e53,550	16,558	50,966	e14,200	e46,600
Industrial do	293	4,026	378	4,590	291	4,252
Stone (crushed) do	W	W	W	W	5,758	25,702
Sulfur (Frasch) thousand metric tons	2,235	W	1,239	W	1,643	W
Combined value of cement, clays (bentonite, 1981-82), gypsum, lime, and values indicated by symbol W	XX	388,005	XX	238,325	XX	258,477
Total	XX	566,396	XX	417,667	XX	446,761

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
MAINE						
Clays thousand short tons	57	$166	37	$76	43	$93
Peat do	W	W	r8	r508	W	W
Sand and gravel (construction) do	e7,500	e19,400	6,701	15,118	e4,800	e12,100
Stone (crushed) do	1,375	5,532	e1,200	e4,000	848	2,851
Combined value of other nonmetals and values indicated by symbol W	XX	18,271	XX	r15,723	XX	11,319
Total	XX	43,369	XX	r35,425	XX	26,363
MARYLAND						
Clays[2] thousand short tons	597	$1,984	405	$1,346	484	$1,747
Gem stones	NA	2	NA	2	NA	2
Lime thousand short tons	9	441	7	396	7	383
Peat do	W	W	r4	W	4	W
Sand and gravel (construction) do	e9,500	e31,800	9,720	32,386	e10,600	e37,800
Stone:						
Crushed do	16,485	74,289	e15,100	e73,500	19,284	80,429
Dimension do	34	1,002	e32	e1,001	12	682
Combined value of cement, clays (ball clay), and values indicated by symbol W	XX	65,937	XX	r62,891	XX	78,366
Total	XX	175,455	XX	r171,522	XX	199,409
MASSACHUSETTS						
Clays thousand short tons	259	$1,322	210	$1,115	237	$1,298
Lime do	170	10,793	135	9,414	156	10,671
Sand and gravel:						
Construction do	e12,500	e31,300	12,003	34,438	e10,400	e36,200
Industrial do	87	W	140	1,615	W	W
Stone:						
Crushed do	7,997	41,037	e6,900	e33,500	7,740	36,002
Dimension do	50	8,616	e51	e9,158	51	10,488
Combined value of gem stones, peat, and values indicated by symbol W	XX	1,669	XX	62	XX	1,016
Total	XX	94,737	XX	89,302	XX	95,675
MICHIGAN						
Cement:						
Masonry thousand short tons	173	$10,584	136	$8,752	W	W
Portland do	3,871	180,641	3,254	149,533	W	W
Clays do	1,610	5,862	1,022	4,370	1,199	$5,693
Gem stones	NA	15	NA	15	NA	15
Gypsum thousand short tons	1,066	6,762	682	5,150	1,097	8,104
Iron ore (usable) thousand long tons, gross weight	14,193	W	W	W	10,713	W
Lime thousand short tons	807	36,800	571	26,823	503	23,142
Peat do	237	4,540	241	4,917	215	4,286
Salt do	2,321	103,293	2,002	106,303	1,355	93,306
Sand and gravel:						
Construction do	e28,100	e68,050	20,567	47,726	e23,000	e52,300
Industrial do	4,393	29,787	2,920	21,934	3,545	27,577
Stone:						
Crushed do	30,013	94,324	e20,700	e67,100	24,763	82,152
Dimension do	6	129	e4	e110	4	112
Combined value of bromine, calcium chloride, copper (1981-82), iodine, iron oxide pigments (crude), magnesium compounds, silver (1981-82), and values indicated by symbol W	XX	899,618	XX	r592,451	XX	864,004
Total	XX	1,440,405	XX	r1,035,184	XX	1,160,691
MINNESOTA						
Clays thousand short tons	84	$1,077	W	W	W	W
Gem stones	NA	5	NA	$5	NA	$5
Iron ore (usable) thousand long tons, gross weight	50,176	2,062,118	23,715	1,021,056	30,699	1,342,455
Lime thousand short tons	155	3,818	133	4,694	W	W

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
MINNESOTA—Continued						
Manganiferous ore short tons	139,571	W	16,307	W	11,314	W
Peat thousand short tons	25	$940	W	W	W	W
Sand and gravel:						
Construction do	e23,950	e49,770	20,276	$44,222	e24,600	e$53,000
Industrial do	W	W	694	5,903	685	12,932
Stone:						
Crushed do	6,995	18,438	e7,100	e20,900	8,580	25,320
Dimension do	41	14,298	e40	e11,940	28	11,365
Combined values of items indicated by symbol W	XX	4,297	XX	1,406	XX	9,953
Total	XX	2,154,761	XX	1,110,126	XX	1,455,030
MISSISSIPPI						
Clays thousand short tons	1,218	$23,309	805	$21,181	1,446	$23,846
Sand and gravel (construction) do	e10,480	e29,260	9,455	27,115	e11,000	e34,600
Stone (crushed) do	W	W	W	W	1,651	4,377
Combined value of cement, sand and gravel (industrial), and values indicated by symbol W	XX	39,682	XX	24,389	XX	26,882
Total	XX	92,251	XX	72,685	XX	89,705
MISSOURI						
Barite thousand short tons	185	$9,725	107	$5,703	W	W
Cement:						
Masonry do	103	5,495	88	4,855	146	$7,339
Portland do	3,732	168,567	3,205	120,339	3,499	157,249
Clays do	1,747	18,414	2r1,383	2r13,409	2r1,418	2r11,848
Copper (recoverable content of ores, etc.) metric tons	8,411	15,783	7,941	r12,745	7,725	13,033
Gem stones	NA	10	NA	10	NA	10
Iron ore thousand long tons	W	W	717	W	877	27,054
Lead (recoverable content of ores, etc.) metric tons	389,721	313,870	474,460	267,150	409,280	195,620
Sand and gravel:						
Construction thousand short tons	e7,500	e16,900	6,359	14,477	e7,700	e17,700
Industrial do	778	8,602	750	8,997	600	7,541
Silver (recoverable content of ores, etc.) thousand troy ounces	1,837	19,322	2,241	17,817	2,021	23,124
Stone (crushed) thousand short tons	40,910	116,297	e38,600	e113,300	39,454	120,700
Zinc (recoverable content of ores, etc.) metric tons	52,904	51,966	63,680	54,009	57,044	52,052
Combined value of clays (fuller's earth, 1982), iron oxide pigments (crude), lime, stone (dimension), and values indicated by symbol W	XX	130,317	XX	100,698	XX	92,539
Total	XX	875,268	XX	r733,509	XX	725,809
MONTANA						
Antimony short tons	214	W	209	W	253	W
Barite thousand short tons	W	W	W	W	10	$750
Clays do	601	$23,111	2218	2$8,064	194	6,205
Copper (recoverable content of ores, etc.) metric tons	62,485	117,257	r64,951	r104,245	33,337	56,245
Gem stones	NA	100	NA	225	NA	300
Gold (recoverable content of ores, etc.) troy ounces	54,267	24,943	75,171	28,258	161,436	68,449
Lead (recoverable content of ores, etc.) metric tons	194	157	661	372	1,163	556
Lime thousand short tons	194	7,621	45	2,331	86	W
Sand and gravel (construction) do	e5,640	e12,910	5,338	12,794	e5,000	e10,200
Silver (recoverable content of ores, etc.) thousand troy ounces	2,989	31,437	6,169	49,041	5,708	65,299

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981		1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MONTANA—Continued						
Stone (crushed) thousand short tons	1,582	$5,137	e1,400	e$4,700	872	$2,344
Zinc (recoverable content of ores, etc.) metric tons	25	24	W	W	--	--
Combined value of cement, clays (fire clay, 1982), graphite (1982-83), gypsum, iron ore, molybdenum (1983), peat, phosphate rock, sand and gravel (industrial), stone (dimension), talc, tungsten ore and concentrate (1981-82), vermiculite, and values indicated by symbol W	XX	80,384	XX	r60,723	XX	82,947
Total	XX	303,081	XX	r270,753	XX	293,295
NEBRASKA						
Clays thousand short tons	136	$409	134	$392	164	$501
Gem stones	NA	W	NA	W	NA	W
Sand and gravel:						
Construction thousand short tons	e11,770	e28,310	r9,731	r23,851	e10,100	e25,000
Industrial do.	19	144	14	105	4	W
Stone (crushed) do.	3,139	14,024	e3,100	e14,300	5,641	30,047
Combined value of cement, lime, and values indicated by symbol W	XX	36,718	XX	36,632	XX	39,296
Total	XX	79,605	XX	r75,280	XX	94,844
NEVADA						
Barite thousand short tons	2,482	$79,716	1,575	$52,727	663	$21,736
Clays do.	73	2,948	103	2,640	58	2,348
Gem stones	NA	1,000	NA	1,200	NA	1,200
Gold (recoverable content of ores, etc.) troy ounces	524,802	241,220	r757,099	r284,601	920,331	390,220
Gypsum thousand short tons	778	6,914	656	4,523	998	7,896
Iron ore thousand long tons	99	1,490	77	1,119	W	W
Lead (recoverable content of ores, etc.) metric tons	W	W	W	W	14	7
Mercury 76-pound flasks	27,819	11,514	25,760	W	25,070	W
Sand and gravel (construction) thousand short tons	e7,065	e15,770	6,027	11,724	e7,500	e16,200
Silver (recoverable content of ores, etc.) thousand troy ounces	3,039	31,970	3,142	24,981	5,164	59,073
Stone (crushed) thousand short tons	1,343	5,664	e1,300	e4,500	1,269	5,358
Zinc (recoverable content of ores, etc.) metric tons	W	W	--	--	--	--
Combined value of cement (portland), copper, diatomite, fluorspar, lime, lithium, magnesite, molybdenum (1982-83), perlite, salt, sand and gravel (industrial), tungsten ore and concentrate (1981-82), and values indicated by symbol W	XX	108,453	XX	r144,448	XX	111,747
Total	XX	506,659	XX	r532,463	XX	615,785
NEW HAMPSHIRE						
Sand and gravel (construction) thousand short tons	e4,528	e$12,990	4,332	$12,593	e4,000	e$12,100
Stone:						
Crushed do.	665	2,599	e600	e3,100	946	2,853
Dimension do.	89	6,889	e107	e7,500	58	4,032
Combined value of other nonmetals	XX	122	XX	101	XX	101
Total	XX	22,600	XX	23,294	XX	19,086
NEW JERSEY						
Clays thousand short tons	62	$563	63	$566	62	$596
Gem stones	NA	1	NA	1	NA	1
Peat thousand short tons	26	1,476	W	W	W	W

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981		1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEW JERSEY—Continued						
Sand and gravel:						
Construction thousand short tons	e9,756	e$26,050	7,940	$25,722	e10,800	e$34,300
Industrial do.	2,305	26,438	2,140	28,151	2,386	31,819
Stone (crushed) do.	10,434	57,819	e10,700	e57,800	12,301	70,421
Zinc (recoverable content of ores, etc.) metric tons	16,198	15,911	16,800	14,248	16,475	15,033
Combined value of iron ore (1981), magnesium compounds, marl (greensand), stone (dimension), titanium concentrate (ilmenite, 1981-82), and values indicated by symbol W	XX	20,404	XX	5,922	XX	2,445
Total	XX	148,662	XX	132,410	XX	154,615
NEW MEXICO						
Clays thousand short tons	264	2$119	260	2$112	50	$115
Copper (recoverable content of ores, etc.) metric tons	154,114	289,204	W	W	W	W
Gem stones	NA	200	NA	200	NA	200
Gold (recoverable content of ores, etc.) troy ounces	65,749	30,221	W	W	W	W
Gypsum thousand short tons	166	2,256	198	887	169	1,016
Lead (recoverable content of ores, etc.) metric tons	W	W	W	W	258	123
Lime thousand short tons	W	W	W	W	17	W
Manganiferous ore (5% to 35% Mn) short tons	12,741	W	--	--	--	--
Perlite thousand short tons	489	14,983	408	13,355	394	13,297
Potassium salts thousand metric tons	1,601	261,200	1,497	204,600	1,278	174,700
Pumice thousand short tons	93	919	97	809	110	1,070
Sand and gravel do.	e6,496	e19,780	5,616	17,670	e7,000	e20,000
Silver (recoverable content of ores, etc.) thousand troy ounces	1,632	17,170	805	6,397	W	W
Stone:						
Crushed thousand short tons	4,162	12,485	e2,800	e13,700	4,730	15,121
Dimension do.	26	173	e18	e138	18	141
Combined value of carbon dioxide (1981-82), cement, clays (fire clay 1981-82), helium (Grade-A), mica (scrap), molybdenum, salt, sand and gravel (industrial, 1982), vanadium (1981), zinc (1981), and values indicated by symbol W	XX	47,697	XX	r171,432	XX	291,411
Total	XX	696,407	XX	r429,300	XX	517,194
NEW YORK						
Clays[2] thousand short tons	597	$2,310	352	$897	371	$869
Gem stones	NA	30	NA	30	NA	30
Lead (recoverable content of ores, etc.) metric tons	968	780	r1,065	r600	1,299	621
Peat thousand short tons	39	811	W	W	18	W
Salt do.	5,597	103,668	6,205	117,718	4,859	100,119
Sand and gravel:						
Construction do.	e18,280	e45,560	r17,338	r46,871	e18,700	e54,200
Industrial do.	55	W	45	512	W	W
Silver (recoverable content of ores, etc.) thousand troy ounces	29	303	27	r216	33	379
Stone:						
Crushed thousand short tons	30,681	117,689	e28,700	e132,800	32,331	137,982
Dimension do.	21	2,291	e22	e2,293	24	4,310
Zinc (recoverable content of ores, etc.) metric tons	36,889	36,235	r52,237	r44,303	56,748	51,783
Combined value of cement, clays (ball clay), emery, garnet (abrasive), gypsum, iron ore (1981-82), lime, talc, titanium concentrate (ilmenite), wollastonite, and values indicated by symbol W	XX	171,554	XX	r155,959	XX	156,351
Total	XX	481,231	XX	r502,199	XX	506,644

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
NORTH CAROLINA						
Clays[2] thousand short tons	2,110	$6,838	1,573	$5,243	2,068	$6,681
Feldspar short tons	462,864	13,517	428,755	12,255	508,641	13,610
Gem stones	NA	50	NA	50	NA	50
Mica (scrap) thousand short tons	92	6,398	67	4,793	69	4,266
Sand and gravel:						
Construction do	e6,294	e18,330	5,198	15,395	e5,600	e16,900
Industrial do	1,236	10,440	716	4,878	1,066	11,689
Stone:						
Crushed do	28,833	117,092	e27,500	e117,600	33,694	145,602
Dimension do	30	2,773	e30	e2,814	87	8,267
Talc and pyrophyllite do	5104	5825	83	1,266	89	1,452
Combined value of cement, clays (kaolin), lithium compounds, olivine, peat (1982-83), phosphate rock, and talc (1981)	XX	r256,997	XX	r135,142	XX	190,641
Total	XX	r433,260	XX	r299,436	XX	399,158
NORTH DAKOTA						
Gem stones	NA	$2	NA	$2	NA	$2
Lime thousand short tons	W	W	W	W	57	6,798
Peat do	W	36	W	W	W	W
Sand and gravel (construction) do	e3,000	e6,500	2,347	4,873	e3,800	e15,000
Combined value of clays, salt, and values indicated by symbol W	XX	8,310	XX	8,102	XX	3,570
Total	XX	14,848	XX	12,977	XX	25,370
OHIO						
Cement:						
Masonry thousand short tons	105	$7,129	86	$6,170	97	$7,454
Portland do	1,461	69,517	1,326	59,598	1,575	71,599
Clays do	2,217	10,411	1,451	6,100	1,716	8,061
Gypsum do	148	1,566	109	1,335	W	W
Lime do	2,767	127,751	1,666	76,370	1,906	84,928
Peat do	10	191	5	144	W	W
Salt do	3,608	90,254	3,514	90,572	2,565	85,988
Sand and gravel:						
Construction do	e32,240	e95,570	r26,160	r83,015	e27,200	e84,600
Industrial do	1,487	20,893	1,223	17,816	1,226	17,848
Stone:						
Crushed do	36,950	125,588	e30,300	e105,200	32,937	114,059
Dimension do	W	W	W	W	49	2,923
Combined value of abrasives, gem stones, and values indicated by symbol W	XX	3,290	XX	3,240	XX	1,684
Total	XX	552,160	XX	r449,560	XX	479,144
OKLAHOMA						
Cement:						
Masonry thousand short tons	W	W	W	W	45	$3,074
Portland do	W	W	W	W	1,719	83,685
Clays do	838	$2,064	752	$1,907	862	2,288
Gem stones	NA	2	NA	2	NA	2
Gypsum thousand short tons	1,177	9,870	1,254	10,089	1,351	11,571
Helium:						
Grade-A million cubic feet	49	1,274	--	--	--	--
Crude do	22	264	--	--	--	--
Pumice thousand short tons	1	W	1	W	1	W
Sand and gravel:						
Construction do	e9,000	e21,700	7,490	17,733	e7,500	e17,300
Industrial do	1,500	14,317	1,222	13,114	1,184	13,221
Stone:						
Crushed do	29,930	83,407	e30,100	e84,200	23,865	76,941
Dimension do	18	738	e18	e968	10	737
Combined value of feldspar, iodine, lime, salt, tripoli, and values indicated by symbol W	XX	100,876	XX	97,031	XX	17,367
Total	XX	234,512	XX	225,044	XX	226,186

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981		1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
OREGON						
Clays thousand short tons	176	$300	149	$212	188	$275
Gem stones	NA	600	NA	500	NA	600
Gold (recoverable content of ores, etc.) troy ounces	2,830	1,301	W	W	322	137
Nickel (content of ores and concentrates) short tons	12,099	W	3,203	W	--	--
Sand and gravel (construction) do	e12,000	e35,100	9,513	30,629	e11,000	e37,000
Silver (recoverable content of ores, etc.) thousand troy ounces	7	79	--	--	1	10
Stone:						
Crushed thousand short tons	16,482	46,055	e14,200	e41,900	13,089	39,876
Dimension do	(3)	5	e(3)	e5	W	W
Talc and soapstone do	W	W	(3)	82	(3)	123
Combined value of cement, copper (1981 and 1983), diatomite, lead (1981 and 1983), lime, pumice, sand and gravel (industrial 1983), and values indicated by symbol W	XX	56,107	XX	r34,516	XX	32,922
Total	XX	139,547	XX	r107,844	XX	110,943
PENNSYLVANIA						
Cement:						
Masonry thousand short tons	293	$14,799	256	$14,048	262	$17,095
Portland do	5,150	215,883	4,800	212,945	5,154	218,539
Clays[2] do	1,246	7,497	931	5,616	916	4,311
Gem stones	NA	5	NA	5	NA	5
Lime thousand short tons	1,690	85,418	1,297	70,902	1,507	81,682
Mica (scrap) do	3	134	W	W	W	W
Peat do	25	647	27	669	22	628
Sand and gravel:						
Construction do	e14,000	e61,100	13,081	55,527	e11,800	e52,000
Industrial do	W	W	969	13,589	W	W
Stone:						
Crushed do	53,258	207,821	e50,400	e200,900	51,523	226,948
Dimension do	51	7,193	e48	e6,354	53	5,799
Tripoli short tons	1,263	W	W	W	--	--
Zinc (recoverable content of ores, etc.) metric tons	24,732	24,293	24,762	21,001	16,792	15,322
Combined value of clays (kaolin) and values indicated by symbol W	XX	13,966	XX	r1,094	XX	12,812
Total	XX	638,756	XX	r602,650	XX	635,141
RHODE ISLAND						
Sand and gravel:						
Construction thousand short tons	e1,332	e$3,985	1,146	$3,671	e1,000	e$2,400
Industrial do	W	W	5	52	--	--
Stone (crushed) do	141	1,116	e130	e1,100	971	5,507
Combined value of other nonmetals and value indicated by symbol W	XX	63	XX	18	XX	23
Total	XX	5,164	XX	4,841	XX	7,930
SOUTH CAROLINA						
Cement, portland thousand short tons	1,765	$79,407	1,624	$66,385	W	W
Clays[2] do	1,632	28,600	1,535	28,166	1,813	$34,830
Gem stones	NA	10	NA	10	NA	10
Manganiferous ore thousand short tons	r22	W	15	W	22	W
Peat do	--	--	5	W	W	W
Sand and gravel:						
Construction do	e5,131	e13,240	4,727	13,170	e5,200	e15,000
Industrial do	803	10,531	720	10,902	842	13,169
Stone:						
Crushed do	14,825	49,830	e14,000	e53,000	15,786	61,054
Dimension do	18	1,109	e14	e904	17	1,165
Combined value of cement (masonry), clays (fuller's earth), copper (1981), gold (1981), mica (scrap), silver (1981), vermiculite, and values indicated by symbol W	XX	22,989	XX	r22,181	XX	105,366
Total	XX	205,716	XX	r194,718	XX	230,594

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981		1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
SOUTH DAKOTA						
Cement:						
Masonry thousand short tons	6	$454	4	$383	4	$359
Portland do.	450	23,290	520	27,978	603	37,435
Clays[2] do.	116	209	128	346	123	353
Feldspar short tons	W	W	W	W	7,109	107
Gem stones	NA	70	NA	70	NA	70
Gold (recoverable content of ores, etc.) troy ounces	278,162	127,854	185,038	69,558	309,784	131,348
Sand and gravel (construction) thousand short tons	e4,285	e9,224	3,816	8,604	e5,100	e11,500
Silver (recoverable content of ores, etc.) thousand troy ounces	56	587	26	209	62	713
Stone:						
Crushed thousand short tons	2,985	9,085	e2,600	e7,400	3,906	12,982
Dimension do.	50	17,543	e48	e16,270	43	15,952
Combined value of beryllium, clays (bentonite), gypsum, lime, mica (scrap), and values indicated by symbol W	XX	6,382	XX	4,855	XX	11,432
Total	XX	194,698	XX	135,673	XX	222,251
TENNESSEE						
Cement:						
Masonry thousand short tons	66	$3,209	W	W	W	W
Portland do.	974	39,378	763	$36,689	W	W
Clays do.	1,047	23,134	766	20,107	1,066	$26,516
Gem stones	NA	5	NA	5	NA	5
Phosphate rock thousand metric tons	1,328	16,201	897	11,596	1,193	28,879
Sand and gravel:						
Construction thousand short tons	e8,830	e24,130	5,051	15,917	e6,100	e18,700
Industrial do.	1,142	5,610	468	4,826	483	5,455
Stone:						
Crushed do.	W	W	W	W	30,578	111,506
Dimension do.	11	1,063	e10	e1,012	7	1,161
Zinc (recoverable content of ores, etc.) metric tons	117,684	115,597	121,306	102,882	109,958	100,336
Combined value of barite, copper, gold (1981), lime, pyrites, silver, and values indicated by symbol W	XX	192,822	XX	r185,453	XX	114,493
Total	XX	421,149	XX	r378,487	XX	407,051
TEXAS						
Cement:						
Masonry thousand short tons	229	$15,699	236	$16,440	276	$19,704
Portland do.	10,262	567,391	9,732	545,679	9,760	534,298
Clays do.	4,172	29,135	4,193	26,497	3,955	22,575
Gem stones	NA	200	NA	200	NA	225
Gypsum thousand short tons	1,783	14,900	1,954	16,681	2,049	16,357
Helium (Grade-A) million cubic feet	238	6,188	458	15,572	524	18,340
Lime thousand short tons	1,393	67,158	1,125	62,277	1,067	60,193
Salt do.	8,397	84,240	7,421	82,805	8,028	65,670
Sand and gravel:						
Construction do.	e46,000	e150,000	45,527	154,515	e58,500	e208,000
Industrial do.	2,242	36,992	r2,201	r35,974	1,788	29,637
Stone:						
Crushed do.	72,454	219,086	e68,000	e205,000	76,453	239,642
Dimension do.	42	5,543	e50	e5,822	50	11,071
Sulfur (Frasch) thousand metric tons	3,674	W	2,360	W	2,468	W
Talc and pyrophyllite thousand short tons	282	4,127	205	3,024	250	3,933
Combined value of asphalt (native, 1981), fluorspar, helium (crude), iron ore, magnesium chloride, magnesium compounds, sodium sulfate, and values indicated by symbol W	XX	551,751	XX	r374,912	XX	338,912
Total	XX	1,752,410	XX	r1,545,398	XX	1,568,557

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981		1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
UTAH						
Clays thousand short tons	290	$2,296	[2]183	[2]$994	[2]227	[2]$1,569
Copper (recoverable content of ores, etc.) metric tons	211,276	396,471	189,090	[r]303,483	169,751	286,403
Gem stones	NA	80	NA	80	NA	80
Gold (recoverable content of ores, etc.) troy ounces	227,706	104,663	174,940	65,762	238,459	101,107
Gypsum thousand short tons	300	2,705	231	2,363	305	2,736
Iron ore (usable) thousand long tons, gross weight	691	W	W	W	W	W
Lead (recoverable content of ores, etc.) metric tons	1,662	1,338	W	W		
Lime thousand short tons	333	16,679	286	15,121	315	16,771
Perlite do.	(3)	4	--	--	W	W
Salt do.	1,072	21,775	1,227	23,210	936	23,184
Sand and gravel:						
Construction do.	[e]8,212	[e]54,550	7,579	14,920	[e]9,800	[e]19,800
Industrial do.	22	286	W	W	24	W
Silver (recoverable content of ores, etc.) thousand troy ounces	2,883	30,321	4,342	34,522	4,567	52,242
Stone:						
Crushed thousand short tons	2,840	12,157	[e]2,500	[e]9,800	4,407	14,636
Dimension do.	3	280	[e]3	[e]280	W	W
Zinc (recoverable content of ores, etc.) metric tons	1,576	1,548	--	--	--	--
Combined value of asphalt (native), beryllium concentrate, carbon dioxide (natural, 1981), cement, clays (fuller's earth, 1982-83), magnesium compounds, molybdenum, phosphate rock, potassium salts, sodium sulfate, tungsten ore and concentrate (1981), vanadium, and values indicated by symbol W	XX	174,729	XX	145,669	XX	138,051
Total	XX	819,882	XX	[r]616,204	XX	656,579
VERMONT						
Sand and gravel (construction) thousand short tons	[e]3,196	[e]$7,254	3,218	$6,854	[e]3,000	[e]$6,200
Stone:						
Crushed do.	1,319	5,144	[e]1,200	[e]5,300	1,339	5,579
Dimension do.	207	30,756	[e]202	[e]29,446	118	19,995
Combined value of other nonmetals	XX	10,919	XX	8,550	XX	10,355
Total	XX	54,073	XX	50,150	XX	42,129
VIRGINIA						
Clays thousand short tons	502	$2,016	422	$2,237	784	$5,467
Gem stones	NA	20	NA	20	NA	20
Iron oxide pigments short tons	W	W	1,269	372	W	W
Lead (recoverable content of ores, etc.) metric tons	1,607	1,294	--	--	--	--
Lime thousand short tons	804	35,984	641	29,118	557	24,637
Sand and gravel (construction) do.	[e]7,109	[e]24,470	6,978	28,522	[e]7,200	[e]30,800
Stone:						
Crushed do.	37,071	152,630	[e]35,200	[e]142,300	37,959	158,724
Dimension do.	4	1,130	[e]4	[e]1,130	93	3,067
Zinc (recoverable content of ores, etc.) metric tons	9,731	9,558	--	--	--	--
Combined value of aplite, cement, gypsum, kyanite, sand and gravel (industrial), talc, vermiculite, and values indicated by symbol W	XX	52,178	XX	59,484	XX	66,629
Total	XX	279,280	XX	263,183	XX	289,344

See footnotes at end of table.

Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
WASHINGTON						
Cement:						
Masonry thousand short tons	15	$1,284	W	W	W	W
Portland do.	1,560	100,845	1,154	$75,988	W	W
Clays do.	[2]263	[2]1,524	251	1,829	[2]282	[2]$1,715
Gem stones	NA	200	NA	200	NA	200
Sand and gravel:						
Construction thousand short tons	[e]16,870	[e]42,130	15,190	40,295	[e]15,800	[e]50,300
Industrial do.	304	3,358	242	2,809	337	4,581
Silver thousand troy ounces	67	709	W	W	W	W
Stone:						
Crushed thousand short tons	9,516	25,619	[e]8,600	[e]23,800	10,451	29,607
Dimension do.	15	2,378	[e]14	[e]2,375	1	37
Talc do.	--	--	8	20	W	W
Combined value of barite (1982-83), clays (fire clay, 1983), copper (1981-82), diatomite, gold, gypsum, lead (1982), lime, olivine, peat, tungsten ore and concentrate (1981), and values indicated by symbol W	XX	30,461	XX	[r]24,766	XX	101,025
Total	XX	208,508	XX	[r]172,082	XX	187,465
WEST VIRGINIA						
Clays[2] thousand short tons	220	$502	210	$583	249	$532
Salt do.	W	W	942	W	1,026	W
Sand and gravel (construction) do.	[e]651	[e]2,601	751	3,392	[e]700	[e]3,400
Stone (crushed) do.	7,885	28,399	[e]5,900	[e]22,700	9,439	37,962
Combined value of cement, clays (fire clay), lime, sand and gravel (industrial), and values indicated by symbol W	XX	56,046	XX	[r]48,945	XX	62,079
Total	XX	87,548	XX	[r]75,620	XX	103,973
WISCONSIN						
Iron ore (usable) thousand long tons, gross weight	W	W	263	W	--	--
Lime thousand short tons	326	$17,548	312	$17,685	319	$17,624
Peat do.	10	535	9	W	9	W
Sand and gravel:						
Construction do.	[e]18,210	[e]94,522	14,515	29,218	[e]14,200	[e]28,800
Industrial do.	1,100	13,180	788	9,662	621	7,208
Stone:						
Crushed do.	15,189	39,962	[e]11,400	[e]36,100	14,252	39,896
Dimension do.	40	4,259	[e]37	[e]2,644	24	2,884
Combined value of abrasive stone, cement, peat (1982), and values indicated by symbol W	XX	41,749	XX	[r]16,400	XX	4,779
Total	XX	151,755	XX	[r]111,709	XX	101,191
WYOMING						
Clays thousand short tons	3,855	$100,926	2,561	$73,696	2,140	$49,059
Gem stones	NA	250	NA	250	NA	250
Gypsum thousand short tons	299	2,625	283	2,805	382	2,963
Sand and gravel (construction) do.	[e]3,680	[e]10,120	3,382	10,279	[e]2,400	[e]8,000
Stone (crushed) do.	3,224	9,858	[e]2,300	[e]7,300	2,019	7,769
Combined value of beryllium concentrate (1982-83), cement (masonry, 1981, portland), iron ore, lead (1981), lime, sodium carbonate, and zinc (1981)	XX	644,279	XX	573,865	XX	561,860
Total	XX	768,058	XX	668,195	XX	629,901

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes certain clays; value included in "Combined value" figure.

[3]Less than 1/2 unit.

[4]Excludes salt in brines; value included in "Combined value" figure.

[5]Excludes talc; value included in "Combined value" figure.

Table 6.—Mineral production[1] in the islands administered by the United States

(Thousand short tons and thousand dollars)

Area and mineral	1981		1982		1983	
	Quantity	Value	Quantity	Value	Quantity	Value
American Samoa: Stone	6	127	NA	NA	NA	NA
Guam: Stone	332	W	NA	NA	329	2,192
Virgin Islands: Stone	W	W	NA	NA	237	2,305

NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 7.—Mineral production[1] in the Commonwealth of Puerto Rico

(Thousand short tons and thousand dollars)

Mineral	1981		1982		1983	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement (portland)	1,226	105,420	986	81,822	931	82,509
Clays	200	474	162	298	125	251
Lime	34	3,884	37	1,906	35	3,885
Sand and gravel	NA	NA	NA	NA	NA	NA
Stone:						
Crushed	20,473	96,223	NA	NA	5,536	26,611
Dimension	105	2,040	NA	NA	W	W
Total[2]	XX	208,041	XX	84,026	XX	113,256

NA Not available. W Withheld to avoid disclosing company proprietary data; not included in "Total." XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Total does not include value of items not available.

Table 8.—U.S. exports of principal minerals and products, excluding mineral fuels

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS				
Aluminum:				
Ingots, slabs, crude—short tons	401,174	$476,186	397,608	$534,048
Scrap—do	214,299	157,666	262,159	249,156
Plates, sheets, bars, etc—do	193,837	440,373	178,898	388,679
Castings and forgings—do	7,180	41,156	10,492	55,346
Aluminum sulfate—metric tons	6,121	1,280	14,094	1,593
Other aluminum compounds—do	36,329	26,663	49,706	36,447
Antimony, metals and alloys, crude—short tons	830	1,711	304	1,038
Bauxite including bauxite concentrate—thousand metric tons	49	8,545	74	10,561
Beryllium—pounds	134,013	3,696	37,477	2,693
Bismuth, metals and alloys—do	52,758	371	306,128	703
Cadmium metal—metric tons	11	126	170	351
Chromium:				
Ore and concentrate:				
Exports—thousand short tons	8	1,574	11	1,874
Reexports—do	57	9,172	5	1,350
Ferrochromium—do	5	5,081	4	4,822
Cobalt (content)—thousand pounds	596	7,690	824	5,715
Copper:				
Ore, concentrate, composition metal, unrefined (copper content)—metric tons	200,157	225,261	57,126	67,759
Scrap—do	54,419	63,484	47,986	66,929
Refined copper and semimanufactures—do	115,147	438,219	157,664	532,595
Other copper manufactures—do	17,591	32,787	9,439	18,360
Ferroalloys not elsewhere listed:				
Ferrophosphorus—short tons	4,031	1,402	26,933	3,716
Ferroalloys, n.e.c—do	4,980	8,481	5,775	7,965
Gold:				
Ore and base bullion—troy ounces	1,333,210	498,139	1,257,800	501,016
Bullion, refined—do	1,637,184	590,947	1,881,233	825,418
Iron ore—thousand long tons	3,178	150,522	3,781	182,744
Iron and steel:				
Pig iron—short tons	54,333	3,784	6,364	528
Iron and steel products (major):				
Steel mill products—do	1,842,313	1,601,431	1,198,623	1,054,794
Other steel products—do	342,406	913,111	246,642	553,894
Iron and steel scrap: Ferrous scrap including rerolling materials, ships, boats, other vessels for scrapping—thousand short tons	6,925	622,711	7,752	650,540

Table 8.—U.S. exports of principal minerals and products, excluding mineral fuels —Continued

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
METALS—Continued					
Lead:					
Ore and concentrate	metric tons	29,104	$10,135	20,119	$7,502
Pigs, bars, anodes, sheets, etc	do.	55,629	48,818	20,449	19,090
Scrap	do.	51,752	17,254	50,918	13,139
Magnesium, metal and alloys, scrap, semimanufactured forms, n.e.c	short tons	39,613	104,845	46,690	124,714
Manganese:					
Ore and concentrate	do.	28,560	2,510	19,314	1,972
Ferromanganese	do.	10,311	7,517	8,433	5,765
Silicomanganese	do.	2,952	1,532	6,426	1,746
Metal	do.	2,948	3,861	6,391	8,531
Molybdenum:					
Ore and concentrate (molybdenum content)	thousand pounds	49,783	232,214	47,068	185,122
Metal and alloys, crude and scrap	do.	697	2,317	577	1,860
Wire	do.	632	9,072	610	7,085
Semimanufactured forms, n.e.c	do.	190	4,762	216	4,589
Powder	do.	426	2,356	396	2,737
Ferromolybdenum	do.	255	1,035	171	687
Compounds	do.	12,441	41,806	8,597	22,158
Nickel:					
Alloys and scrap including unwrought metal, ingots, bars, sheets, anodes, etc	short tons	49,729	257,182	38,344	154,536
Catalysts	do.	2,874	19,654	3,165	13,940
Wire	do.	481	6,011	1,039	8,831
Semifabricated forms, n.e.c	do.	3,945	32,248	1,365	14,420
Platinum-group metals:					
Ore and scrap	troy ounces	r397,307	r83,722	782,967	193,463
Palladium, rhodium, iridium, osmiridium, ruthenium, osmium (metal and alloys including scrap)	do.	262,764	41,057	261,188	45,799
Platinum (metal and alloys)	do.	175,805	57,682	184,599	70,652
Rare-earth metals: Ferrocerium and alloys	short tons	27	264	73	393
Selenium	thousand pounds	259	749	206	771
Silicon:					
Ferrosilicon	short tons	14,932	11,996	11,338	10,712
Silicon carbide, crude and in grains (including reexports)	do.	6,979	8,374	5,590	7,164
Silver:					
Ore, concentrate, waste, sweepings	thousand troy ounces	12,594	102,768	18,294	208,066
Bullion, refined	do.	12,876	105,977	13,658	169,383
Tantalum:					
Ore, metal, other forms	thousand pounds	r617	20,113	332	14,030
Powder	do.	115	16,231	123	14,397
Tin:					
Ingots, pigs, bars, etc.:					
Exports	metric tons	5,769	84,454	1,340	17,305
Reexports	do.	rNA	rNA	NA	NA
Tinplate and terneplate	do.	r217,840	118,870	171,121	83,827
Titanium:					
Ore and concentrate	short tons	21,682	1,280	4,391	1,006
Unwrought and scrap metal	do.	4,496	8,192	5,676	9,173
Intermediate mill shapes and mill products, n.e.c	do.	3,600	100,608	2,154	52,197
Pigments and oxides	do.	74,122	82,068	93,521	92,132
Tungsten (tungsten content):					
Ore and concentrate	thousand pounds	672	3,387	2	11
Carbide powder	do.	1,214	14,059	729	9,277
Alloy powder	do.	1,327	17,239	785	7,692
Vanadium:					
Ore and concentrate (vanadium content)	do.	114	626	117	273
Pentoxide, etc	do.	3,163	6,808	5,297	7,871
Ferrovanadium	do.	653	3,436	1,550	6,144
Zinc:					
Slabs, pigs, or blocks	metric tons	341	547	427	801
Sheets, plates, strips, other forms, n.e.c	do.	995	2,351	957	2,142
Waste, scrap, dust (zinc content)	do.	19,059	13,818	22,856	11,169
Semifabricated forms, n.e.c	do.	1,891	3,549	1,708	3,257
Ore and concentrate	do.	77,289	32,534	60,168	22,868
Zirconium:					
Ore and concentrate	thousand pounds	22,023	3,268	26,443	3,316
Oxide	do.	2,033	5,420	1,396	1,898
Metals, alloys, other forms	do.	1,756	43,952	1,494	39,514
NONMETALS					
Abrasives (includes reexports):					
Industrial diamond, natural or synthetic:					
Powder or dust	thousand carats	30,625	66,934	42,312	82,499
Other	do.	1,930	22,525	3,185	34,065
Diamond grinding wheels	do.	473	5,714	467	4,910
Other natural and artificial metallic abrasives and products		NA	r101,603	NA	95,431

See footnotes at end of table.

Table 8.—U.S. exports of principal minerals and products, excluding mineral fuels —Continued

Mineral	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
NONMETALS —Continued				
Asbestos:				
Exports:				
Unmanufactured metric tons	58,525	$19,543	54,236	$19,398
Products do.	NA	126,704	NA	128,584
Reexports:				
Unmanufactured do.	246	170	398	285
Products do.	NA	1,163	NA	998
Barite: Natural barium sulfate short tons	48,533	6,510	22,816	3,514
Boron:				
Boric acid do.	35,030	19,082	38,498	20,688
Sodium borates, refined do.	r227,404	r59,000	224,672	51,000
Bromine compounds thousand pounds	55,600	21,100	61,300	21,600
Calcium:				
Other calcium compounds including precipitated calcium carbonate short tons	31,282	15,613	20,000	13,700
Chloride do.	55,057	11,065	40,597	9,550
Dicalcium phosphate do.	61,308	36,454	48,000	32,600
Cement: Hydraulic and clinker do.	r203,366	27,456	118,393	17,360
Clays:				
Kaolin or china clay thousand short tons	1,296	146,989	1,338	157,882
Bentonite do.	668	54,713	554	42,580
Other do.	655	65,998	592	53,775
Diatomite do.	141	29,863	146	31,569
Feldspar, leucite, nepheline syenite thousand pounds	21,600	989	18,720	856
Fluorspar short tons	10,573	1,084	9,236	962
Gem stones (including reexports):				
Diamond thousand carats	2,683	638,655	2,489	622,411
Pearls	NA	4,247	NA	4,985
Other	NA	106,105	NA	104,020
Graphite, natural short tons	10,335	4,099	9,435	3,455
Gypsum:				
Crude, crushed or calcined thousand short tons	123	13,319	117	13,621
Manufactured, wallboard and plaster articles	NA	16,231	NA	18,467
Helium million cubic feet	378	19,735	368	19,626
Lime short tons	22,541	3,199	28,154	4,815
Lithium compounds:				
Lithium carbonate[1] thousand pounds	10,910	13,506	17,779	23,953
Lithium hydroxide do.	5,250	8,931	5,719	10,159
Other lithium compounds do.	8,738	12,791	4,278	8,183
Magnesium compounds:				
Magnesite, dead-burned short tons	12,869	2,721	10,855	1,955
Magnesite, crude, caustic-calcined, lump or ground do.	23,125	10,925	16,621	8,426
Mica:				
Waste, scrap, ground thousand pounds	22,000	2,886	20,416	2,657
Block, film, splittings do.	294	296	70	109
Manufactured, cut or stamped, built-up do.	NA	5,499	NA	4,001
Mineral-earth pigments, iron oxide, natural and synthetic short tons	9,065	17,795	12,661	20,692
Nitrogen compounds (major) thousand short tons	7,806	1,178,740	7,484	1,050,061
Phosphate rock thousand metric tons	9,735	383,554	12,197	423,361
Phosphatic fertilizers:				
Phosphoric acid do.	1,423	407,081	1,219	322,146
Superphosphates do.	1,148	158,140	1,263	164,672
Diammonium phosphates do.	3,707	678,685	4,758	729,233
Elemental phosphorus metric tons	15,084	25,125	21,752	34,116
Pigments and compounds: Zinc oxide (metal content) thousand metric tons	r323	r528	330	492
Potash:				
Potassium chloride metric tons	691,040	56,710	385,980	30,700
Potassium sulfate do.	140,000	27,648	86,320	16,390
Quartz, crystal:				
Cultured thousand pounds	115	3,500	80	3,258
Natural do.	69	380	28	156
Salt:				
Crude and refined thousand short tons	1,001	16,647	517	12,368
Shipments to noncontiguous territories do.	65	8,451	30	4,101
Sand and gravel:				
Construction:				
Sand do.	631	5,397	934	4,620
Gravel do.	497	2,680	369	1,810
Industrial sand do.	818	26,320	1,047	26,057
Sodium compounds:				
Sodium sulfate do.	111	12,162	91	11,380
Sodium carbonate do.	1,109	140,616	1,636	154,584
Stone:				
Crushed do.	2,065	19,026	2,413	23,021
Dimension do.	NA	18,678	NA	21,185
Sulfur, crude thousand metric tons	961	122,143	992	109,298
Talc, crude and ground thousand short tons	232	12,957	218	12,916
Total	XX	r13,158,477	XX	12,317,027

rRevised. NA Not available. XX Not applicable.
[1]Before 1982, lithium carbonate exports were included with "Other lithium compounds."

Table 9.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels

Mineral	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
METALS				
Aluminum:				
Metal—short tons	679,375	$858,017	818,676	$1,021,273
Scrap—do	74,338	54,240	97,524	87,468
Plates, sheets, bars, etc—do	214,343	416,033	286,614	537,319
Aluminum oxide (alumina)—thousand metric tons	r3,182	770,444	4,030	811,021
Antimony:				
Ore and concentrate (antimony content)—short tons	2,769	4,289	2,770	2,335
Sulfide including needle or liquated—do	88	188	47	58
Metal—do	1,900	3,893	1,282	1,987
Oxide—do	10,433	18,045	10,604	13,318
Arsenic:				
White (As_2O_3 content)—do	16,092	15,241	11,229	8,406
Metallic—do	150	1,044	268	1,401
Bauxite, crude—thousand metric tons	10,122	NA	7,601	NA
Beryllium ore—short tons	2,652	3,215	2,194	2,755
Bismuth, metals and alloys (gross weight)—pounds	2,026,245	3,206	1,971,956	3,121
Cadmium metal—metric tons	2,305	4,684	2,196	3,842
Calcium metal—pounds	333,054	967	332,834	866
Cesium compounds—do	16,647	799	19,227	617
Chromium:				
Ore and concentrate (Cr_2O_3 content)—thousand short tons	209	29,670	86	10,390
Ferrochromium (gross weight)—do	141	77,495	280	109,012
Ferrochromium-silicon—do	7	3,322	1	670
Metal—do	2	10,078	3	13,687
Cobalt:				
Metal—thousand pounds	11,610	137,652	15,853	110,076
Oxide (gross weight)—do	362	2,560	403	1,813
Salts and compounds (gross weight)—do	1,340	2,650	1,671	2,244
Columbium ore—do	910	2,765	1,482	3,316
Copper (copper content):				
Ore and concentrate—metric tons	118,055	141,478	90,597	81,695
Matte—do	4,042	3,609	3,252	4,286
Blister—do	97,374	142,249	46,371	66,027
Refined in ingots, etc—do	258,439	394,654	459,568	700,564
Scrap—do	28,076	35,281	43,723	62,947
Ferroalloys not elsewhere listed, including spiegeleisen—short tons	7,115	21,896	3,098	15,801
Gallium—kilograms	5,199	1,958	7,294	3,195
Germanium—do	12,459	9,287	20,916	10,527
Gold:				
Ore and base bullion—troy ounces	682,661	242,885	993,793	401,548
Bullion, refined—do	4,237,669	1,650,719	3,599,188	1,575,570
Hafnium—pounds	--	--	478	50,058
Indium—thousand troy ounces	686	2,186	1,073	2,795
Iron ore—thousand long tons	14,501	470,847	13,246	445,731
Iron and steel:				
Pig iron—short tons	321,702	48,940	242,114	31,917
Iron and steel products (major):				
Steel mill products—do	16,536,292	8,947,132	17,034,388	6,333,636
Other products—do	744,790	1,342,878	804,095	795,481
Scrap including tinplate—thousand short tons	r474	r38,020	641	48,219
Lead:				
Ore, flue dust, matte (lead content)—metric tons	18,945	8,784	19,753	5,712
Base bullion (lead content)—do	19	28	53	23
Pigs and bars (lead content)—do	94,855	58,633	134,357	64,225
Reclaimed scrap, etc. (lead content)—do	4,834	1,755	4,212	1,340
Sheets, pipes, shot—do	467	694	496	1,632
Magnesium:				
Metal and scrap—short tons	3,652	5,732	3,969	7,174
Alloys (magnesium content)—do	955	3,889	2,143	6,151
Sheets, tubing, ribbons, wire, other forms (magnesium content)—do	177	5,982	238	2,939
Manganese:				
Ore (35% or more contained manganese)—do	237,759	16,160	368,297	19,867
Ferromanganese—do	492,708	154,490	341,608	93,083
Ferrosilicon-manganese (manganese content)—do	41,121	21,471	91,992	40,117
Metal—do	5,226	5,213	5,950	5,323
Mercury:				
Compounds—pounds	37,974	269	135,758	717
Metal—76-pound flasks	8,916	3,003	12,786	3,813

See footnotes at end of table.

Table 9.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS —Continued				
Molybdenum:				
Ore and concentrate (molybdenum content) thousand pounds	3,115	$13,429	1,673	$3,528
Waste and scrap (gross weight) do	NA	1,474	NA	2,141
Metal:				
Unwrought (molybdenum content) do	67	1,370	97	1,398
Wrought (gross weight) do	79	1,959	94	2,331
Ferromolybdenum (gross weight) do	1,665	6,308	1,157	3,189
Material in chief value molybdenum (molybdenum content) do	2,749	12,143	3,445	12,985
Compounds (gross weight) do	4,772	13,030	5,791	9,425
Nickel:				
Pigs, ingots, shot, cathodes short tons	82,297	446,850	90,839	418,943
Plates, bars, etc do	5,120	50,348	4,105	84,553
Slurry do	58,568	105,633	62,454	83,613
Scrap do	4,300	13,349	6,071	17,691
Powder and flakes do	12,132	72,845	12,725	65,747
Ferronickel do	21,352	28,215	45,134	65,264
Oxide do	3,144	13,461	4,209	19,083
Platinum-group metals:				
Unwrought:				
Grains and nuggets (platinum) troy ounces	3,298	1,120	8,513	2,145
Sponge (platinum) do	689,647	305,356	1,005,208	435,333
Sweepings, waste, scrap do	339,095	42,236	417,431	44,308
Iridium do	19,402	9,242	23,266	7,150
Palladium do	1,039,210	98,285	1,223,951	151,149
Rhodium do	68,968	36,284	119,958	48,171
Ruthenium do	133,798	5,395	163,623	5,379
Other platinum-group metals do	23,429	7,501	22,875	7,248
Semimanufactured:				
Platinum do	114,028	42,515	109,376	36,663
Palladium do	60,760	5,159	108,247	12,643
Rhodium do	1,005	459	11,245	1,539
Other platinum-group metals do	1,066	384	213	69
Rare-earth metals:				
Ferrocerium and other cerium alloys short tons	95	1,092	115	1,185
Monazite do	7,940	3,070	4,440	1,517
Metals including scandium and yttrium pounds	7,094	139	1,766	182
Rhenium:				
Metal including scrap do	176	88	623	180
Ammonium perrhenate do	5,193	803	5,947	1,131
Selenium and selenium compounds (selenium content) do	765,731	7,711	654,839	5,922
Silicon:				
Metal (over 96% silicon content) short tons	26,338	52,195	28,173	52,026
Ferrosilicon do	76,732	40,343	159,443	67,445
Silver:				
Ore and base bullion thousand troy ounces	12,530	91,638	13,911	145,419
Bullion, refined do	96,917	786,154	161,199	1,926,102
Sweepings, waste, doré do	8,010	49,287	4,781	52,048
Tantalum ore thousand pounds	1,297	16,286	536	4,017
Tellurium (tellurium content) pounds	36,600	906	26,080	622
Thallium do	2,827	103	3,110	448
Tin:				
Concentrate (tin content) metric tons	1,961	21,544	969	9,549
Dross, skimmings, scrap, residue, tin alloys, n.s.p.f. do	3,068	4,364	1,193	1,219
Tinfoil, powder, flitters, etc	NA	12,288	NA	10,728
Tin scrap and other tin-bearing material excluding tinplate scrap	NA	NA	NA	NA
Tin compounds metric tons	321	2,667	642	4,120
Titanium:				
Ilmenite[1] short tons	596,211	41,630	398,036	29,423
Rutile do	163,325	39,610	111,578	23,532
Metal do	3,713	40,680	3,787	27,899
Ferrotitanium and ferrosilicon titanium do	152	263	893	1,288
Pigments do	138,922	146,569	174,857	165,495
Tungsten ore and concentrate (tungsten content) thousand pounds	7,778	46,748	6,307	25,717
Vanadium (vanadium content):				
Ferrovanadium do	1,339	8,065	1,362	6,259
Pentoxide do	238	1,063	754	2,363
Vanadium-bearing materials do	2,225	5,194	115	86

See footnotes at end of table.

Table 9.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
METALS —Continued					
Zinc:					
Ore (zinc content)	metric tons	66,809	$27,132	63,156	$16,548
Blocks, pigs, slabs	do.	456,233	370,773	617,679	503,888
Sheets, etc.	do.	700	694	319	426
Fume (zinc content)	do.	11	6	631	420
Waste and scrap	do.	2,653	1,232	3,900	1,676
Dross and skimmings	do.	7,104	3,134	6,508	3,314
Dust, powder, flakes	do.	5,864	6,925	6,533	7,126
Manufactured		NA	540	NA	543
Zirconium:					
Ore including zirconium sand	short tons	68,465	6,144	44,487	4,420
Metal, scrap, compounds	do.	1,243	15,431	1,687	15,901
NONMETALS					
Abrasives:					
Diamond (industrial)	thousand carats	19,127	85,837	24,877	88,617
Other		NA	159,211	NA	201,248
Asbestos	metric tons	241,737	64,925	196,387	57,956
Barite:					
Crude and ground	thousand short tons	2,344	120,518	1,397	67,404
Witherite	short tons	333	126	50	16
Chemicals	do.	23,857	13,163	27,832	16,093
Boron:					
Boric acid	do.	4,362	1,903	7,881	3,456
Calcium borate, crude[2]	do.	39,000	6,386	40,000	8,309
Calcium chloride	do.	60,623	3,010	13,784	1,293
Cement: Hydraulic and clinker	thousand short tons	2,929	110,886	4,268	161,439
Clays	short tons	24,245	4,514	20,864	3,488
Cryolite	do.	6,218	4,266	7,199	4,784
Feldspar:					
Crude	do.	48	24	18	6
Ground and crushed	do.	--	--	46	25
Fluorspar	do.	543,723	67,665	453,314	47,032
Gem stones:					
Diamond	thousand carats	4,636	1,917,612	6,265	2,275,373
Emeralds	do.	2,167	120,809	2,117	134,130
Other		NA	346,031	NA	446,951
Graphite, natural	short tons	r53,150	r15,676	43,586	11,921
Gypsum:					
Crude, ground, calcined	thousand short tons	6,720	36,285	8,035	63,983
Manufactured		NA	17,361	NA	30,614
Iodine, crude	thousand pounds	4,728	27,709	6,218	34,039
Lime:					
Hydrated	short tons	60,108	3,305	58,811	3,431
Other	do.	288,266	13,503	223,752	11,345
Lithium:					
Ore	do.	15	5	8	4
Compounds	do.	133	568	189	1,978
Magnesium compounds:					
Crude magnesite	do.	r3,305	306	54	25
Lump or ground caustic-calcined magnesia	do.	13,959	2,055	25,457	5,476
Refractory magnesia, dead-burned, fused magnesite, dead-burned dolomite	do.	59,519	14,588	80,429	14,340
Compounds	do.	44,797	7,965	50,029	9,780
Mica:					
Waste, scrap, ground	thousand pounds	15,854	2,151	14,091	2,189
Block, film, splittings	do.	3,173	1,449	1,899	986
Manufactured, cut or stamped, built-up	do.	724	2,936	735	2,583
Mineral-earth pigments, iron oxide:					
Ocher, crude and refined	short tons	31	20	(3)	3
Siennas, crude and refined	do.	112	46	141	56
Umber, crude and refined	do.	3,768	649	6,640	996
Vandyke brown	do.	423	153	769	309
Other natural and refined	do.	880	576	841	342
Synthetic	do.	20,641	11,886	22,356	14,978
Nepheline syenite:					
Crude	do.	316	16	212	13
Ground, crushed, etc	do.	455,280	13,735	407,139	13,984
Nitrogen compounds (major) including urea	thousand short tons	4,841	681,368	6,281	793,574
Peat:					
Fertilizer-grade	short tons	309,467	38,605	371,486	46,001
Poultry- and stable-grade	do.	60,533	7,752	47,220	6,066
Phosphates, crude and apatite	thousand metric tons	(3)	1,302	9	376
Phosphatic fertilizers:					
Fertilizer and fertilizer materials	do.	8	1,672	36	3,622
Elemental phosphorus	do.	(3)	1,017	2	3,410
Other	do.	41	r6,812	20	5,841

See footnotes at end of table.

Table 9.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS —Continued					
Pigments and salts:					
Lead pigments and compounds	metric tons	12,904	$10,613	15,667	$11,444
Zinc pigments and compounds	do.	35,721	30,932	40,876	34,709
Potash	do.	6,337,900	575,400	7,322,100	600,600
Pumice:					
Crude or unmanufactured	short tons	2,887	102	2,699	113
Wholly or partly manufactured	do.	r118,233	r695	181,606	1,166
Manufactured, n.s.p.f		NA	r103	NA	106
Quartz crystal (Brazilian lascas)	thousand pounds	417	245	153	121
Salt	thousand short tons	5,451	56,184	5,997	60,194
Sand and gravel:					
Industrial sand	do.	r90	2,523	58	1,619
Other sand and gravel	do.	185	1,479	123	1,047
Sodium compounds:					
Sodium bicarbonate	do.	7	1,360	(3)	(3)
Sodium carbonate	do.	18	r2,419	20	2,704
Sodium sulfate	do.	394	28,758	343	27,921
Stone:					
Crushed	do.	1,664	10,570	2,277	10,709
Dimension		NA	169,874	NA	195,378
Calcium carbonate fines	thousand short tons	192	5,811	392	4,104
Strontium:					
Minerals	short tons	33,075	2,057	49,796	3,706
Compounds	do.	1,943	1,850	1,138	1,125
Sulfur and compounds, sulfur ore and other forms, n.e.s	thousand metric tons	1,905	164,885	1,695	129,110
Talc, unmanufactured	thousand short tons	27	r6,264	44	7,691
Total		XX	r24,397,961	XX	23,984,432

rRevised. NA Not available. XX Not applicable.
[1]Includes titanium slag averaging about 70% TiO_2. For details, see Titanium chapter.
[2]Owing to a change of reporting, 1982 calcium borate, crude, imports are not comparable with those of previous years.
[3]Less than 1/2 unit.
[4]No longer reported.

Table 10.—Comparison of world and U.S. production of selected nonfuel mineral commodities

(Thousand short tons unless otherwise specified)

Mineral	1982			1983[p]		
	World production[1]	U.S. production	U.S. percent of world production	World production[1]	U.S. production	U.S. percent of world production
METALS, MINE BASIS						
Antimony (content of ore and concentrate) short tons	59,277	503	1	53,301	838	2
Arsenic trioxide[2] metric tons	26,264	W	NA	25,276	W	NA
Bauxite[3] thousand metric tons	77,793	732	1	76,016	679	1
Beryl[2] short tons	3,414	W	NA	3,189	W	NA
Bismuth thousand pounds	8,799	W	NA	8,935	W	NA
Chromite	8,770	--	--	8,921	--	--
Cobalt (content of ore and concentrate) short tons	26,846	--	--	26,596	--	--
Columbium-tantalum concentrate (gross weight) thousand pounds	56,261	NA	NA	45,846	--	--
Copper (content of ore and concentrate) thousand metric tons	8,071	1,147	14	8,027	1,038	13
Gold (content of ore and concentrate) thousand troy ounces	43,057	1,466	3	44,533	1,957	4
Iron ore (gross weight) thousand long tons	769,149	35,433	5	730,080	38,000	5
Lead (content of ore and concentrate) thousand metric tons	3,408	513	15	3,324	449	14
Manganese ore (35% or more Mn, gross weight)	26,607	--	--	24,739	--	--
Mercury thousand 76-pound flasks	198	26	13	188	25	13
Molybdenum (content of ore and concentrate) thousand pounds	207,344	84,381	41	137,861	33,951	25
Nickel (content of ore and concentrate)	705	3	(4)	759	--	--
Platinum-group metals[2] thousand troy ounces	6,431	8	(4)	6,482	6	(4)
Silver (content of ore and concentrate) do.	383,766	40,248	10	390,618	43,415	11
Tin (content of ore and concentrate) metric tons	237,176	W	NA	211,620	W	NA
Titanium concentrates (gross weight):						
Ilmenite	3,346	263	8	2,876	W	NA
Rutile	374	W	NA	359	W	NA
Tungsten ore and concentrate (contained tungsten) metric tons	45,305	1,521	3	38,882	980	3
Vanadium (content of ore and concentrate) short tons	35,898	4,098	11	30,087	2,171	7
Zinc (content of ore and concentrate) thousand metric tons	6,238	303	5	6,246	275	4
METALS, SMELTER BASIS						
Aluminum (primary only)	14,802	3,609	24	15,284	3,696	24
Cadmium metric tons	16,452	1,007	6	17,244	1,052	6
Cobalt short tons	21,649	508	2	20,316	103	1
Copper smelter (primary and secondary)[5] thousand metric tons	8,281	1,021	12	8,304	987	12
Iron, pig	502,400	43,342	9	505,000	48,770	10
Lead, smelter (primary and secondary)[6] thousand metric tons	5,255	1,088	21	5,234	1,018	19
Magnesium (primary)	273	102	37	291	115	40
Nickel[7]	660	45	7	685	33	5
Selenium[8] kilograms	1,119,821	242,996	22	1,326,533	353,860	27
Steel, raw	707,081	[9]74,577	11	724,480	[9]84,615	12
Tellurium[8] kilograms	101,746	W	NA	110,900	W	NA
Tin metric tons	239,213	[10]3,500	1	222,035	[10]2,500	1
Zinc (primary and secondary) thousand metric tons	5,865	302	5	6,175	305	5
NONMETALS						
Asbestos do.	4,080	64	2	4,157	70	2
Barite	8,257	[11]1,845	22	6,348	[11]754	12
Boron minerals	2,503	1,234	49	2,450	1,303	53
Bromine thousand pounds	826,963	[11]401,100	48	795,770	[11]370,000	46
Cement, hydraulic	969,338	[12]64,341	7	1,020,346	[12]71,347	7
Clays:						
Bentonite[8]	5,628	[11]3,245	58	4,284	[11]1,938	45
Fuller's earth[8]	2,216	[11]1,683	76	2,452	[11]1,912	78
Kaolin[2]	21,098	[11]6,362	30	22,217	[11]7,203	32

See footnotes at end of table.

Table 10.—Comparison of world and U.S. production of selected nonfuel mineral commodities —Continued

(Thousand short tons unless otherwise specified)

Mineral	1982			1983[p]		
	World production[1]	U.S. production	U.S. percent of world production	World production[1]	U.S. production	U.S. percent of world production
NONMETALS —Continued						
Corundum ——short tons	20,918	--	--	19,384	--	--
Diamond ——thousand carats	44,367	--	--	56,119	--	--
Diatomite	1,666	[11]613	37	1,677	[11]619	37
Feldspar	3,745	615	16	3,842	710	18
Fluorspar	4,713	77	2	4,741	61	1
Graphite ——short tons	646,674	W	NA	645,333	W	NA
Gypsum	78,970	10,538	13	85,824	12,884	15
Iodine, crude ——thousand pounds	27,016	W	NA	27,491	W	NA
Lime	118,082	[11 12]14,112	12	119,147	[11 12]14,902	12
Magnesite	12,119	W	NA	12,103	W	NA
Mica (including scrap and ground) thousand pounds	474,867	212,000	45	534,831	280,000	52
Nitrogen, N content of ammonia	83,563	12,968	16	85,442	11,246	13
Peat	414,039	798	([4])	413,511	704	([4])
Perlite	1,556	[11]506	33	1,532	[11]474	31
Phosphate rock (gross weight) thousand metric tons	122,202	37,414	31	135,000	42,573	32
Potash (K_2O equivalent) ——do	24,664	1,784	7	26,678	1,429	5
Pumice[8]	12,707	416	3	11,766	449	4
Salt	181,951	[11 12]37,910	21	182,752	[11 12]34,605	19
Sodium compounds, natural and manufactured:						
Sodium carbonate	30,367	7,819	26	31,262	8,467	27
Sodium sulfate	5,370	864	16	5,229	855	16
Strontium[8] ——short tons	122,779	--	--	121,210	--	--
Sulfur, all forms thousand metric tons	50,776	9,787	19	50,472	9,290	18
Talc and pyrophyllite	7,539	1,135	15	7,553	1,066	14
Vermiculite[8]	562	316	56	495	282	57

[p]Preliminary. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1]For those commodities for which U.S. data are withheld to avoid disclosing company proprietary data, the world total excludes U.S. output and the U.S. percent of world production cannot be reported.

[2]World total does not include an estimate for output in China.

[3]U.S. figures represent dried bauxite equivalent of crude ore; to the extent possible, individual country figures that are included in the world total are also on the dried bauxite equivalent basis, but for some countries, available data are insufficient to permit this adjustment.

[4]Less than 0.5%.

[5]Primary and secondary blister and anode copper, including electrowon refined copper that is not included as blister or anode.

[6]Includes bullion.

[7]Refined nickel plus nickel content of ferronickel, and nickel oxide.

[8]World total does not include estimates for output in the U.S.S.R. or China.

[9]Data from American Iron and Steel Institute. Excludes production of castings by companies that do not report steel ingot.

[10]Includes tin content of alloys made directly from ore.

[11]Quantity sold or used by producers.

[12]Includes Puerto Rico.

The Mineral Industry of Alabama

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Alabama for collecting information on all nonfuel minerals.

By James R. Boyle[1] and Ernest A. Mancini[2]

The value of Alabama's nonfuel mineral production in 1983 was $361.3 million, an increase of $61.9 million over that of 1982. The increase reversed a downward trend that started in 1980 and established a new record high for value of nonfuel minerals in the State. Output of most nonfuel minerals increased to some degree with unit value increases creating the record-high value year. Cement, clays, lime, sand and gravel, and crushed stone were the major commodities produced in Alabama.

Alabama led the Nation in the production of crushed marble; was second in bauxite; fourth in ferroalloys, dimension marble, common clay, and fire clay; fifth in bentonite and kaolin; and sixth in masonry cement and lime.

Table 1.—Nonfuel mineral production in Alabama[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	150	$9,086	210	$13,417
Portland	do.	2,558	104,461	3,279	150,255
Clays	do.	[2]1,323	[2]13,193	1,863	20,758
Gem stones		NA	1	NA	1
Lime	thousand short tons	907	42,380	981	41,149
Sand and gravel:					
Construction	do.	7,019	17,226	e8,600	e23,500
Industrial	do.	960	8,096	418	3,256
Stone:					
Crushed	do.	e21,200	e89,600	20,558	95,374
Dimension	do.	e8	e2,341	7	2,661
Combined value of bauxite, clays (bentonite), phosphate rock, and salt		XX	13,025	XX	10,955
Total		XX	299,409	XX	361,326

eEstimated. NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes bentonite; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Alabama, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Autauga	(2)	W	Sand and gravel (construction).
Baldwin	W	W	Clays.
Barbour	W	W	Clays, bauxite.
Bibb	W	W	Clays.
Blount	W	W	Cement.
Calhoun	W	W	Clays, sand and gravel (construction).
Cherokee	(2)	--	
Chilton	W	W	Sand and gravel (construction), clays.
Clarke	(2)	W	Sand and gravel (construction).
Clay	(2)	--	
Coffee	(2)	W	Do.
Colbert	W	$45	Do.
Conecuh	(2)	--	
Coosa	$1,422	(3)	
Crenshaw	W	37	Sand and gravel (industrial).
Dale	(2)	W	Sand and gravel (construction).
Dallas	115	1,618	Sand and gravel (industrial), sand and gravel (construction), clays.
De Kalb	630	(3)	
Elmore	W	2,156	Sand and gravel (construction), clays.
Escambia	(2)	637	Sand and gravel (construction).
Etowah	W	270	Do.
Fayette	(2)	190	Do.
Franklin	W	1,092	Do.
Geneva	(2)	W	Do.
Greene	(2)	--	
Hale	(2)	W	Do.
Henry	W	W	Bauxite.
Jackson	W	(3)	
Jefferson	W	W	Cement, clays.
Lamar	(2)	--	
Lawrence	1,348	(3)	
Lee	3,166	(3)	
Limestone	W	W	Phosphate rock.
Lowndes	W	W	Clays.
Macon	158	W	Sand and gravel (industrial).
Madison	W	W	Sand and gravel (construction), clays.
Marengo	W	W	Cement.
Marion	124	275	Sand and gravel (construction), clays.
Marshall	W	W	Clays.
Mobile	20,148	29,900	Cement, sand and gravel (construction), clays, sand and gravel (industrial).
Monroe	712	(3)	
Montgomery	12	W	Sand and gravel (industrial), sand and gravel (construction).
Morgan	4,014	(3)	
Randolph	1,723	(3)	
Russell	568	W	Sand and gravel (construction), clays.
St. Clair	25,671	W	Cement.
Shelby	104,861	W	Lime, cement, clays.
Sumter	W	W	Clays, sand and gravel (construction).
Talladega	16,015	(3)	
Tuscaloosa	W	W	Sand and gravel (construction), sand and gravel (industrial).
Walker	W	W	Clays.
Washington	W	W	Salt, sand and gravel (construction).
Wilcox	117	(3)	
Undistributed[4]	109,652	171,247	
Sand and gravel (construction)	e23,340	XX	
Stone:			
Crushed	XX	e89,600	
Dimension	XX	e2,341	
Total[5]	313,797	299,409	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Bullock, Butler, Chambers, Choctaw, Cleburne, Covington, Cullman, Houston, Lauderdale, Perry, Pike, Tallapoosa, and Winston. County distribution for construction sand and gravel (1981), and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Includes gem stones and sand and gravel (construction, 1982) that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Alabama business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,742.0	1,754.9	+0.7
Unemployment	do.	287.9	238.4	-17.2
Employment (nonagricultural):				
Mining[1]	do.	13.6	13.1	-3.7
Manufacturing	do.	326.6	344.6	+5.5
Contract construction	do.	52.7	60.1	+14.0
Transportation and public utilities	do.	68.8	70.6	+2.6
Wholesale and retail trade	do.	261.1	273.9	+4.9
Finance, insurance, real estate	do.	58.4	59.8	+2.4
Services	do.	213.6	216.3	+1.3
Government	do.	290.8	286.0	-1.6
Total nonagricultural employment[1]	do.	1,285.6	1,324.4	+3.0
Personal income:				
Total	millions	$34,119	$36,562	+7.2
Per capita		$8,647	$9,235	+6.8
Construction activity:				
Number of private and public residential units authorized		9,011	17,301	+92.0
Value of nonresidential construction	millions	$393.2	$530.2	+34.8
Value of State road contract awards	do.	$211.8	$232.0	+9.5
Shipments of portland and masonry cement to and within the State	thousand short tons	994	1,173	+18.0
Nonfuel mineral production value:				
Total crude mineral value	millions	$299.4	$361.3	+20.7
Value per capita, resident population		$76	$91	+19.7
Value per square mile		$5,802	$6,988	+20.4

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

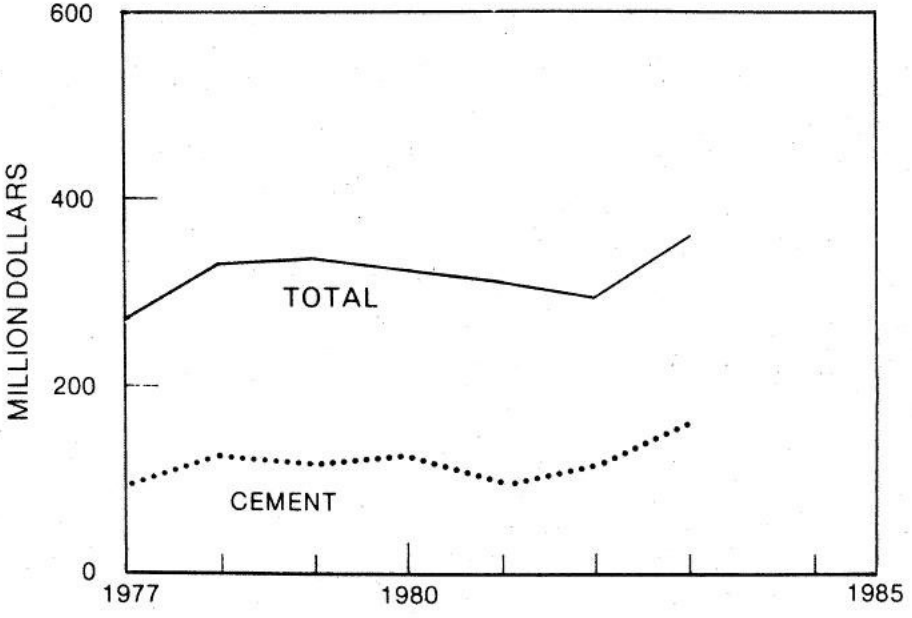

Figure 1.—Value of cement and total value of nonfuel mineral production in Alabama.

Trends and Developments.—Although economic recovery was evident about mid-year, adverse economic conditions continued to have a severe impact on most industries within the State. At yearend the unemployment rate of 12.8% was one of the highest in the Nation, although decreasing from 16% (revised) at yearend 1982. Most manufacturing and nonmanufacturing groups experienced a decrease in the unemployment rate with the major exception of nonfuel mining, which dropped 5.2% from 1982 employment levels. According to the Bureau of Labor Statistics,[3] unemployment in Alabama will not drop below the 10% rate until 1990. Much of the heavy industry in the State has been impacted severely during the recession and is not expected to make a full recovery. However, the State's economy improved considerably over that of 1982 with the rebound attributed to the nationwide recovery in the housing and automotive industries. Both residential and industrial construction activities improved over that of 1982.

The Alabama Development Office (ADO), in its 1983 report on new and expanding industries, announced 110 new operations and expansions totaling $248.4 million in mineral-related fields as follows: bituminous coal mining, 4 expansions with a total investment of $55 million; oil and gas, 4 expansions with a total investment of $5 million; mining and quarrying of nonmetallic minerals, 1 new and 9 expansions with a total investment of $2.3 million; stone, clay, glass, and concrete products, 2 new and 51 expansions with a total investment of $19.7 million; and primary metals, 3 new and 36 expansions with a total investment of $166.4 million. The number of expansions and total value were slightly lower than announced for 1982.

The Alabama State Docks at the Port of Mobile handled over 22 million tons of material during fiscal year 1983, down 24% from that of fiscal year 1982. Bulk materials shipments comprised the major activity at the facility with tonnage handled increasing slightly. Major nonfuel minerals were iron ore (813,035 tons) and pellets (511,093 tons). Other minerals included manganese (45,568 tons), ilmenite (94,268 tons), rutile (23,162 tons), and potash (88,848 tons). The port also handled cement, gypsum, oyster shells, sand and gravel, and stone. Potash was imported for the first time from the Dead Sea Works Ltd., Israel, destined for Mississippi Chemical Corp.'s plant in Pascagoula, MS. Plans call for from 100,000 to 300,000 tons to be imported yearly.

Construction continued on the Tennessee-Tombigbee Waterway, connecting the Gulf of Mexico to the Tennessee River. With the project over 85% complete, construction aggregate requirements have declined, adversely affecting mineral producers in the area. With a completion date of mid-1985, the Alabama State Docks continued its modernization plans to meet the anticipated cargo movements. To increase efficiency, a new car dump, car puller, and additional trackage were installed at the Bulk Materials Handling Plant. Many nonfuel mineral operations were expected to utilize the waterway to expand their market areas because of lower transportation costs. Other commodities expected to be shipped on the waterway include metallic ores and primary metals.

The State's primary metal industries continued to be hard hit in 1983, reaching its lowest level of operation since the downward trend started in 1979. Depressed markets for steel products and high levels of imports impacted the State's steel, foundry, and ferroalloy industries.

Connors Steel Co., Birmingham, shut down in September and put its electric steel plant up for sale. Workers had rejected a contract requesting a 3-year freeze in wages. Reported losses in 1983 ranged up to $2 million per month. Republic Steel Corp., Gadsden, requested workers to consider possible concessions aimed at reducing costs and increasing productivity. Implied in the request was the possibility of a plant shutdown. United States Steel Corp.'s steelmaking facilities remained closed during 1983, with construction continuing on its new pipe mill expected to go on-stream early in 1984. Autlan Manganese Corp., Mobile, which closed in 1982, remained closed throughout 1983. Possibilities of reopening remained unclear for the silicomanganese plant because of the depressed steel industry and imports from Brazil.

Depressed markets for aluminum and high energy costs also impacted on the State's aluminum smelters. Reynolds Metals Co., Listerhill, and Revere Copper & Brass Inc., Scottsboro, remained shut down during 1983; both companies considered permanent closure of their plants. By yearend, Reynolds announced the reopening of one of its potlines because of lower energy rates offered by the Tennessee Valley Authority.

Work was completed on conversion of the

old Sloss blast furnace in Birmingham into an industrial museum. The facility, closed in 1971 because of air pollution regulations, reopened in September as a museum. The furnaces, dating back to 1881, were donated by Jim Walter Resources Inc. to the city of Birmingham for use as a museum. A $3 million bond issue was approved in 1977 to refurbish the furnaces; the facility will also be used for concerts and special events.

The Hall Chemical Co.'s proposed catalyst reclamation plant in Mobile's Theodore industrial area was expected to go on-stream in 1985. The $40 million facility will recover aluminum salts, cobalt, nickel, and vanadium from hydrotreating and hydroforging catalysts used in the processing of high-sulfur crudes. The recovered materials will be used in the company's Arab plant where it makes salts from metals.

Texasgulf Minerals & Metals Inc. announced plans to construct a $5 million plasma smelting facility in Anniston. Catalyst material removed from automotive exhaust emission catalytic converters will be used as plant feed. The plant, one of the first in the world, will utilize plasma arc smelting to recover up to 45,000 troy ounces annually of platinum-group metals from residue.

Employment.[4]—Primary metals employment stabilized following 3 years of decline, but employment levels have declined 46% from the peak years of 1978-79. Employment in the brick, cement, and glass industries rose in 1983 after declining the past 4 years. The State's coal industry remained weak because of decreased demand from domestic and foreign industries. Two large coal mines closed in 1983, and coal mining employment fell nearly 7% during the year. Although the unemployment rate at year-end was 12.8%, officials at the Federal Reserve Bank of Atlanta anticipate continued improvement in labor market conditions with the possibility of a single-digit unemployment rate in 1984.

Legislation and Government Programs.—The Geological Survey of Alabama continued its program that focused on the prudent development and use of the mineral, water, and energy resources of the State.

Water resource investigations continued to be a major focus of the Survey's effort in 1983. Cooperative studies with the U.S. Geological Survey (USGS) involved collection of surface water, ground water, water quality, and water use data, and performance of water quality analyses. Additional studies included investigation of the aquifers in southeast Alabama, evaluation of waste disposal sites, and hydrologic investigations of watersheds in the Warrior Coalfield. Mineral resource investigations included the initiation of a study of zeolite resources and completion of a summary map of Alabama Piedmont mineral resources. Final phases were completed for an assessment of gibbsite resources, and a summary map of limestone resources prepared. A mineral atlas series was developed and initial reports undertaken to provide basic data on mineralogy, prospecting, mining, petrology, and geology of specific potential industrial minerals. Energy resource investigations included various studies of coal, including estimates of Alabama's coal reserves and resources. The oil and gas potential of the Black Warrior Basin and the oil shale potential of the Chattanooga shale were also investigated. Environmental geology research activities included studies that collected baseline biological, sediment, and water quality data concerning the effects of surface mining and methane gas production; investigations to delineate sensitive environments and areas of significant shoreline change in coastal Alabama; and a program to collect comparative biological and water quality data from oilfields. The Survey added emphasis to the preparation of a new State geologic map by revising and upgrading existing maps and initiating field mapping in areas where additional stratigraphic and structural control were essential.

The Environmental Protection Agency granted the State of Alabama an extension to April 1, 1984, to file an application to manage the Federal hazardous waste program. In the interim, the Alabama Department of Environmental Management (ADEM) retained its power to enforce phase one (inspection and enforcement) of the law. The State must file an interim authorization application by April 1, 1984, and a final application by July 31, 1984. The total program must be approved by January 1985, or the Federal Government will take control of the program. Prior to the State's filing, the legislature must pass legislation early in 1984 to bring the State under the program. If the State fails to gain authority, ADEM will lose its $1 million annual grant and those seeking hazardous waste permits will have to file separate applications with both State and Federal officials.

The U.S. Bureau of Land Management

reported $549,713 in mineral lease payments to the State in 1983. The Federal Government divides bonuses, rentals, and royalties received from Federal mineral leasing activities on public lands equally with the States in which the minerals occur.

USGS continued its cooperative agreement with the Geological Survey of Alabama in regard to water resources investigations. Several open file aeromagnetic maps were completed on portions of Alabama and included southwestern Alabama (OF83-0603), southeastern Alabama (OF83-0610), and south-central Alabama (OF83-0611). In addition, an open file report that contained a summary of selected publications, project activities, and data sources related to hydrology in the Warrior and Plateau Coalfields of Alabama (OF82-0913) was completed. In cooperation with the U.S. Bureau of Mines, mineral resources potential maps of the Sipsey Wilderness and additions (MF-1288-D) and of the Big Sandy, West Elliotts Creek, and Reed Brake roadless areas (MF-1505-B) were printed. In addition, a report, "Mineral Resource Potential of the Adams Gap and Shinbone Creek Roadless Areas, Clay County, Alabama," was also jointly prepared. Early in 1983, the President signed a bill creating a 6,800-acre wilderness in Talladega National Forest (Public Law 97-411). This area, Cheaha Wilderness, includes part of the Adams Gap and Shinbone Creek roadless areas. The USGS also continued several studies on energy resources and regional geology.

The Mineral Resource Institute of the University of Alabama at Tuscaloosa received funding of $150,000 from the U.S. Bureau of Mines under Title III of Public Law 95-87. The funding was designed to encourage the training of mining engineers and other scientists involved in mineral-related studies. A research grant of $100,000 was also made to the university from the generic mineral technology center for mine system design. The institute continued research in mineral exploration, mining, processing, utilization, and conservation. Primary emphases were on energy-related projects, but nonfuel research was conducted on metallic and nonmetallic mineral resources in the State. In addition to research directed to various mineral commodities, research was also conducted on characteristics of subsidence and surface mining blasting effects on underground mining. The institute also conducted and cosponsored several short courses on mineral-related subjects.

In fiscal year 1983, the U.S. Bureau of Mines had several contracts in the State involving research activities. Wyle Laboratories and Aaberg & Associates, both of Huntsville, were contractors with three contracts totaling nearly $200,000. Research activities centered on noise control and machine redesign concepts. Since 1981, the Bureau has completed mineral assessment surveys and/or reports on 6,100 acres of wilderness and wilderness suitable lands in the State.

The U.S. Bureau of Mines Tuscaloosa Research Center was involved in several mineral-related projects in Alabama. Among them were (1) recycling of zircon from investment casting molds, (2) dewatering of coal-clay wastes, (3) development of chemical binders to increase mine roof stability, and (4) basic clay testing in cooperation with various State agencies. Other Bureau accomplishments and activities of interest were (1) development of steel fiber reinforced concrete cribs, (2) development of a lightweight miner's battery, (3) development of software for a computerized coalbed methane data base, and (4) under a Bureau contract, the Bituminous Coal Research has developed the engineering criteria and hardware for a prototype back-mounted waterspray to suppress frictional face ignitions of methane.

One U.S. Bureau of Mines publication resulting from research that was directly related to the mineral industry in Alabama was Report of Investigations 8824, "Dewatering of Coal-Clay Waste Slurries From Preparation Plants."

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for the bulk of the value of Alabama's total nonfuel mineral production. Construction minerals output increased because of increased construction activity, but increase in primary metal and automotive output also affected nonfuel minerals production. The ADO reported that 63 operations involved with the nonmetallic minerals industries expanded to some degree in 1983 at an estimated expenditure of $22 million.

Abrasives (Manufactured).—Artificial

abrasives were manufactured by one company in Madison County. Abrasive-grade, high-purity fused aluminum oxide and aluminum zirconium oxide were produced by Norton Co. in Huntsville. Norton announced an expansion of its plant through ADO totaling $380,000.

Cement.—Cement accounted for over one-third of the value of nonmetallic minerals produced in Alabama, with both masonry and portland cements being produced. Nationally, Alabama ranked sixth and seventh in the production of masonry and portland cement, respectively. Production and unit value of both types of cement increased; output of portland cement reached its highest level in over 10 years.

Portland cement was produced at six plants in the State, two in Jefferson County and one each in Marengo, Mobile, St. Clair, and Shelby Counties. Five of the plants used the dry process while Allied Products Co. used the wet process. The six companies operated eight kilns. Major end uses for portland cement were ready-mix concrete, concrete products, building materials, and highway construction. Principal raw materials used in making cement included cement rock, chalk, clays, iron ore, limestone, sand, and shale.

Table 4.—Alabama: Portland cement salient statistics

(Short tons unless otherwise specified)

	1982	1983
Number of active plants	6	6
Production	2,677,233	3,195,141
Shipments from mills:		
Quantity	2,558,394	3,279,393
Value	$104,460,929	$150,254,922
Stocks at mills, Dec. 31	359,595	367,119

Table 5.—Alabama: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1982	1983
Number of active plants	5	5
Production	146,268	205,121
Shipments from mills:		
Quantity	150,358	210,394
Value	$9,086,207	$13,416,694
Stocks at mills, Dec. 31	23,316	27,692

During the year, Blue Circle Industries Ltd. purchased Martin Marietta Corp.'s facility at Calera. The facility will operate under Blue Circle Inc. At National Cement Co. Inc.'s Ragland plant, two 200-ton-per-hour drag chain conveyors were installed for clinker movement from storage to finish grinding. The conveyors were expected to be on-line early in 1984. Three other cement operations announced expansions through ADO totaling over $5 million. Companies involved in expansions were Ideal Basic Industries Inc. (Theodore), Lehigh Portland Cement Co. (Leeds), and Blue Circle (Calera).

Cheney Lime & Cement Co. was one of two plants nationally that produced masonry cement exclusively.

Clays.—During the year, the State's clay industry produced common clay, fire clay, bentonite, and kaolin. Output and value of total clays increased. Alabama ranked fourth nationally in the production of common clay and fire clay, and fifth in bentonite and kaolin. Clay ranked fifth in mineral value in Alabama in 1983. During the year, 22 companies mined clay at 38 pits in 18 counties.

Common clay was mined by 14 companies at 20 pits in 13 counties; leading counties were Jefferson, Russell, and Sumter. Production and value increased 40.9% and 36.9%, respectively, reflecting the upturn in construction activities. Major uses were brick, cement, and concrete block.

Henry Brick Co., Selma, completed conversion of one of its brickmaking facilities from natural gas to pulverized waste wood. Plans are to convert the other facility and to build a new clay storage and preparation facility. By yearend, the company was operating at about 70% of capacity.

Dickey Clay Co., Bessemer, installed a 6-million-British-thermal-unit-per-hour, coal-fired air heater for use in drying clay pipe. Reportedly fuel savings totaled about $100,000 per year.

Donoho Clay Co., Anniston, continued its $1.3 million expansion program that started in 1981. The company, to increase output of refractories, purchased a nearby shutdown facility with assistance of industrial revenue bonds issued by the city of Anniston. The company expects to double sales in the next year through new product lines for the steel industry. Three clay operations announced expansions through ADO totaling about $400,000. The companies were all producers of refractory clay.

Vulcan Materials Co., Parkwood, operated its lightweight aggregate plant for about 6 months. The kiln and mine closed in November with plans to reopen in May 1984.

Fire clay was mined by four companies at six pits in Calhoun, St. Clair, and Shelby Counties. Production and value increased 52.2% and 72.5%, respectively, reflecting an increase in unit price.

Kaolin was mined by 3 companies at 11 pits in Barbour and Henry Counties. Production and value increased 24.7% and 76.8%, respectively. Major uses were in firebrick and other refractories. Kaolin occurs in association with bauxite, which was also used for refractory purposes. Mining companies continued to operate at reduced levels during the year with frequent shutdowns.

American Colloid Co. mined bentonite at its operation in Lowndes County for use in drilling muds and the foundry industry. Production increased slightly.

Lime.—Alabama ranked sixth nationally in the production of lime, which was the third leading commodity, valuewise, produced in the State in 1983. Lime was produced by four companies in Shelby County. Output increased slightly but remained below 1 million tons for the second straight year while total value decreased. Both quicklime and hydrated lime output increased with unit prices decreasing. Production was expected to increase as steel mills reopened in the Birmingham area. Other uses were in paper manufacture and water purification.

Table 6.—Alabama: Lime sold or used by producers, by use

Use	1982		1983	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Paper and pulp	299,815	$14,251	218,457	$9,402
Water purification	108,904	4,936	208,808	7,699
Mason's lime	10,567	663	W	W
Sugar refining	7,543	383	W	W
Other[1]	480,623	22,147	554,190	24,048
Total	907,452	42,380	981,455	41,149

W Withheld to avoid disclosing company proprietary data.
[1]Includes acid water neutralization, animal and human food, aluminum and bauxite, basic oxygen steel (1983), coke and gas (1983), copper ore concentration, electric steel, magnesia from seawater or brine, oil well drilling, other ore concentration, other chemical and industrial uses, other construction lime (1982), petroleum refining, road stabilization, sewage treatment, sulfur removal from stack gases (1983), soil stabilization, tanning, and uses indicated by symbol W.

Mica.—Western Mica Co.'s scrap mica grinding facility at Heflin closed in February. The plant's three mills were shipped to North Carolina for use at Kings Mountain. Mining of mica ceased in Alabama in 1980, but the grinding facility had remained open using Connecticut ores.

Mullite (Synthetic).—Synthetic mullite was produced by Harbison-Walker Refractories Co. Inc. at Eufaula. Output was used primarily for the manufacture of refractories with demand at a low level because of the depressed steel industry. Production and value decreased from that of 1982 along with a decrease in unit value. Synthetic mullite is a product of sintering a mixture of aluminous and siliceous material.

Perlite (Expanded).—Two plants, W. R. Grace & Co., Birmingham, and National Gypsum Co., Mobile, expanded perlite from ore shipped in from the Western United States. Production and value increased substantially over that of 1982. The material was used for formed products, horticulture purposes, and concrete aggregate.

Phosphate Rock.—Farmers Construction Co. mined phosphate rock from the Gilbert pit in Limestone County for Monsanto Co. The ore was shipped by rail to Monsanto's operations in Tennessee for reduction to elemental phosphorus. Production and value decreased from that of 1982 with a decrease in unit value. Mining ceased at midyear.

Salt.—Alabama ranked 10th nationally in the production of salt. Olin Corp., in Washington County, produced salt from brine wells by solution mining a near-surface salt dome. Production and value decreased. The salt was used in chemical manufacture, chiefly caustic soda, chlorinated organics, and sodium chlorate and hypochlorite. A portion of the solid salt produced was shipped to Olin's chloralkali plant in Augusta, GA.

Sand and Gravel.—Alabama produced both construction and industrial sand and gravel in 1983. Total sand and gravel production and value was estimated to have increased from that of 1982; unit values decreased.

Construction.—Construction sand and

gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Table 7.—Alabama: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	3,260	$8,102	$2.49	NA	NA	NA
Gravel	2,837	7,811	2.75	NA	NA	NA
Sand and gravel (unprocessed)	922	1,314	1.43	NA	NA	NA
Total or average	7,019	[1]17,226	2.45	[e]8,600	[e]$23,500	[e]$2.73
Industrial sand	960	8,096	8.43	418	3,256	7.79
Grand total or average	7,979	[1]25,323	3.17	[e]9,018	[e]26,756	[e]2.97

[e]Estimated. NA Not available.
[1]Data do not add to total shown because of independent rounding.

Construction sand and gravel ranked fourth in terms of mineral value in Alabama in 1983; production increased for the first time since 1978. Increase in unit value of over 10% created the increased total value over that of 1982. Although construction activities increased, high inventory levels from late 1982 and early 1983 prevented an upturn in mining activities. Many sand and gravel facilities operated intermittently during the year, depending on proximity and extent of construction activities. Most operations were relatively small with no individual pit producing 1.5 million tons. Five sand and gravel operations announced expansion plans through ADO totaling nearly $800,000.

Industrial.—Six companies produced industrial sand and gravel with output decreasing; unit values also decreased. Industrial sand and gravel was used primarily by foundries for molds and cores. Production for use at silicon alloy plants decreased because of reduced output from alloy plants. All industrial sand and gravel producers were relatively small with individual output under 200,000 tons per year.

Slag—Iron and Steel.—Alabama was 1 of 22 States that reported processing and utilization of iron and steel slag. Two companies air-cooled blast furnace slag, which is typically used as road base, railroad ballast, and as asphaltic concrete aggregate. One company sold steel slag that has the same uses. Total output and value decreased 23.3% and 20.4%, respectively, from that of 1982. Output and value of iron slag decreased, while that of steel slag increased.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Crushed stone ranked second in mineral value in Alabama with output decreasing slightly from the estimated 1982 production. Material mined included limestone, dolomite, marble, and granite. Alabama led the Nation in output of crushed marble, with 42% of the Nation's output. Crushed stone was produced by 27 companies at 47 operations in 19 counties. Crushed stone was used primarily in cement manufacture, as concrete aggregate, and as a road base. Principal production was from Shelby, Jefferson, and Colbert Counties. Six quarries each produced in excess of 1 million tons per year and accounted for 38.9% of all crushed stone. The top 12 companies produced nearly 90% of the State's output of crushed stone. Shipments were mainly by truck, with minor tonnages shipped by rail or waterway. Most operations continued to operate intermittently during the year with a pickup in the last quarter of the year. ADO reported seven expansions of crushed stone operations totaling over $11 million.

Table 8.—Alabama: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	W	W
Riprap and jetty stone	600	2,212
Filter stone	96	413
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,327	13,146
Bituminous aggregate, coarse	1,578	6,122
Bituminous surface treatment aggregate	136	594
Railroad ballast	W	W
Fine aggregate (-3/8 inch):		
Stone sand:		
Concrete	489	1,997
Bituminous mix or seal	W	W
Screening, undesignated	89	304
Other	W	W
Coarse and fine aggregate:		
Graded road base or subbase	2,374	8,384
Unpaved road surfacing	320	1,474
Terrazzo and exposed aggregate	W	W
Crusher run, fill, or waste	1,662	6,546
Agricultural:		
Agricultural limestone	759	3,601
Other	W	W
Chemical and metallurgical:		
Cement manufacture	3,821	19,936
Lime manufacture	1,820	6,931
Dead-burned dolomite manufacture	W	W
Flux stone	157	794
Sulfur oxide removal	W	W
Special:		
Mine dusting or acid water treatment	W	W
Asphalt fillers or extenders	W	W
Whiting or whiting substitute	246	4,050
Other fillers or extenders	436	9,364
Roofing granules	W	W
Other[2]	2,648	9,506
Total	20,558	95,374

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."

[1]Includes limestone, dolomite, granite, and marble.

[2]Includes refractory stone, abrasives, acid neutralization, chemicals, paper manufacture, uses not specified, and uses indicated by symbol W.

Moulton Limestone Co., Moulton, a producer of agricultural lime, planned to install a hammer mill and screens to increase capacity, with scheduled completion by mid-1984.

The conversion of the domestic paper industry to alkaline sizing affected the marble industry in Sylacauga. Thompson Weinman Co. was installing new mill facilities to produce superfine calcium carbonates (0.07 micrometers) to meet the needs of the paper industry. Moretti-Harrah Marble Co. was also undergoing a $10 million expansion to furnish material to the same market. Moretti-Harrah also produces dimension marble, but about 85% of its output was from calcium carbonate operations. The material acts as a filler or extender and was also used in plastics and paints.

Dimension.—Production of dimension stone remained at about the same level as that of 1982 while value increased. Alabama ranked fourth nationally in output of dimension marble. Marble was quarried in Talladega County, limestone was mined from an underground operation in Franklin County, and sandstone was quarried in Blount County. The blocks were processed primarily to produce cut and sawed stone. Ground marble was used as an extender while the crushed limestone was sold as agricultural lime.

Sulfur (Recovered).—Alabama ranked fifth nationally in output of recovered sulfur. Two companies recovered sulfur from two petroleum refineries in Mobile and Tuscaloosa Counties. Two other companies recovered sulfur from natural gas processing plants in Escambia and Washington Counties. Exxon Co., Hunt Oil Co., Phillips Petroleum Co., and Union Oil Co. sold 401,000 metric tons valued at $36.3 million, a decrease of 8.9% in quantity and 21.2% in value from that of 1982, indicating a decrease in unit value.

Talc.—Cyprus Industrial Minerals Co. ground talc from out of State at its plant in Talladega County, near Alpine, with output decreasing. The product was used primarily in paper and various cosmetic preparations. The company planned to conduct an exploratory program in late 1983 or early 1984 to

develop a local source of talc.

Vermiculite (Exfoliated).—W. R. Grace & Co., Jefferson County, exfoliated vermiculite at its plant in Irondale from crude ore shipped into the State. Primary uses were in concrete aggregate, block, loose fill insulation, and as a sand conditioner.

METALS

Primary metal production was one of the most important industries in the State. Most of the State's adverse economic conditions can be traced to the hard hit metals industry, which started a downward trend in 1979 and continued through 1983. The four leading counties with primary metal output were Colbert, Jackson, Jefferson, and Etowah. The industry in Alabama consists of aluminum, ferroalloys, steel, and various foundries. ADO announced 3 new and 36 expansions of the primary metals industry operations with a total investment of $166.4 million.

Aluminum.—Alabama was 1 of 17 States with primary aluminum production facilities. The two companies in the State, Revere, Scottsboro, and Reynolds, Sheffield, were shut down for the entire year. Reasons cited were weak demand and high operating costs, mainly power. Revere's facilities were reportedly one of the highest unit cost operations in the Nation. Reynolds announced the restarting of a 44,000-ton-per-year potline early in 1984. The offer of discounted electric rates from the Tennessee Valley Authority prompted the decision, along with increased demand and reduced inventories. Total capacity of the facilities is 202,000 tons per year. Reynolds also announced the shutdown of its wire, rod, and bar department at its alloy plant in Florence. The permanent phaseout was expected to be completed by March 1984, with the loss of 300 positions. The reasons cited for the shutdown were the age of the facilities and high operating costs. Revere's shutdown was coupled with a file for reorganization under Chapter 11 of the Bankruptcy Code. However, the company announced through ADO a $200,000 expansion at its aluminum coiled sheet facility.

Ford Motor Co. completed shutdown of its aluminum casting plant at Sheffield late in the year. High operating costs was the main reason cited for closure.

Bauxite.—Alabama ranked second nationally in bauxite production. Three companies mined bauxite in Barbour and Henry Counties for use in refractories and chemical manufacture. Production and value decreased with output at its lowest level in over 10 years; unit prices also decreased. All producers operated intermittently during the year with some operating at less than 50% of capacity. Dresser Industries Inc. completed construction of a $10 million ceramic proppant plant in Eufaula. The plant went on-stream in June, making proppants from bauxitic clay for use in the petroleum industry. The plant had not reached capacity production at yearend.

Ferroalloys.—Alabama ranked fourth nationally in shipments of ferroalloys, with output and value increasing 14.9% and 4.9%, respectively. The increase was the first in over 6 years of decreasing output. Products included ferromanganese, ferrosilicon, silicomanganese, and silicon metal. Many of the ferroalloy facilities remained closed during the year or operated at reduced levels. International Minerals & Chemical Corp. announced a $1.5 million expansion program at its Bridgeport facility, which produces ferrosilicon. Autlan Manganese, Mobile, remained closed during 1983. Possibilities of reopening in 1984 remained unclear because of imports and the depressed steel industry. Globe Metallurgical Div., Selma, of Interlake Inc., and Ohio Ferro-Alloys Corp., Montgomery, operated on a reduced schedule during 1983; both produced silicon. Imports of ferrosilicon through the Port of Mobile impacted severely on these operations.

Iron and Steel.—Alabama was 1 of 13 States in the Nation that produced pig iron; shipments decreased 10.7%, while value decreased 25.4% from that of 1982. Jim Walter Resources, Birmingham; Republic Steel, Gadsden; and United States Steel, Fairfield, were the major iron and steel companies. United States Steel remained closed during the year while the others experienced reduced output. The depressed market for steel products and imports impacted on the State's steel and foundry industries. United States Steel completed construction of its $700 million seamless pipe mill at Fairfield and planned to initially use steel from Italy until the Fairfield Steelworks returned to steel production. The pipe mill has a capacity of 600,000 tons per year of pipe ranging from 3-1/2- to 9-5/8-inches in diameter. At yearend, the company announced the steelworks would be reopened early in 1984 to produce flat-roll steel for the pipe mill. The company

considered permanent closure of the steelworks, but after negotiations with the union and consideration that the company had invested $1.3 billion in facilities over the past several years, it decided to restart the furnaces. It will also install a $100 million continuous slab caster to improve efficiency. The company announced that the Coke Works would not reopen for several years and that the Ensley Works were permanently closed.

Republic Steel started up operations early in the year and operated at reduced levels through 1983. During the year, the company sought additional concessions aimed at reducing costs and increasing productivity; the proposal was rejected. Late in the year, LTV Corp. agreed to acquire Republic Steel through a $700 million exchange of stock that would create the Nation's second largest steelmaker. The acquisition was subject to stockholder and U.S. Department of Justice approval. The Gadsden facility was reportedly being considered for closure. Republic Steel announced through ADO an expansion program of $1.75 million for production of carbon steel plates. Republic Steel reportedly shipped 674,000 tons of steel on sales of $270.5 million in 1983, which represents about 55% of the facility's sustainable capability.

Connors Steel Co., Birmingham, closed in September after workers refused to accept a wage freeze. Later in the year, the facilities were purchased for $6 million by SMI Steel Inc., a subsidiary of Commercial Metals Co., Dallas, TX. The plant will use scrap metal for production of reinforcing bars with full production of 240,000 tons per year expected by 1986. An additional $4 million will be used for modernizing facilities. Birmingham's Industrial Development Board approved $10 million in tax exempt bonds to cover the costs of acquisition and improvements.

A. J. Gerrard and Co., Des Plaines, IL, announced plans to build a $2 million steel pickling plant at Florence. Present facilities include a wire production facility and strip rolling mill. Production was expected by early 1984.

Ferrous Foundries.—Iron and steel foundries were a significant industry that affected mineral producers in the State. Most foundries, however, were adversely affected by the national recession. Raw material utilized included scrap, clay, coal, limestone, and sand, most of which came from sources in the southeastern region. The Alabama Directory of Mining and Manufacturing listed 43 gray iron foundries, 27 steel foundries, 8 steel investment foundries, and 2 malleable iron foundries. In 1983, ADO reported 15 expansions throughout the industry totaling $15.4 million.

American Cast Iron Pipe Co. completed modernization of its facilities to produce ductile iron pipe. The new facility will produce 18- to 36-inch-diameter pipe, 20 feet in length, and reached full production late in the year. The facilities included three cranes, two casting machines, and an annealing oven.

Rutile (Synthetic).—Kerr-McGee Corp., Mobile, operated its synthetic rutile plant with output shipped to the company's Hamilton, MS, plant for processing to titanium dioxide pigments. Ilmenite from Australia was used as feed material for the synthetic rutile plant; over 90,000 tons was imported through the Port of Mobile. Kerr-McGee operated slightly below its 110,000-ton-per-year capacity.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, AL.
[2]State geologist, Geological Survey of Alabama, Tuscaloosa, AL.
[3]ADECA News. Jan. 1984, p. 8.
[4]Federal Reserve Bank of Atlanta. Economic Review. Feb. 1984, pp. 58-65.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum smelters:			
Revere Copper & Brass Inc	Box 191 Rome, NY 13440	Plant	Jackson.
Reynolds Metals Co	Reynolds Metals Bldg. Richmond, VA 23218	do	Colbert.
Bauxite:			
A. P. Green Refractories Co.,[1] a subsidiary of United States Gypsum Co.	Mexico, MO 65265	Mine and plant	Barbour.
Eufaula Minerals Co.[1]	Box 556 Eufaula, AL 36027	Plant	Do.
Harbison-Walker Refractories Co. Inc.,[1] a division of Dresser Industries Inc.	Dale Rd. Route 1, Box 58 Eufaula, AL 36027	Mine and plant	Do.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Cement:			
Allied Products Co.[2]	Box 36130 Birmingham, AL 35236	Plant	Jefferson.
Blue Circle Inc.[3]	18th Floor, Daniel Bldg. Birmingham, AL 35233	do	Shelby.
Citadel Cement Corp	2625 Cumberland Pkwy. NW. Atlanta, GA 30339	do	Marengo.
Ideal Basic Industries Inc.[3]	950 17th St. Box 8789 Denver, CO 80201	Plants	Mobile.
Lehigh Portland Cement Co	800 2d Ave., South Leeds, AL 35094	Plant	Jefferson.
National Cement Co. Inc	Drawer A Ragland, AL 35131	do	St. Clair.
Clays:			
Bickerstaff Clay Products Co. Inc	Box 517 Bessemer, AL 35020	Mines	Jefferson and Russell.
Blue Circle Inc	18th Floor, Daniel Bldg. Birmingham, AL 35233	Mine	Shelby.
Jenkins Brick Co	Box 91 Montgomery, AL 37101	Mines	Chilton, Elmore, Montgomery.
Tombigbee Lightweight Aggregate Corp., a division of Breeko Industries Inc.	Box V Livingston, AL 35470	Mine	Sumter.
Ferroalloys:			
Alabama Alloy Co. Inc	Box 31195 Birmingham, AL 35222	Electric furnace	Jefferson.
Autlan Manganese Corp	Box 2703 Mobile, AL 36601	do	Mobile.
Interlake Inc., Globe Metallurgical Div.	Box 348 Selma, AL 36701	do	Dallas.
International Minerals & Chemical Corp., TAC Alloys Div.	Garner Rd. Bridgeport, AL 35740	do	Jackson.
Ohio Ferro-Alloys Corp	Box 68 Montgomery, AL 36057	do	Montgomery.
Reynolds Metals Co	Box 191 Sheffield, AL 35660	do	Colbert.
Lime:			
Allied Products Co	Box 36130 Birmingham, AL 35236	Plants	Shelby.
Blue Circle Inc.[4]	18th Floor, Daniel Bldg. Birmingham, AL 35233	Plant	Do.
Cheney Lime & Cement Co	Allgood, AL 35013	do	Do.
S. I. Lime Co	Suite 204 Three Riverchase Office Plaza Birmingham, AL 35244	do	Do.
Phosphate:			
Monsanto Co	Columbia, TN 38401	Pit	Limestone.
Pig iron:			
Jim Walter Resources Inc	330 1st Ave., North Birmingham, AL 35202	Furnaces	Jefferson.
Republic Steel Corp	1629 Republic Bldg. Cleveland, OH 44115	Furnaces and mills.	Etowah and Jefferson.
United States Steel Corp	Box 599 Fairfield, AL 35064	do	Jefferson.
Salt:			
Olin Corp	120 Long Ridge Rd. Stamford, CT 06904	Brine wells	Washington.
Sand and gravel (1982):			
Holland and Woodward Co. Inc	Box 1947 Decatur, AL 35601	Surface mine and plant.	Franklin.
R & S Materials Inc	Box 3547 Montgomery, AL 36109	do	Autauga, Elmore, Montgomery.
Southern Industries, Radcliff Materials.	Drawer 2068 Mobile, AL 36601	do	Mobile and Montgomery.
C. T. Thackston	Box 3211 Montgomery, AL 36109	do	Montgomery.
Stone:			
Allied Products Co	Box 628 Alabaster, AL 35007	Quarries	Shelby.
Hoover Inc	Box 155 Hollywood, AL 35752	do	Colbert and Jackson.
Ideal Basic Industries Inc	950 17th St. Box 8789 Denver, CO 80201	Quarry	Monroe.
Southern Stone Co. Inc.[5]	Box C-200 Birmingham, AL 35283	Quarries	Bibb, Colbert, Lee, Shelby.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Vulcan Materials Co.[6]	Box 7324-A Birmingham, AL 35223	Quarries	Calhoun, Colbert, Etowah, Franklin, Jackson, Madison, Shelby.
Talc:			
Cyprus Industrial Minerals Co	Alpine, AL 35014	Plant	Talladega.

[1]Also kaolin.
[2]Also lime.
[3]Also clays and stone.
[4]Also cement, clays, and stone.
[5]Also sand and gravel.
[6]Also clays and sand and gravel.

The Mineral Industry of Alaska

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Division of Geological and Geophysical Surveys, Alaska Department of Natural Resources, for collecting information on all nonfuel minerals.

By Tom L. Pittman[1]

The value of nonfuel mineral production reported in Alaska in 1983 was $122.5 million; in 1982, the value was $112.9 million. The increase in 1983 was due to greater values reported for gold and for construction sand and gravel. No production of antimony or platinum-group metals was reported in 1983. Alaska ranked 36th in the United States in reported nonfuel mineral production.

Table 1.—Nonfuel mineral production in Alaska[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$60	NA	$60
Gold (recoverable content of ores, etc.) troy ounces	30,513	11,470	34,702	14,714
Sand and gravel (construction) thousand short tons	40,832	74,895	e45,200	e97,200
Silver (recoverable content of ores, etc.) thousand troy ounces	2	17	4	47
Stone (crushed) thousand short tons	e5,100	e25,200	1,981	9,460
Combined value of copper, lead, and tin	XX	1,269	XX	971
Total	XX	112,911	XX	122,452

eEstimated. NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Alaska, by region[1]

(Thousands)

Region	1981	1982	Minerals produced in 1982 in order of value
Alaska Peninsula	W	(2)	
Cook Inlet-Susitna	W	W	Sand and gravel (construction), gold, silver.
Copper River	W	W	Gold, sand and gravel (construction).
Kenai Peninsula	W	W	Sand and gravel (construction), gold.
Kodiak	$1,200	W	Sand and gravel (construction).
Kuskokwim	W	$1,072	Gold, silver.
Northern Alaska	(3)	10	Sand and gravel (construction), jade.
Seward Peninsula	W	W	Gold, silver, tin.
Southeastern Alaska	W	W	Sand and gravel (construction), gold, silver, lead, copper.
Yukon River	W	W	Gold, sand and gravel (construction), silver.
Undistributed[4]	39,400	86,630	
Sand and gravel (construction)	e75,600	XX	
Stone (crushed)	XX	e25,200	
Total	116,200	5112,911	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]No nonfuel mineral production was reported in the Aleutian Islands, Bering Sea, Bristol Bay, and Northwestern Alaska regions. County distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2]Crushed stone was produced; data not available by region.

[3]Construction sand and gravel was produced; data not available by region.

[4]Includes gem stones and some construction sand and gravel that cannot be assigned to specific regions and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Alaska business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	212.2	220.1	+3.7
Unemployment	do	27.5	29.1	+5.8
Employment (nonagricultural):				
Mining[1]	do	8.3	8.1	-2.4
Manufacturing	do	7.6	6.7	-11.8
Contract construction	do	14.3	15.0	+4.9
Transportation and public utilities	do	17.2	17.3	+.6
Wholesale and retail trade	do	37.4	42.5	+13.6
Finance, insurance, real estate	do	9.8	10.6	+8.2
Services	do	37.3	37.2	-.3
Government	do	61.0	62.1	+1.8
Total nonagricultural employment[1]	do	192.9	199.5	+3.4
Personal income:				
Total	millions	$7,358	$8,059	+9.5
Per capita		$16,598	$16,820	+1.3
Construction activity:				
Number of private and public residential units authorized		8,290	12,152	+46.6
Value of nonresidential construction	millions	$313.4	$350.7	+11.9
Value of State road contract awards	do	$111.8	$123.0	+10.0
Shipments of portland cement to and within the State	thousand short tons	171	180	+5.3
Nonfuel mineral production value:				
Total crude mineral value	millions	$112.9	$122.5	+8.5
Value per capita, resident population		$258	$256	-.8
Value per square mile		$193	$207	+7.2

pPreliminary.

[1]Includes bituminous coal and oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

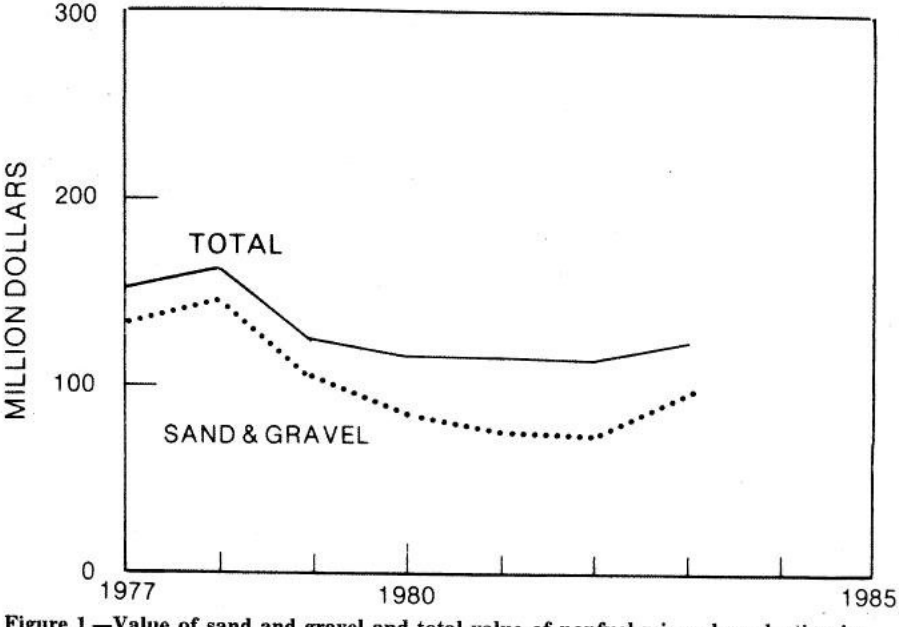

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Alaska.

Trends and Developments.—Exploration and development expenditures in 1983 were about three-quarters of the expenditures in 1982. In 1983, 10,728 new mining claims were recorded, down from the 14,958 recorded in 1982. The proportion of claims located for precious metals increased in 1983, and companies spent about twice as much money exploring for gold and silver as they spent in 1982. Major exploration projects were completed at the Quartz Hill molybdenum deposit in Southeastern Alaska, the Red Dog zinc-lead-silver deposits in northwestern Alaska, and the asbestos deposits near Eagle in the east-central part of the State. Exploration, plant and tailings dam studies, and road surveys were accomplished at the Greens Creek silver-gold-zinc-lead deposits southwest of Juneau. Large bulk samples were taken by the various operators of each of these projects, and beneficiation studies were completed or were currently progressing.

Placer gold production and the number of operators in 1983 were about the same as in 1982. There were notable increases in the construction and use of settling ponds, more efficient use of water, and efforts to save fine sizes of gold. State and Federal agencies increased their monitoring of placer processing effluents and enforcement of water-quality standards. There was increased effort to have the State reclassify certain streams for industrial use and so lower the water-quality restrictions on them.

Important discoveries announced during 1983 included the Johnson River precious metal-base metal deposits about 140 miles southwest of Anchorage and the Coal Creek tin-copper deposit near Talkeetna, which is about 80 miles north of Anchorage.

Annual canvasses and surveys of Alaska mineral producers, developers, and explorers by the U.S. Bureau of Mines and the State Division of Geological and Geophysical Surveys (DGGS) provide detailed information on the mineral industry. Summarized results of the State surveys are presented in "Alaska's Mineral Industry 1983." This is the third annual report produced jointly by the Alaska Department of Commerce and Economic Development, Office of Mineral Development (OMD), and the Alaska Department of Natural Resources (DNR), DGGS. Development expenditures, according to State surveys, were about $27.9 million in 1983, down from about $41.6 million in 1982. Exploration expenditures were $34.1 million in 1983, much less than the $45.6 million reported in 1982.

Exploration Activities.—The exploration activities on most base metal deposits were limited to little more than that necessary to satisfy the annual work requirements to hold unpatented claims. Some drilling was done on the lead-zinc-silver claims in the Wulik River area in the De Long Mountains, and a deposit adjacent to the Red Dog was drilled out, adding reserves to that operation.

Modest activities using various methods were conducted at the copper-zinc deposits along the south flank of the Brooks Range from the vicinity of Arctic Camp easterly to Picnic Creek. Some placer and lode gold activity occurred in the Chandalar District. On the Seward Peninsula, drilling for gold and tin placers and at gold, tin, and lead-silver deposits occurred. Tungsten occurs at several of these gold and tin lode deposits.

Base metal claims were located in the Kaiyuh Mountains southwest of Galena. Base metals, tin, and tungsten were sought north and east of McGrath. Mineralized lands in the Kantishna Hills and Dunkle Mine areas of the Denali National Park-Preserve were explored, as mandated by a provision of the Alaska National Interest Lands Conservation Act. Gold placer and lode exploration continued near Fairbanks, and placer exploration continued in the Valdez Creek, Circle, and Fortymile areas. Work continued on tin and tungsten prospects in the Chena River and Salcha River Basin areas east of Fairbanks. Exploration of base metal massive-sulfide deposits continued along the Alaska Range from just east of Healy to the south of Tok. Some of these deposits contain significant amounts of precious metals and at least one contains tin. At Nabesna, north of the Wrangell Mountains, and near Valdez, there were exploration projects for lode gold at old mines and prospects.

Rewarding exploration drilling projects were carried out at the Coal Creek tin deposit near Talkeetna and at the Johnson River precious and base metals deposits, south of Tuxedni Bay on Cook Inlet. Old gold mines and old and new prospects were explored on Unga Island, near the western end of the Alaska Peninsula, and several prospects on the peninsula were investigated.

In Southeastern Alaska, claim-staking and exploration for copper-zinc-barite deposits were very active in the Mount Henry Clay area, adjacent to the Canadian border, northwest of Haines. This work, and activity on the Canadian side, resulted from the exploration of the Windy Craggy copper-cobalt-gold deposit to the northwest. Additional drilling on nickel-copper-cobalt deposits took place on Yakobi and Chichagof Islands. Several companies explored at base metal deposits with some precious metals content on Prince of Wales Island and other localities. Gold lode deposits were explored north of Juneau, on Chichagof Island northwest of Sitka, east of Ketchikan, and near Hyder.

Exploration of asbestos deposits south of Eagle continued. Construction sand and gravel deposits were sought in and near the oilfields and lease areas along the Arctic coast, near Bethel, and in the vicinities of Anchorage and Juneau.

Employment.—A State survey indicated nonfuel and coal mining employed at least 2,500 people seasonally. About 400 were engaged in sand and gravel and stone operations. Placer mines employed at least 2,000. No estimates were given for employment in coal mining or for exploration on nonproducing projects.

Legislation and Government Programs.—About 40 bills of interest to the minerals industry were introduced in the 1983 session of the Alaska Legislature. Four of these bills were enacted as laws. They were an act amending motor fuel tax provisions, an act relating to toxic and hazardous substances in the workplace, an act relating to mining lease locations on, and classification of, State land, and a joint resolution proposing an amendment to the Constitution of the State of Alaska relating to annulment of regulations by the legislature.

The Division of Minerals and Energy Management published summaries of the statutes, regulations, and mining rights applying to State lands. An excellent reference guide on permitting was published by OMD. It is entitled "Permit Guidelines for the Mineral Industry in Alaska," by J. P. Fernette. The Office of Management and Budget was developing regulations to clarify and streamline the permitting process. Producers of commercial quantities of minerals from State lands must obtain a production license. Regulations implementing the act passed by the State legislature in 1982 were in effect in 1983.

DNR was reactivating the offshore prospecting and leasing program on the State's tidal and submerged lands, covering locatable minerals. Prospecting permits were to be issued for 7 years. The permit can be

converted to a noncompetitive offshore mining lease if the permittee developed a workable deposit. This lease was good for up to 10 years.

A Division of Mining was created within DNR. It includes the DGGS Minerals Information offices and most of the nonoil and nongas functions of the Division of Minerals and Energy Management. It will administer most of the State's nonfuel mineral programs. Several new local Coastal Management Programs were accepted, and progress was made on the Southeast Tidelands Area Plan.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Anchorage Sand and Gravel Co. produced Type I cement for general construction uses and some Type III, high-early-strength cement at the company's clinker grinding and blending plant in Anchorage. Most of the cement was used by the company in its ready-mixed concrete operations.

Gem Stones.—The value of gem stones reported in 1983 was $60,000, the same as reported in 1982. This value probably is for soapstone only. Jade was recovered at the Jade Mountain area east of Kotzebue from Native lands and privately owned claims. NANA Regional Corp. Inc. mined and transported most of the production to Kotzebue. It was worked up there and marketed by its Jade Mountain Products Inc. NANA installed new machinery this year that will allow the production of jade tiles for building and decorative uses. Display-grade epidote and other mineral specimens were recovered from claims in the Green Monster Mountain area on Prince of Wales Island. Brown coral recovered from coastal waters was used in the production of jewelry items. Clays from the Healy Coalfields and other sources and selected rock-flour materials were used in ceramic work by local manufacturers and hobby potters. Soapstone was quarried in the Talkeetna Mountains and in the Salcha River area.

Limestone.—Sherman Smith, of Cooper Landing, continued his efforts to obtain the required permits to build a road and to produce agricultural limestone from his claims on the Russian River, on the Kenai Peninsula. Additional exploration and claim-staking occurred on limestone deposits at View Cove, on Dall Island in Southeastern Alaska. The objective was to acquire chemical and cement-grade material.

Sand and Gravel (Construction).—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel produced in 1983 was estimated to be 45.2 million tons valued at an estimated $97.2 million, a substantial increase over the amount and value of 1982 production. Alaska ranked third in the United States in estimated construction sand and gravel produced. No production of industrial sand and gravel in Alaska was reported.

About three-quarters of the sand and gravel consumed in Alaska was used in the oilfields on the North slope for roads, construction pads, and gravel islands. The islands are built offshore to site drill rigs and their facilities over favorable geologic structures. Mukluk Island, the largest such island built in arctic Alaska, was constructed during the winter and summer of 1983. It required about 1.25 million cubic yards of gravel. The base of the island is 48 feet below sea level, the top is 25 feet above sea level, and it is 350 feet across the top. Sohio Alaska Petroleum Co. is the operator of the Mukluk project.

An increasing proportion of the sand and gravel used in the Anchorage area is shipped by rail from pits near Palmer, about 50 miles north, and other pits in the Matanuska Valley. Rail shipments from the valley were about 4.4 million tons, or about 54,000 carloads, in 1983. There were 36,518 carloads in 1982, 22,698 carloads in 1981, and 5,245 carloads in 1980. Most of the formerly productive pits in Anchorage are depleted, and known reserves now lie within areas zoned for residential and other types of construction.

Table 4.—Alaska: Construction sand and gravel sold or used by producers

	1982			1983[e]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	662	$2,128	$3.21	NA	NA	NA
Gravel	2,279	8,206	3.60	NA	NA	NA
Sand and gravel (unprocessed)	37,891	64,[illegible]1	1.70	NA	NA	NA
Total or average	40,832	74,895	1.83	45,200	$97,200	$2.15

[e]Estimated. NA Not available.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone production reported in 1983 was 1.98 million tons valued at $9.46 million. This is less than one-half as much as the 5.1 million tons valued at $25.2 million reported in 1982. No production of dimension stone was reported to the U.S. Bureau of Mines.

About two-thirds of the crushed stone was sold or used by producers for unpaved road surfacing. Graded road base or subbase and other uses, including railroad ballast, each used about 10% of production. Less than 4% each was used for coarse concrete aggregate and coarse bituminous aggregate. About 60% of the crushed stone reported was produced by the U.S. Forest Service and used on forest roads. Other major producers were Aleutian Constructors, Anchorage; City of Sitka; Ketchikan Ready-Mix and Quarry Inc., Ketchikan; South Coast Inc., Ketchikan; and Yutan Construction Co., Fairbanks. By regions, Southeastern Alaska reported 83%; Yukon River, 7.7%; Cook Inlet, 7.6%; and smaller amounts were produced in the Alaska Peninsula and Copper River regions.

Table 5.—Alaska: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1 1/2 inch):		
Riprap and jetty stone	12	85
Filter stone	3	39
Coarse aggregate, graded:		
Concrete aggregate, coarse	68	318
Bituminous aggregate, coarse	76	325
Bituminous surface treatment aggregate	1	W
Fine aggregate (–3/8 inch):		
Stone sand, concrete	17	65
Stone sand, bituminous mix or seal	42	193
Coarse and fine aggregate:		
Graded road base or subbase	189	1,061
Unpaved road surfacing	1,333	6,297
Terrazzo and exposed aggregate	W	29
Crusher run, select material or fill	40	208
Special: Other[2]	201	841
Total[3]	1,981	9,460

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes limestone, granite, shell, traprock, and miscellaneous stone.
[2]Includes railroad ballast, uses not specified, and uses indicated by symbol W.
[3]Data do not add to totals shown because of independent rounding.

METALS

Antimony.—No antimony production was reported to the U.S. Bureau of Mines. The State report indicated John Millhouse mined 20 short tons of high-grade antimony ore from the Slate Creek Mine in the Kantishna District.

Copper and Lead.—No production of copper or lead ores was reported. Small amounts of both metals were contained in gold concentrates obtained by retreatment of lode mine tailings. GCO Minerals Co. and Houston International Minerals Corp. (HIMCO) continued exploration at their LIK and other lead-zinc-silver claims in the Wulik River area. Bear Creek explored on its claims west of the Red Dog zinc deposit. Bear Creek continued a modest program on its Arctic Camp copper-zinc deposit, Bornite copper-zinc-cobalt deposit, and other prospects in the Ambler area. The Anaconda and Sunshine Mining Co. partnership claims were operated by Ambler Mining Co. These claims include the Sun, Smucker, and Picnic Creek claim groups. Each company also had claims not included in the partnership. Noranda Exploration Inc., GCO, and Cominco American Incorporated maintained their various copper-belt claims. Greatland obtained the Omilak lead-zinc-silver prospect. It is near the Omilak Mine, an old lead-silver property about 35 miles north of Golovin on the Seward Peninsula. Anaconda located claims, mapped geology, and drilled in the Illinois and Mud Creek areas of the Kaiyuh Hills, about 60 miles southwest of Galena. Anaconda and Patino Inc. explored for base metals in other parts of the western district.

Geneva Pacific Corp. concluded its long-term exploration project on about 500 claims and donated the land to the Federal Government. The claims are about 15 miles east of McCarthy, within the Wrangell-St. Ellias National Park and Preserve. The claims extend on both sides of Chitistone and Glacier Creeks. The company did not take a tax writeoff on the gift of about 10,000 acres of land. Bear Creek continued exploration of a massive-sulfide copper-zinc-lead-silver deposit near Sheep Mountain, east of Healy. There are tin-bearing zones in the deposit. Several stratabound deposits in the Alaska Range, including the old Liberty Bell Mine, are being evaluated. HOMEX, operator for a group of companies, explored in the Bonnifield District for base and precious metals, and Resource Associates of Alaska Inc. (RAA) maintained a large block of claims and did additional exploratory work on copper-lead-zinc deposits in the Delta Schist Belt south of Tok. RAA discovered the host trends several years ago along the north slope of the east-central Alaska Range.

Over 35 deposits have been found. Hunt Oil Co., Minerals Div., maintained several claim groups and located additional claims in the southern Alaska Range. Hunt also worked on claims in the Big River area south of McGrath. These claims were located following geologic mapping and studies started in 1981. Various areas contain lead, zinc, gold, silver, molybdenum, tin, and tungsten minerals.

Favorable exploration results at the Windy-Craggy copper-cobalt-gold deposit to the west in British Columbia have caused intensified prospecting in the Mount Henry Clay area 35 to 40 miles northwest of Haines. Field people from several companies prospected the area and claims were located. Exxon Minerals Inc. used various exploration techniques to evaluate a block of 69 lode claims southwest of the head of Twelvemile Arm and another block of 318 claims east of Twelvemile Arm, on Prince of Wales Island. Exxon also examined copper and other prospects in the general area. Noranda continued drilling and other exploratory work near Niblack Anchorage, west of Moira Sound. Cominco and Anaconda are also interested in this area. Noranda also investigated prospects near the south end of Dall Island and in other parts of Southeastern Alaska.

Gold.—Reported gold production in 1983 was 34,700 troy ounces valued at about $14.7 million. This is probably about 20% of the actual Alaskan production.

The best estimate of gold production in 1983 is at least 169,000 troy ounces, derived by the State. The estimate, according to "Alaska's Mineral Industry 1983," is based on information from (1) 25 consultants familiar with activities in 30 mining districts; (2) DGGS questionnaires and other volunteered information, including data from about 100 mechanized placer mines statewide; (3) company news releases and annual reports to stockholders; and (4) estimates of gold bullion refined from two precious-metal refiners.

These State surveys indicate about 296 mechanized placer mines and about 40 recreational placers produced approximately 169,000 ounces of gold and 18,000 ounces of byproduct silver. Production of gold from

lode mines was probably less than 300 ounces. The Department of Revenue issued about 700 Alaska Mining Licenses in 1983 to applicants that planned to produce gold by placer mining, from placer exploration, or from prospecting.

The State's survey summary gives the best available distribution of placer gold production and operating mines. The number of mines listed will be major operators in each of the State regions. The northern region had 15 major operators and produced an estimated 6,200 troy ounces of gold. This region contains the Noatak, Shungnak, Koyukuk, and Chandalar Districts. In 1982, 18 operators produced about 9,000 ounces of gold. This year was especially dry in the Koyukuk District, hampering most of the operations. The most productive creeks were Archibald, Emma, Linda, Nolan, Portland, Union, and Vermont in the Wiseman area. There were operations on Crevice Creek, and Wild River Ventures mined its underground placer in the winter and sluiced that gravel and worked a surface placer in the summer.

In the Chandalar District, Canadian Barranca Corp. Ltd. succeeded Jan Drew Holdings Ltd. as operator on the placer claims of Little Squaw Gold Mining Co. and certain other claims. Barranca reported running three sluices of its own design. Two of the sluices were side-by-side and fed by two D-9 bulldozers. Tailings were removed by a front-end loader. The other sluice used a D-9 and a front-end loader. The lode mines and mill did not operate in 1983. Underground drilling and drifting was reported on the 200-foot level of the Little Squaw Mine, and there was some exploration on the Eneveloe Prospect.

Placid Oil Co. explored in the Chandalar area. Assessment work and prospecting was done in the Wiseman area by several operators. Midnight Mining Association located claims on Prospect Creek and explored for base and precious metals.

In the western region, 35 operators produced an estimated 41,000 ounces of gold. This region includes the Seward Peninsula and the Koyukuk, Hughes, and Ruby Districts. In 1982, 34 operators produced an estimated 34,500 ounces of gold. Alaska Gold Co. was the largest producer. It operated Dredge No. 5 on the Third Beach, north of Nome; Dredge No. 6 on the Submarine Beach, west of the Nome airport; and the Hogatza dredge, west of Hughes. These units are floating bucketline dredges. The Nome units have 9-cubic-foot buckets, and the Hogatza unit is a 7-cubic-foot boat.

The Nome unit employed about 140 people during the operating season and about 30 to 35 during the winter. Cold water thawing is required to melt the permafrost ahead of the dredges. This operation is very labor intensive. Several smaller family operated dredges were active: Ron Engstrom with a 2-1/2-cubic-foot boat on Basin Creek; the Tweet family on Henry Creek with a 2-1/2-cubic-foot boat; Steve Peterson near Council; and Pat Bliss on the Ungalik River.

There were productive sluicing operations on many of the creeks and rivers. Among these were Anvil, Buster, Candle, Casadepaga, Dahl, Dexter, Garfield, Gold Run, Rainbow, Snow, and Sweepstakes Creeks. Up to 100 people worked on the Nome beach using about every imaginable small-scale method of gold recovery, mostly with small returns for their efforts. Phoenix Marine Engineering Co. moved equipment in to start mining the offshore extension of the channel of Daniels Creek, about 50 miles east of Nome. The cutterhead dredge barge, the gold recovery barge, and the big tug arrived at the site late in September, and the various units were immediately swamped or driven ashore by a fall storm. The crew and tug were saved and got to the Nome harbor. Reportedly, heavy equipment from Nome beached the two barges for the winter. Phoenix was the operator for Aurick Offshore Mining Corp., the leaseholder.

There was considerable exploration for gold on the peninsula. Noranda Exploration Inc. completed drilling on the Mud Creek deposit, near the north coast, and ran recovery tests on bulk samples. Placid also explored placer property. Several operators from other regions were scouting for placer ground to move to because of depleting reserves in their usual working areas. Greatland Exploration Ltd. investigated and leased some claims on Anvil Creek, Dexter Divide, and Dexter Creek. Berg and Wetlesen churn-drilled in the Candle Creek area. World Evangelism Inc. explored claims north of Golovin and staked some new claims. Omega Energy Corp. did some geochemical and geophysical work on the eastern part of the Seward Peninsula. Cornwall Pacific Resources Ltd. continued drill exploration at the Big Hurrah Mine, north of Solomon. The gold ore carries some tungsten. Recent results indicate additional ore in the old underground mine and a possible surface mine reserve. Cornwall is

composed of the United States, British Columbia, and Alaska interests and is operated out of Anchorage by C. C. Hawley, of the Hawley Resource Group.

The eastern interior region reported the recovery of about 85,000 ounces of gold by 180 operators. In 1982, this region was credited with 88,500 ounces of gold produced by 201 operators.

This region extends from about 20 miles west of Tanana east to the Canadian boundary and from the latitude of Paxon to about 30 miles north of Fort Yukon. This region produced about one-half of the State's gold in 1983. The State reported six mines each produced in the 2,500- to 4,000-ounce range, and many others produced at the "several hundred ounce level." The largest reported producer was a mine at Livengood operated by Galaxy Minerals Ltd., credited with almost 12,000 ounces of gold. Galaxy was formed to acquire and operate the placer deposit formerly leased and operated by Canadian Natural Resources Ltd.

The Circle District was the most active in the State with 42 medium-to-large mechanized mines and 80 to 100 smaller mechanized and recreational ventures. Water shortages and decreased reserves reduced production in the Fortymile, Manley, Rampart, and Richardson Districts. Production increased in the Fairbanks, Livengood, Bonnifield, and Kantishna areas. Tri-Con Mining did some pilotplant work at the Grant Mine, west of Fairbanks, and ran some of the mill tailings through the new circuit. Several placer operators made recovery tests and improved their gold recovery methods enough to allow some of them to rework previously mined ground. The Lucky placer and lode claims in the Livengood area were explored by New Dynasty Inc. Placer exploration was widespread and intensive, especially in the Fairbanks area.

Denali Mining Co. leased its Valdez Creek placer property to a joint venture group consisting of Camindex Minerals Ltd., Barrick Resources Corp., Talcorp Ltd., and Sullivan Mines Ltd. Camindex is the operator. The preliminary reserves figure announced indicated about 358,000 cubic yards averaging 0.085 ounce of gold per cubic yard in the Tammany and the A channels. The claim group is still not fully explored. This property is about 50 miles east of Cantwell, just north of the Denali Highway. A mining operation is being planned for 1984. Aspen Exploration Corp., Denver, CO, also drilled claims in the Valdez Creek area.

Noranda reopened old workings and examined the Nabesna Mine, on the north flank of the Wrangell Mountains. This skarn-type deposit produced about 67,000 ounces of gold from 88,000 short tons of ore from about 1930 to 1941. Silverado Mines Ltd. did some exploration work at the Grant Mine, through Tri-Con, its operator. Placid continued exploration on its lode and placer claims in the Cleary area, north of Fairbanks. Mohawk Resources Alaska Inc. and Alaska Mineral Services (AMS) each did more work on their properties in the Cleary area. Mohawk has a small custom mill at Fox that is set up to treat a variety of ores and concentrates. AMS is constructing a mill. UNC Teton Exploration Drilling Inc. drilled the Zachley skarn-type gold-silver-copper deposit on the south slope of the Alaska Range. This project was a joint venture with RAA.

In the southwestern region, 25 operators recovered about 15,500 ounces of gold. In 1982, 26 mines recovered about 19,600 ounces of gold. The production came from the Crooked Creek, Flat, George River, Innoko, and Nyac areas. Most of the operators in these remote areas are oldtimers and experienced, with long production records. In the Nyac area, Tuluksak Dredging Ltd. operated its 4-cubic-foot dredge. The 6-cubic-foot dredge of Northland Gold Dredging Ltd. was idle. Northland was unable to get a permit from the U.S. Corps of Engineers to cross the Tuluksak River early enough for an economic dredging season. Several protests and environmental problems must be overcome to clear the permit. Northland's dredge was a substantial producer in 1982.

The south-central region's 25 operators produced about 20,800 ounces of gold, compared with an estimated 22,145 ounces recovered by 38 placer mines in 1982. Territorial Corp. and some smaller mines worked in the Slate Creek area, in the Chistochina District. The Nelchina District was active, with Nelchina Mines Inc. the main producer. The State reported that Talmo Inc. ran a substantial operation in the Wrangell National Park-Preserve. A number of mines were active in the Cache Creek, Nizina, and Kenai Peninsula Districts. Lode mine activity was reported in the Willow Creek District, but the only reported production was from placer mining.

Underground exploration and development took place at the Independence Mine and some mill tests were reported. Fern

Development Corp. continued work at the old Fern Mine, and there was drifting reported at the Gold Cord Mine by Gold Cord Development Corp. Anaconda Minerals Co. put in a small airstrip on the Johnson River, south of Tuxedni Bay, inland from the west shore of Cook Inlet. They drilled on gold and base metal prospects north and south of the river. The old Cliff Mine, west of Valdez, was investigated. It was the foremost producer in that area from 1910 to 1942. Some small-scale stream and beach placer mining occurred along the Gulf of Alaska between Cape Yakataga and Icy Cape. North Coast Mining Co. conducted test-pitting and bulk sampling operations near Lawrence Creek and continued sampling and exploration on several other claim groups. Aspen continued offshore and beach exploration along Cook Inlet for gold, heavy minerals, and sand and gravel resources. The State was reactivating it's offshore prospecting permit and leasing system. Aspen applied for prospecting permits and also for Corps of Engineers permits to sample prospective deposits at about 30 specific sites.

The State estimates three operators produced about 500 ounces of placer gold in the Southeastern and Alaska Peninsula regions. In the southeastern region, John Schnabel operated a placer mine west of Haines, in the Porcupine River area.

Some other very small-scale activity occurred along the Porcupine River and its tributaries. Some gold was produced from retreatment of Alaska Juneau lode mine tailings and mill cleanup. Juneau Mining Co. continued test work on recovery of gold from Alaska Gastineau mill tailings deposited along the beach at Thane, about 4 miles south of Juneau. A retreatment plant was being built that would use centrifugal concentrators to produce a product for shipment to smelter. The plant would be fed through a pipeline by a cutterhead dredge with a rated capacity of 300 cubic yards per hour. Plant shakedown runs were started late in November, about the end of the anticipated operating season.

Barrick Petroleum Alaska Corp. (BPC), a subsidiary of Barrick Resources Corp., of Toronto, Canada, started negotiating with the owners of the Alaska Juneau Mine and the Treadwell Group properties for a long-range, three-stage lease. BPC intends to investigate the possibility of establishing a large-scale, low-grade underground mining and milling operation. The properties are owned by the Alaska Electric Light and Power Co. and the City-Borough of Juneau. Bear Creek Mining Co. drilled a wide gold-bearing shear zone at the old Jualin Mine property of Hyak Mining Co. Placid continued drilling and other work at its Kensington-Comet property, west of the Jualin and north of Juneau. Enserch Exploration Inc. continued exploration at the Hirst-Chichagof Mine. Queenstake Resources Ltd. and Exvenco Inc. acquired an option to earn a 50% interest in the old Chichagof Mine.

The property is on the west side of Chichagof Island, about 40 miles north of Sitka, and about two miles south of the Hirst-Chichagof. Queenstake, as operator, was reopening some old workings, preparing for a drilling project, and investigating retreatment of the old tailings. The Chichagof Mine produced about 647,700 ounces of gold from about .596,500 tons of ore between 1905 and 1942. The owners reported about 400,000 tons of tailings available that averaged about 0.11 ounce of gold per ton. Several other companies scouted for gold properties in the Juneau area, east of Ketchikan near Thorne Arm and in the Hyder District.

Several companies explored for gold in the Alaska Peninsula region. Alaska Apollo Gold Mines Ltd. continued reopening and exploring the old Apollo and Sitka Mines on Unga Island, south of the Alaska Peninsula and Port Moller. Apollo drilled about 20,000 feet of core holes, adding to ore reserves, and did mapping and geologic studies. Exploration drilling on the Shumagin vein indicated a possible major new ore zone. Drill holes and underground sampling confirmed significant values in gold, silver, and lead. Preliminary prospecting results on the nearby Empire Ridge area were promising. A company report released in December indicated ore reserves in all categories totaled about 500,000 tons and were estimated to average about 0.3 ounce of gold and 1.0 ounce of silver per ton.

Teton and RAA participated in a joint venture exploration project on Unga Island. They used 15 people and drilled over 4,000 feet. RAA explored for precious metals on lands belonging to the Aleut and the Bristol Bay Native Corporations. They used geologic mapping, geochemistry, and geophysical surveys on the Alaska Peninsula and some of the Aleutian Islands.

Table 6.—Alaska: Reported placer production of gold

Year	Mines producing	Material treated[1] (thousand cubic yards)	Gold recovered		
			Troy ounces	Value (thousands)	Average value per cubic yard
1979	14	778	6,675	$2,053	$2.639
1980	21	973	11,386	6,975	7.169
1981	21	3,257	26,432	12,149	3.730
1982	20	3,264	30,181	11,345	3.476
1983	19	2,879	34,649	14,691	5.103

[1]Excludes material treated primarily for the recovery of platinum.

Iron and Steel.—There was no reported production of ferrous metals or slags. An unknown amount of iron and steel scrap was shipped out as backhaul on southbound barges.

Molybdenum.—U.S. Borax and Chemical Corp. received patents to 32 lode mining claims, covering part of the Quartz Hill molybdenum deposit. The mine access road from Wilson Arm to the minesite was completed and opened August 12. The 5,000-ton bulk sample that had just been mined from underground workings was trucked to the beach and shipped by barge and rail to the Hanna Mining Research Center at Nashwauk, MN. Comprehensive pilot plant testing was started when the bulk sample was received. Bechtel Civil and Minerals studied and evaluated possible sites for the various plant and surface facilities and worked on other design and engineering problems. An Environmental Impact Statement for the mine project was scheduled for release in mid-1984. Aspects of marine tailings disposal and environmental problems were subjects of continuing studies. The company decided worker's homes should be in Ketchikan, and employees would commute to the operation, probably on a weekly basis. The project area is about 45 miles east of Ketchikan and would require travel by marine vessel. A site for a concentrate roasting and chemical plant was obtained near Grays Harbor, WA. The surface mine was to be designed to operate at 40,000 tons per day initially, and was to be increased to 80,000 tons per day. Project expenditures through 1983 will have been about $100 million, with about $25 million on environmental concerns. Announced ore reserves are 1.5 billion tons of minable ore averaging 0.14% molybdenite. This includes 200 million tons of readily accessible ore containing 0.2% molybdenite.

Platinum-Group Metals.—No production of these metals was reported to the U.S. Bureau of Mines. The State lists platinum produced valued at $100,000. The Salmon River dredge of Hanson Properties Inc. operated for about 1 month. Considerable sampling was done on old tailings; bulk samples were processed; and methods were tried to get better metal recoveries from the clayey gravels. Orbex Minerals Ltd. continued a minimum exploration project at the Salt Chuck Mine on Prince of Wales Island, west of Ketchikan.

This mine was credited with the production of 5 million pounds of copper, 19,000 troy ounces of palladium, and 2,500 ounces of platinum in sulfide concentrates prior to 1941. Aleco Inc.'s nickel-copper-cobalt deposits on Yakobi and Chichagof Islands were acquired by Galactic Resources Ltd. and Cornucopia Resources Ltd. Their drilling and exploration program in 1983 was designed to determine the amounts and distribution of the platinum-group metals in the sulfide-bearing deposits.

Silver.—Silver production reported to the U.S. Bureau of Mines was about 4,000 troy ounces. The State reported silver production at 33,200 ounces valued at $332,000. Most of the silver was recovered as a natural alloy with placer gold. Some silver ore was reported shipped from the Granite Mountain area in the Wrangell Mountains. Nick Begich, Jr., mined silver-gold ore at the Wieler Mine, in the Kantishna district. About 150 tons of hand-sorted, high-grade material was flown to the Denali Park highway by helicopter and trucked to the Mohawk mill at Fox for further concentration.

Noranda Mining Inc. continued various exploration and development activities at the Greens Creek joint venture property on Admiralty Island, about 18 miles west of

Juneau. In 1983, the ore reserves were reported to be 4 million tons averaging 10 ounces of silver per ton, 0.1 ounce of gold per ton, 8% to 10% zinc, 2.5% lead, and 0.5% copper. Anaconda purchased the interest in the joint venture formerly owned by Marietta Resources International.

U.S. Forest Service examinations confirmed the validity of eight of the core claims. The validity of the remaining claims has not been determined, but under the present land status the deadline is December 2, 1985. Noranda Mining increased its exploration drilling in 1983 but petitioned the U.S. Forest Service to have the Greens Creek watershed removed from the Admiralty Island National Monument and the slightly larger adjacent Youngs Creek watershed placed in the monument. This action would remove the time restraint and allow more orderly and economical exploration from underground as mining proceeds. The draft Environmental Impact Statement for this proposed action was released in December for review and comment. The Greens Creek Final Environmental Impact Statement and the Record of Decision were completed in January 1983.

Tin.—Alaska ranked first in the United States in reported tin production. Most of the tin was recovered by Lost River Mining at its Cape Creek placer mine on the Seward Peninsula. The State reported that about 11 drums of cassiterite concentrate were recovered at a placer mine in the Tozi-Moran area west of Tanana. Anaconda continued exploration at its Kougarok Mountain tin deposit on the Seward Peninsula. Duval Corp. worked on tin and tungsten prospects in the Medfra area, and RAA maintained some tin-gold prospects out of Ruby.

Tin and tungsten claims in the Salcha and the Chena River basins were explored by Bear Creek, Union Carbide Corp., and HIMCO. The Coal Creek tin deposit west of Hurricane was discovered and drilled out by HIMCO. This cassiterite-bearing sheeted vein system has drill-indicated reserves of about 5 million tons that average greater than 0.2% tin.

Zinc.—Cominco continued exploratory drilling at the Red Dog zinc-lead-silver deposits about 90 miles north of Kotzebue. Drilling at the Hilltop outlined an additional reserve of fine-grained massive sulfide ore. This deposit was reported to be about 95 feet thick, dips to the south, and have metal values similar to the Red Dog deposit. A bulk sample for milling tests was obtained from the main deposit by drilling 4-inch-diameter holes through the ore zone. Environmental data gathering, design and layout of plant and facilities, and feasibility studies continued. Title to land in the project area was conveyed to NANA in June. The Environmental Protection Agency was preparing the Environmental Impact Statement for the proposed operation.

State legislation was enacted to permit creation of regional transportation authorities. An authority could issue revenue bonds to a total of $400 million. Creation of a regional authority could help finance transportation facilities for the Red Dog and other remote mining projects. Transportation facilities for Red Dog may cost up to $200 million. NANA was working with the Federal Government on a possible land trade to facilitate establishment of a transportation corridor from the minesite to the Chukchi Sea south of Kivilina.

[1]State Liaison Officer, Bureau of Mines, Juneau, AK.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	Region
Cement:			
Anchorage Sand and Gravel Co	1813 East 1st Ave. Anchorage, AK 99601	Grind and blend.	Cook Inlet-Susitna.
Gold:			
Alaska Gold Co	Box 64 Nome, AK 99762	Placer-dredge	Seward Peninsula.
Ault Enterprises	Box 82330 Fairbanks, AK 99708	Placer	Yukon River.
Bedrock Co	Box 1505 Fairbanks, AK 99707	do	Do.
Galaxy Minerals Ltd	Box 467 Fairbanks, AK 99707	do	Do.
Nelchina Mines	1850 Wickersham Dr. Anchorage, AK 99507	do	Cook Inlet-Susitna.
Territorial Corp	Box 6217 Albuquerque, NM 87197	do	Copper River.
Tuluksak Dredging Ltd	Nyac, AK 99642	Placer-dredge	Kuskokwim River.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	Region
Sand and gravel (construction):			
Alaska Aggregate Corp	7800 Lake Otis Parkway Anchorage, AK 99502	Pit	Cook Inlet-Susitna.
Anchorage Sand and Gravel Co	1813 East 1st Ave. Anchorage, AK 99501	Pit	Do.
Fairbanks Sand and Gravel Co	Box 686 Fairbanks, AK 99707	Pit	Yukon River.
Phil Godfrey	2961 Riverside Dr. Juneau, AK 99801	Pit	Southeastern Alaska.
Juneau Ready-Mix Inc	Box 270 Juneau, AK 99802	Pit	Do.
U.S. Bureau of Land Management	Box 13, 701 C St. Anchorage, AK 99513	Pit	Various.
Stone (crushed):			
Aleutian Constructors	Box 4D Anchorage, AK 99509	Quarries	Do.
Ketchikan Ready-Mix and Quarry Inc	Box 8100 Ketchikan, AK 99901	Quarry	Southeastern Alaska.
City of Sitka	Box 79 Sitka, AK 99835	do	Do.
South Coast Inc	Box 8620 Ketchikan, AK 99901	do	Do.
U.S. Forest Service, Region 10	Box 1628 Juneau, AK 99802	Quarries	Various.
Yutan Construction Co	Box 1775 Fairbanks, AK 99707	Quarry	Yukon River.
Tin:			
Lost River Mining	Box 411 Nome, AK 99762	Placer	Seward Peninsula.

The Mineral Industry of Arizona

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Arizona Department of Mineral Resources for collecting information on all nonfuel minerals.

By Lorraine B. Burgin[1]

The value of Arizona nonfuel mineral production continued declining from the record high $2.6 billion in 1981, to $1.6 billion in 1982 and $1.5 billion in 1983—a 42% drop in 3 years. The slowdown in copper output and its coproduct and/or by-product molybdenum was the principal cause of this decline. Gold and silver, also copper-production byproducts, rose in value when precious metals prices remained fairly high most of the year. Gold also increased in output, whereas silver production continued to decline as some important copper producers shut down or reduced output.

Table 1.—Nonfuel mineral production in Arizona[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	143	$998	151	$1,425
Copper (recoverable content of ores, etc.)	metric tons	r769,521	r1,235,055	678,216	1,144,285
Gem stones		NA	2,800	NA	2,800
Gold (recoverable content of ores, etc.)	troy ounces	61,050	22,949	61,991	26,284
Gypsum	thousand short tons	175	1,205	265	1,929
Lead (recoverable content of ores, etc.)	metric tons	359	202	144	69
Lime	thousand short tons	326	17,080	340	16,700
Molybdenum (content of concentrate)	thousand pounds	r20,445	r89,928	23,934	79,459
Pumice	thousand short tons	1	7	2	15
Sand and gravel:					
Construction	do.	19,124	58,375	e23,200	e75,000
Industrial	do.	107	1,617	W	W
Silver (recoverable content of ores, etc.)	thousand troy ounces	r6,309	r50,159	4,492	51,383
Stone:					
Crushed	thousand short tons	e5,200	e22,200	4,755	24,079
Dimension	do.	W	e580	(2)	1
Combined value of cement, perlite, pyrites, salt, and value indicated by symbol W		XX	79,105	XX	87,449
Total		XX	r1,582,260	XX	1,510,878

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Less than 1/2 unit.

Table 2.—Value of nonfuel mineral production in Arizona, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Apache	W	W	Sand and gravel (industrial), clays, sand and gravel (construction).
Cochise	$34,433	$19,856	Copper, lime, gold, silver, sand and gravel (construction), sand and gravel (industrial), lead.
Coconino	2,812	1,332	Sand and gravel (construction).
Gila	292,459	189,916	Copper, molybdenum, silver, gold, sand and gravel (construction), lime, lead.
Graham	13	184	Sand and gravel (construction), pumice.
Greenlee	349,173	W	Copper, gold, silver, sand and gravel (construction), molybdenum.
Maricopa	1,893	35,718	Sand and gravel (construction), lime, salt, clays.
Mohave	65,078	1,448	Sand and gravel (construction), copper, gold, molybdenum.
Navajo	(2)	1,829	Sand and gravel (construction).
Pima	955,793	579,965	Copper, molybdenum, cement, silver, sand and gravel (construction), gold, clays, lead.
Pinal	597,995	374,927	Copper, molybdenum, gold, silver, sand and gravel (construction), lime, gypsum, perlite, sand and gravel (industrial), lead, pyrites, clays.
Santa Cruz	(2)	430	Sand and gravel (construction).
Yavapai	192,969	173,475	Copper, cement, lime, molybdenum, silver, sand and gravel (construction), gold, gypsum, clays.
Yuma	W	W	Sand and gravel (construction), copper, silver, sand and gravel (industrial).
Undistributed[3]	5,817	180,396	
Sand and gravel (construction)	e63,340	XX	
Stone:			
Crushed	XX	e22,200	
Dimension	XX	e580	
Total[4]	2,561,780	1,582,260	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Arizona business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,365.5	1,399.4	+2.5
Unemployment	do.	148.3	87.1	-41.3
Employment (nonagricultural):				
Mining[1]	do.	14.0	14.3	+2.1
Manufacturing	do.	149.5	162.1	+8.4
Contract construction	do.	66.9	82.0	+22.6
Transportation and public utilities	do.	56.2	57.8	+2.8
Wholesale and retail trade	do.	251.2	267.6	+6.5
Finance, insurance, real estate	do.	63.3	67.0	+5.8
Services	do.	230.9	248.7	+7.7
Government	do.	208.0	202.1	-2.8
Total nonagricultural employment[1]	do.	1,040.0	1,101.6	+5.9
Personal income:				
Total	millions	$29,109	$31,761	+9.1
Per capita		$10,067	$10,719	+6.5
Construction activity:				
Number of private and public residential units authorized		36,821	63,977	+73.8
Value of nonresidential construction	millions	$793.1	$867.6	+9.4
Value of State road contract awards	do.	$135.0	$291.0	+115.6
Shipments of portland cement to and within the State	thousand short tons	1,245	1,645	+32.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,582.3	$1,510.9	-4.5
Value per capita, resident population		$566	$510	-9.9
Value per square mile		$14,216	$13,253	-6.8

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

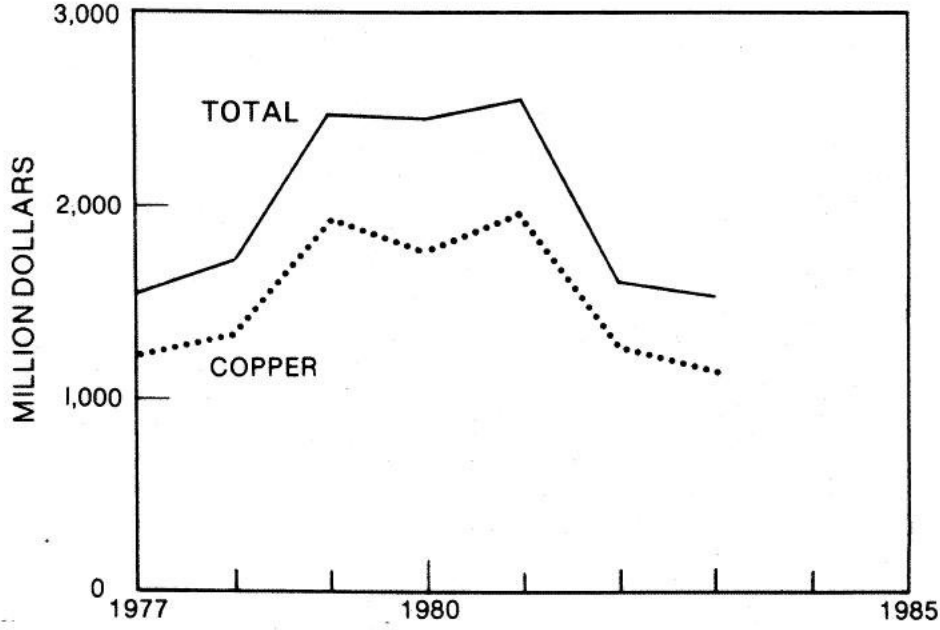

Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Arizona.

In value of nonfuel mineral production, the State dropped from second to third place nationally, and rankings changed in every metal except copper. Copper remained in first place with 65.3% of the Nation's output; molybdenum rose from second to first place with nearly 49% of the national total; silver slid from second to fifth place with 10% of domestic production; and gold slumped from sixth to seventh place with 3% of that production. Although the value of metal production dropped from $1.4 billion in 1982 to $1.3 billion in 1983, the metals group stabilized at 86.1% of the total value of nonfuel mineral production in 1983, compared with about 86.4% in 1982.

In the nonmetals group, the leading commodities, in descending order of value, were portland cement, construction sand and gravel, crushed stone, lime, sulfuric acid, masonry cement, gem stones, gypsum, and clays. All commodities increased in value except for industrial sand and gravel, perlite, and sulfuric acid. In output, gains were noted in all except dimension stone, industrial sand and gravel, lime, perlite, and sulfuric acid. Arizona continued to rank first nationally in production of gem stones.

Trends and Developments.—Arizona's copper industry failed to recover from recession-dominated 1982. The prolonged slump in world demand and high world production levels led to large inventories, and despite major cutbacks in U.S. production, prices of copper deteriorated. Also, in the face of declining prices, company demands for employee concessions led to severe labor problems. Before copper prices began to drop in the latter half of the year, several idled Arizona mines were reactivated to take advantage of the slightly higher prices that existed earlier in the year; reactivation was probably cheaper than maintaining the facilities on standby. Without exception, the large operating mines reduced schedules and employed fewer workers. In addition, producers instituted numerous measures to improve productivity and lower costs. At the same time, companies continued installing and maintaining expensive pollution control systems to protect the environment and bring the operations into compliance with State and Federal regulations. Nearly every corporation reported heavy operating losses in their metals divisions.

For the first time since 1917, Arizona ranked first nationally in molybdenum concentrate shipments. In 1983, slumping molybdenum prices forced the country's largest primary molybdenum producer to idle its Colorado molybdenum operations, thereby pushing Arizona into the number one position. Most of the State's molybdenum production was a byproduct of copper production.

Posing severe problems at several operations, labor relations were of major concern to the copper industry throughout 1983. Five 3-year labor contracts expired on June 30 and one in August. In April, Kennecott set a precedent and settled early with a pact containing a wage freeze, but continued cost-of-living allowances (COLA) that provided a 1-cent per hour raise for each 0.3 point rise in the Consumer Price Index. ASARCO Incorporated, Inspiration Consolidated Copper Co., Magma Copper Co., and Pinto Valley Copper Co., and their unions, patterned their agreements after Kennecott's, and those contracts were renewed without striking. Phelps Dodge Corp., however, asked its workers to accept a wage freeze, eliminate COLA, reduce fringe benefits, and lower pay for new workers. Rejecting the proposal, the union walked out on strike. Phelps Dodge, however, continued to operate with management personnel, workers who would cross picket lines, and new hires. Violence erupted in August, but by September, operations were back to normal. The strike, however, continued through yearend. Anamax Mining Co. workers struck in August after their contract expired and no settlement was reached. Management personnel replaced those union employees, but the mine had already been shut down in January 1983; the strike also closed the concentrator. After Duval Corp. and its union representatives failed to negotiate a new contract in October, work was halted for a few days, but union employees returned to the job rather than risk being replaced. Neither the Phelps Dodge nor the Anamax and Duval contracts had been settled by yearend.

Exploration Activities.—In fiscal year 1983, the Bureau of Land Management (BLM) recorded 21,050 new claims in Arizona, compared with 45,867 in fiscal year 1982. Most exploration was centered in the western part of the State, with Mohave and Yavapai Counties leading in the number of activities, followed by Gila, Pinal, Maricopa, Coconino, La Paz, Pima, Graham, Cochise, Santa Cruz, Greenlee, Yuma, Apache, and Navajo Counties.

According to the Arizona Department of Mineral Resources (ADMR), mineral exploration and development was dominated by

the search for gold and silver in areas known to host epithermal and mesothermal gold veins. Particular attention was given to low-angle thrusts, detachment surfaces, and associated structures similar to those proven to contain mineral deposits in southeastern California. Other areas explored for gold and silver included the Ash Peak district, Greenlee County; Oro Blanco district, Santa Cruz County; and the Tombstone-Pierce area, Cochise County. In northwest Arizona, uranium exploration was targeted on small high-grade uranium-bearing breccia pipes.

In a new publication, the ADMR listed 169 small mining properties by location using township and range, the commodity sought, name and address of operation, and a brief notation of exploration and development activities in 1982-83.[2]

In fiscal year 1983, BLM issued the following number and type of mineral patents in the State: one, asbestos (62 acres); five, copper (345 acres); one, copper-silver (55 acres); three, surface minerals (87 acres); and three, mill sites (15 acres).

Legislation and Government Programs.—On April 13, 1983, the Governor of Arizona signed Senate bill 1364 that levied a tax of 1% of the gross proceeds of sales or gross income from mining, quarrying, or producing for sale or commercial use any oil, natural gas, limestone, sand or gravel, or nonmetalliferous mineral products. Also approved was Senate bill 1309 that exempted from transaction privilege and affiliated excise taxes the sale of mining machinery or equipment used to extract ores from the earth or to prepare the material for extraction and transportation to the surface.

Throughout the year, groups met to resolve differences on areas proposed for preservation as wilderness in Arizona. In rare agreement, mining interests, local governments, public land managers, and environmental groups approved 394,900 acres of the Arizona Strip north of the Grand Canyon and parts of the Utah border land as wilderness; the areas had been considered for wilderness designation since 1976. A bill to designate these areas as wilderness was introduced in the U.S. Congress, and hearings were set for 1984; passage of the legislation also would free 672,870 acres in both States for grazing, mining, and timber production.

On June 12, the Environmental Protection Agency (EPA), under section 112 of the Clean Air Act, proposed a new standard for inorganic arsenic that would reduce such emissions by 20% nationwide. Phelps Dodge at Morenci and Kennecott and Asarco at Hayden were cited as three of six low-arsenic feed smelters that may have to spend more than $35 million in improvements under the new guidelines. In October, the EPA was ordered by a Federal Appeals Court to toughen regulations allowing the use of tall stacks by nonferrous smelters and utilities for dispersing sulfur dioxide emissions.

The Pima Association of Governments and the Upper Santa Cruz Mines Task Force completed a 2-year study of ground water problems associated with mining and farming in a 15- to 20-mile-wide section of the Upper Santa Cruz Basin south of Tucson. The study concluded that ground water was being polluted by copper operations south of Tucson and from the Globe-Miami area.

In the Globe-Miami area, a separate 14-member Mineral Extraction Task Force, funded by the EPA, Inspiration, Pinto Valley Copper, Ranchers Exploration and Development Corp., and the U.S. Bureau of Mines, also reported to the Central Arizona Association of Governments that copper operations near Miami were contributing to contamination of ground water. At least two wells had been shut down; however, the Gila Conglomerate aquifer, upstream of mining activity and Miami's major source of drinking water, was not contaminated. The task force warned that in the long term, if pollution were not halted, ground and surface waters contaminated with metals and sulfates (albeit greatly diluted) could reach Roosevelt Lake, the major drinking water supply for the Salt River Valley. Cleanup of the area would be expensive for the copper producers; however, if the mines were shut down and prevention practices discontinued, degradation of the water quality could increase.[3]

In 1982 and 1983, unusual flooding in Chase Creek Canyon released waters, normally held by a diversion dam for recycling, over waste dumps at the Morenci Mine. Phelps Dodge was working with the Arizona Department of Health Services to solve the problem and estimated that costs of an integrated mine development and environmental control program could exceed $50 million in the next 7 years.

Under title III of Public Law 95-87, the University of Arizona in Tucson received from the U.S. Bureau of Mines $150,000 in fiscal year 1983 for operations and research.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Copper.—Copper production continued to decline, about 12% in tonnage and more than 7% in value. The average copper cathode price increased from $0.73 per pound in 1982 to $0.77 in 1983, accounting for the smaller drop in value of output. Three open pit mines and concentrators were reopened during the year. Mining was suspended at three properties, leaving only their leaching operations functioning; two other surface mines that were closed in 1982 also remained idle except for leaching operations. One open pit mine was mothballed, and production was reduced at six operations. In 1982, Arizona's copper industry employed approximately 15,300 with a total payroll of $387 million; during 1983, average employment decreased to approximately 12,500, and the payroll fell to $339 million.[4]

Compared with 123,098,309 metric tons treated in 1982, 122,743,740 metric tons of material was treated in 1983. Of the total output, 524,295 metric tons of copper was recovered from 115,990,148 metric tons of ore treated by concentration; and 51,201 metric tons of copper was recovered from processing 75,807 metric tons of copper precipitates. Another 97,343 metric tons of copper was electrowon or precipitated from vat-leaching solutions.

Copper was produced at 29 operations in the following counties, in descending order of output: Pima, Pinal, Greenlee, Gila, Yavapai, Cochise, and Mohave. Of these, 15 were large-scale operations treating over 100,000 tons of ore per year. The larger operations are discussed in the following section where all quantities are in short tons unless otherwise noted.

Amoco Minerals Co., a subsidiary of Standard Oil Co. (Indiana), through its subsidiary, Cyprus Mines Corp., managed Cyprus Bagdad Copper Corp., Cyprus Pima Mining Co. (owned 75.01% by Amoco Minerals and 24.99% by Utah International Corp.), and Cyprus Johnson Copper Co.

In Yavapai County, 120 miles northwest of Phoenix and 60 miles west of Prescott, the Cyprus Bagdad operation included an open pit copper mine, a 54,000-ton-per-day concentrator, and a solvent extraction-electrowinning (SX-EW) plant. Most of the firm's concentrates were processed at the Phelps Dodge Hidalgo, NM, smelter. As of December 31, 1983, Amoco Minerals estimated proven copper reserves at the Bagdad Mine at 385.1 million tons of 0.47% copper.

Low production costs and the incentive to keep its nonunion work force intact encouraged the company to maintain full production at this location despite low copper prices. The facility was shut down twice during the year for a week at a time, and the work force was cut back by normal attrition and by a hiring freeze. Also, to cut costs, some businesses, including the company store, were sold. However, company housing and other services were continued. Company operations essentially supported a town of more than 3,000.

In late December 1983, Cyprus Bagdad announced that 150 of its 875 workers would be furloughed in mid-January 1984 and production reduced 25%; the layoffs would be the first since 1938. By yearend, with the shutdown of one grinding circuit, the concentrator was operating at its preexpansion design level of 40,000 tons per day.

In 1983, Cyprus Bagdad became the second Arizona firm listed with the London Metals Exchange as a supplier of acceptable-grade electrowon cathode copper. Anamax's Twin Buttes operation was the other company. The listing required that the electrowon copper cathode have impurities no greater than 65 parts per million; for that designation, more than 300 metric tons of copper was tested in continuous-casting rod mills in Belgium, the United Kingdom, and the Federal Republic of Germany.[5]

The Cyprus Pima open pit copper mine and 32,500-ton-per-day concentrator, about 16 miles south of Tucson, Pima County, remained closed in 1983. With mothballing of the plant 90% completed, the work force was reduced from more than 700 in January 1982 to 42 at the beginning of 1983. During 1983, those employees completed preservation tasks and maintained security, and by yearend, the work force was down to 15. The operation was preserved so that when copper prices improved the mine could be brought on-stream with 1 month's notice.

On December 31, 1983, Amoco Minerals estimated that the Cyprus Pima Mine contained 120.8 million tons of ore of 0.48% copper. A proposed plan to replace the concentrator and extend the pit eastward into a large low-grade ore body was not

considered feasible under present economic conditions.[6]

The Cyprus Johnson operation, 20 miles east of Benson, Cochise County, consisted of an open pit mine, heap leach, and SX-EW plant. The stripping operations halted in November 1982 remained suspended in 1983. Mining the already exposed oxide ore continued at a reduced rate; at midyear, the plant was producing 27,000 pounds of electrowon copper cathode per day. Although employment dropped from 75 to 47 by August, production was maintained at substantially the same rate throughout 1983. As of January 1983, the company estimated reserves of 2.5 million tons of oxide with an average grade of 0.48% copper.

Amoco Minerals cited losses of about $46 million in its minerals operations in 1983, compared with a loss of $71 million in 1982.

Anamax, equally owned by AMAX Inc. and Anaconda Minerals Co., a wholly owned subsidiary of the Atlantic Richfield Co. (Arco), operated the Twin Buttes Mine 25 miles south of Tucson, Pima County. The Twin Buttes operation included an open pit mine, a 45,000-ton-per-day sulfide-ore concentrator, a 10,000-ton-per-day ion-exchange electrowinning plant for processing solutions from leached copper oxide ores, and a uranium oxide plant. Anamax's share of ores from the Eisenhower Mining Co.'s Eisenhower (Palo Verde) property was treated at the Twin Buttes sulfide concentrator. Copper concentrates from the Twin Buttes Mine continued to be sold to Nippon Mining Co. Ltd. of Japan and Norddeutsche Affinerie Aktiengesellschaft of the Federal Republic of Germany. Anamax was responsible for operating the oxide plant and producing electrowon cathode copper; however, each partner purchased and sold its own share of cathode copper.

According to the 1983 AMAX annual report, the volume of Twin Buttes and Palo Verde ores processed through the concentrator fell from 8,174,000 tons of 0.78% copper in 1982 to 1,992,000 tons of 0.67% copper in 1983; production from the Twin Buttes oxide plant dropped from 1,840,000 tons of 1.06% copper in 1982 to 1,765,000 tons of 0.93% copper in 1983. The AMAX share of copper recovered from concentrates and cathodes dropped from 72,434 tons in 1982 to 24,486 in 1983. The 1983 AMAX 10K Annual Report submitted to the Securities and Exchange Commission showed that byproduct molybdenum production from the sulfide ore processed by Anamax plunged from 4.1 million pounds in 1982 to 0.6 million pounds in 1983; and silver contained in concentrates dropped from 2.2 million ounces in 1982 to 0.4 million ounces in 1983.

During 1983, in conjunction with a new mining plan, AMAX reduced ore reserve estimates at the Twin Buttes Mine to 122 million tons of sulfide ore with an average grade of 0.72% copper and 23 million tons of oxide ore with an average grade of 1.08% copper as of December 31, 1983. At yearend, the company wrote down its investment in Anamax from $177 million to $112 million. AMAX showed a $489 million net loss in 1983, compared with a $390 million loss in 1982. The company reduced the declared value of all its copper and molybdenum properties.

Following an October 1979 Federal Trade Commission order based on antitrust grounds that required Arco to divest most of its interest in Anamax within 5 years, Arco unsuccessfully sought a purchaser for that interest.

At the end of January 1983, operations at the Twin Buttes open pit were suspended, and the oxide plant was supplied with stockpiled ore. The sulfide concentrator was limited to processing only ores from the Eisenhower-Palo Verde deposit. Of the approximately 1,100 workers at the Twin Buttes operation, 300 hourly and 210 salaried people were laid off indefinitely.

A strike beginning midnight July 31 shut down the sulfide mill and concentrator for the remainder of the year; however, management personnel continued to operate the oxide plant. About 350 workers represented by the International Union of Operating Engineers (IUOE), International Brotherhood of Electrical Workers (IBEW), United Steelworkers of America (USWA), and the International Brotherhood of Teamsters, Chauffers, Warehousemen, and Helpers of America (Teamsters) walked off the job. By yearend, the strike had not been settled.

Although water continued to be a problem in the area, Anamax notified the Central Arizona Water Conservation District that the company could no longer give assurance that it would contract for Central Arizona Project (CAP) water. An annual 6,105 acre feet of CAP water, with the amount decreasing through the year 2024, had been set aside for Anamax.[7]

Under an Anamax and Asarco equal partnership, Eisenhower Mining mined the Eisenhower (Palo Verde) copper deposit 6.5 miles north of the Twin Buttes Mine be-

tween Asarco's Mission and San Xavier Mines. Asarco continued operating the mine; ores from each partner's interest in the project were either crushed and treated at the Asarco Mission concentrator or transported over a 6.5-mile conveyor system for treatment at the Anamax Twin Buttes concentrator. Asarco treated 3,036,000 tons of ore and recovered 20,800 tons of copper and 409,000 ounces of silver in 1983. In its 1983 annual report, Asarco estimated the partnership's total reserves at yearend were 121 million tons of 0.66% copper and 0.16 ounce of silver per ton; Asarco's reserves were 28.7 million tons of 0.81% copper and 0.23 ounce of silver per ton.

In August, production at the Eisenhower Mine was curtailed because of a strike against Asarco's partner, Anamax, which declared a force majeure on receiving ore deliveries. The strike was still in effect at yearend.

Asarco owned and operated the Mission and San Xavier open pit mines and the Mission 22,500-ton-per-day concentrator near Sahuarita, Pima County, about 15 miles south of Tucson; the Sacaton open pit mine and 11,000-ton-per-day concentrator, about 3 miles northwest of Casa Grande, Pinal County; and the Silver Bell open pit mine and 11,400-ton-per-day concentrator at Silver Bell, Pima County, 38 miles northwest of Tucson. Concentrates were treated at the Asarco 175,000-ton-per-year smelter at Hayden, Gila County, where blister copper was produced and copper anodes cast for shipment to its refinery at Amarillo, TX.

The 1983 Asarco annual report noted production at its Arizona properties as follows:

1. Mission treated 3,993,000 tons of ore, recovering 24,000 tons of copper and 398,000 ounces of silver.

2. A total of 2,784,000 tons of San Xavier ores was processed through the Mission concentrator, yielding 11,300 tons of copper and 138,000 ounces of silver.

3. Sacaton treated 4,003,000 tons of ore, recovering 18,800 tons of copper, 134,000 ounces of silver, and 1,983 ounces of gold.

4. Silver Bell recovered 9,000 tons of copper and 31,000 ounces of silver from 860,000 tons of ore.

As of December 31, 1983, Asarco estimated reserves at its Arizona properties as follows: San Xavier, 159 million tons of 0.51% copper and 0.08 ounce of silver per ton; Mission, 81 million tons of 0.75% copper and 0.17 ounce of silver per ton; Silver Bell, 21.7 million tons of 0.68% copper and 0.07 ounce of silver per ton; and Sacaton, 15.9 million tons of 1.2% copper and 0.04 ounce of silver per ton.

Recovering from a record loss in 1982, Asarco posted net earnings of $58.3 million in 1983. Improved silver and copper prices in the first three quarters, higher sales volume, reduction in number of employees, and increased productivity contributed in part to the rise in earnings.

In September, however, a sharp drop in copper prices forced Asarco to defer stripping operations at its Mission Mine, and 120 workers were laid off, leaving about 400 production employees. Overall, the Mission Unit (Mission, San Xavier, and Eisenhower operations) reduced the total work force by 27%.

Closed since December 1981, Asarco's Silver Bell Mine was brought back into full production, October 1, 1983, to coincide with the startup of the company's new Inco flash furnace at Hayden. Output from the mine was planned to replace the loss of concentrates expected in March 1984 when the Sacaton open pit mine was to be phased out. During the shutdown, the leaching operation continued to produce about 6,000 tons per year, approximately 30% of the mine's total output. The molybdenum plant, however, was not restarted. Of approximately 277 workers idled at Silver Bell in 1981, 181 returned in 1983.

Employment at Sacaton was reduced 18% as personnel requirements declined; ore reserves were exhausted, and preparations were made during the year for complete shutdown.

For the first time since 1964, Asarco reached agreement with its unions on new 3-year contracts without a strike. Effective July 1, the contract provided no increase in wages, retained the COLA clause, and revised certain benefit programs to reduce costs.

The $132.6 million major modernization project at the Asarco Hayden smelter was essentially complete in October 1983. The new Inco-type oxygen flash-smelting furnace brought on-stream in November was expected to be fully operational by April 1984. The flash-smelting furnace replaced the roasters and reverberatory furnaces. When the dried copper concentrates entered the preheated furnace in combination with 95% pure oxygen, the resulting reaction produced temperatures of about 2,400° F, thereby melting the concentrates. The new furnace was expected to help the oper-

ation comply with ambient air purity requirements.

Construction at the 1,600-ton-per-day Hayden smelter included, in addition to the new furnace, a 650-ton-per-day oxygen plant, a water treatment plant, and a 2,800-ton-per-day acid plant. A higher grade matte of 53% to 57% copper was to be attained with the Inco-type flash furnace. The Hayden plant will receive 60,000 to 65,000 tons of concentrates per month from Silver Bell and up to 27,000 tons per month from Kennecott's Ray operation. Asarco estimated a yearly electric bill of $6 to $7 million with the new oxygen flash furnace.[8] The plant, expected to produce 15,000 tons per month anode copper, was to employ 550 workers with an annual payroll of approximately $15.4 million. At midyear, 90 workers were furloughed for 3 weeks to allow for modifications.

E. I. du Pont de Nemours & Co. Inc. signed a 3-year agreement with Asarco to purchase more than 300,000 tons per year of byproduct sulfuric acid produced at the Hayden acid plant. The acid was to be marketed in the west-central States (Arkansas, Iowa, Kansas, Missouri, Nebraska, and Oklahoma).[9]

Duval, a subsidiary of Pennzoil Co., operated the Sierrita open pit copper-molybdenum mine and 82,500-ton-per-day concentrator 30 miles south of Tucson, Pima County. The Copper Leach Electrolysis and Regeneration (CLEAR) hydrometallurgical plant, shut down in April 1982, remained closed in 1983. The company's Esperanza copper-molybdenum open pit mine and 15,000-ton-per-day concentrator adjacent to the Sierrita Mine, and its Mineral Park molybdenum-copper surface mine and 19,000-ton-per-day concentrator 15 miles north of Kingman, remained idle throughout 1982 and 1983. However, copper was recovered at leaching and precipitation facilities at both properties. Copper concentrates and precipitates were sold to Asarco and treated at its Hayden smelter in 1983. During the year, the company entered into new smelting and refining contracts with Inspiration, Phelps Dodge, and Nippon Mining for the sale and toll of Sierrita concentrates.

In its 10K Annual Report, Pennzoil showed that Duval's combined copper production at its operating properties in Arizona and Nevada increased from 116,053,000 pounds in 1982 to 143,020,000 pounds in 1983, approximately 58% of its 1981 production. Molybdenum coproduct production increased from 9,752,000 pounds in 1982 to 12,596,000 in 1983, about 58% of its 1981 production. Silver output rose from 315 ounces in 1982 to 990 ounces in 1983, and gold rose from 71 ounces in 1982 to 80 ounces in 1983.

According to the Pennzoil 1983 annual report, as of December 31, 1983, combined ore reserves at Duval's Arizona and Nevada properties were an estimated 413 million tons containing 0.285% copper and 0.037% molybdenum.

Pennzoil reported that its operating losses in its Duval metals division were $30.9 million in 1983, $30 million less than losses in 1982. The decrease resulted from a reduction in mine shutdown costs and nonrecurring severance payments, which were $5 million in 1983, compared with $24.4 million in 1982. Also, lower unit costs and higher sale prices for copper, gold, and silver trimmed the loss by $11 million compared with 1982 levels.

The Sierrita Mine operated at one-half capacity most of 1983 and with a greatly reduced work force; at yearend, approximately 900 were employed, compared with 2,505 in 1981. A short-lived strike was called on October 1 when Duval and three unions failed to agree on a new 3-year contract. At that time, of 675 hourly workers, 450 belonged to the unions and 275 were salaried employees. By using salaried workers and the hourly workers who chose to return to work, Duval maintained prestrike production levels, and 5 days after their contracts had expired, most hourly workers were back on the job without a contract. The unions approved such local issues as overtime pay, vacations, bonuses, seniority, and training programs; but negotiations stalled on Duval's refusal to grant a COLA allowance while offering a $1-per-hour raise over the 3-year life of the contract. In 1983, the average hourly worker earned $13.30 per hour, or approximately $25,000 in wages and $10,000 per year in benefits. Although the Teamsters and IBEW accepted the new contract, USWA, Laborers' International Union of North America (LIUNA), and the IUOE failed to agree with Duval by yearend.

During the year, the company brought on-stream its innovative, giant movable in-pit primary crusher at the Sierrita Mine. The new system, which follows the mining course in the pit, met or exceeded design specifications for its initial operation and was expected to handle greater throughput

than conventional crushing methods. Savings from the three-crusher system at Sierrita were expected to amount to 10% to 15% of total mining costs. Described in the technical literature were the Sierrita incremental pit design system, the in-pit movable crushing system, and the conveyor belt design.[10]

Although Duval had no plans to reopen the Mineral Park Mine and many furloughed employees had changed jobs or moved away, its four unions ratified a new contract on December 1. The IUOE, USWA, Teamsters, and LIUNA represented 300 of the 434 workers at Mineral Park when the mine closed December 15, 1981. In late 1983, only 20 people were employed at the property. Under the pact, average wages were to be reduced from $12.89 to $10.98 an hour, and entry-level wages were to be dropped from $11.24 to $8 an hour. The contract also reduced medical and dental benefits and called for cross training employees in related work areas.

As a result of the reorganization of its parent company, Plateau Holdings Inc., Inspiration Consolidated Copper Co. became a subsidiary of the newly organized Inspiration Resources Corp. effective July 6, 1983. Previously, Inspiration Consolidated was a subsidiary of Plateau Holdings, which in turn was owned equally by Hudson Bay Mining & Smelting Co. Ltd., Toronto, Canada, and Mineral Resources Corp. Ltd., Bermuda.

Inspiration operated the Joe Bush-Thornton open pit mines in the Inspiration area and a heap leach at the Upper and Lower Ox Hide open pit mines 3 miles west of Miami, Gila County. The Christmas open pit and underground mines and 5,500-ton-per-day concentrator, 35 miles south of Miami, remained inactive in 1983. The company's principal plants in the Miami-Inspiration area included crushing facilities, a 20,000-ton-per-day concentrator, a smelter with a rated annual capacity of 110,000 tons of copper in concentrate, a sulfuric acid plant, a solvent-extraction plant, an electrowinning and electrorefining tankhouse, and a continuous-cast rod-fabricating plant. Inspiration also smelts copper-bearing materials and provides some refining and rod-fabricating services for other copper producers.

The Inspiration Resources 1983 10K Annual Report showed 14,724,000 tons of ore containing 0.525% copper and 23,718,000 tons of waste were mined at its Inspiration-area mines in 1983, compared with 15,455,000 tons of ore containing 0.543% copper and 21,872,000 tons of waste in 1982. At the smelter, 104,000 tons of Inspiration's own copper concentrates was treated in 1983, compared with 77,000 tons in 1982; toll and purchased concentrates dropped to 96,000 tons in 1983, compared with 158,000 tons in 1982. Copper production from the refinery rose to 162,245 pounds in 1983, compared with 152,376 pounds in 1982, and from the rod plant, increased to 182,606 pounds in 1983 from 172,487 pounds in 1982. Total copper recovered from the Inspiration-area mines increased to 138,726 pounds in 1983, from 127,156 pounds in 1982. According to Inspiration Resources' 1983 annual report, Inspiration lost $16.8 million before interest and taxes on deliveries of 178.5 million pounds of copper, compared with a $9 million loss on deliveries of 142 million pounds in 1982.

As of December 31, 1983, the company reported estimates of 178 million tons of 0.52% copper in proven reserves and 12 million tons of 0.52% copper in probable reserves at its Inspiration-area mines. Estimated ore reserves at the Christmas, Ox Hide, and Sanchez Mines remained the same as in 1982.

For the first time in 20 years, Inspiration and representatives of its 10 labor unions agreed on a new 3-year labor contract without a strike. The settlement included a freeze on wages and pension benefits, but provided for COLA increases and retention of hospitalization benefits. The company employed about 1,475 at midyear, but in August, laid off 235 employees because of a lack of concentrates.

The decrease in the amount of toll and purchased concentrates treated in Inspiration's smelter during the year was attributed to the continued shutdown of the Pinto Valley operations, shutdown of the smelter for maintenance in July, and the lack of concentrates in August, September, November, and December. During the year, Newmont Mining Corp. indicated that after the contract with the former owners (Cities Service Co.) of the Pinto Valley operation had expired in August 1984, those concentrates would be shipped to its own smelter at San Manuel, 50 miles south of Miami. Inspiration renewed efforts to acquire new sources of concentrates, and in August 1983, signed an agreement with Duval for purchasing concentrates from its Sierrita Mine beginning in early 1984. Also, on December

1, 1983, Inspiration reached an agreement in principle with Amoco Minerals for a 50-50 partnership in the Inspiration smelter. The agreement was to provide for a 2-year, $57 million construction program that was to bring the smelter into compliance with State and Federal air quality standards and increase its annual capacity to 150,000 tons of copper in concentrates. The smelter would also process copper concentrates from Amoco's Bagdad Mine after Amoco's contracts with other smelters expired.

Over a 12-year period, Inspiration had expended $101 million for constructing a new smelter, acid plant, and related pollution control facilities; during 1983, the company spent about $1 million.

Kennecott Minerals Co., a subsidiary of Standard Oil Co. of Ohio (Sohio), changed its name to Kennecott effective March 14, 1983. The company operated the Ray Mines Div. in Arizona. The installations included the open pit copper mine, a 15,000-ton-per-day silicate ore vat leach, a solvent extraction plant, and a 14,000-ton-per-day electrowinning refinery near Ray, Pinal County, and 22 miles to the southeast, a 27,000-ton-per-day concentrator, a smelter with an annual capacity of 80,000 tons of copper anodes, and a sulfuric acid plant at Hayden, Gila County.

According to the Sohio 1983 annual report, Ray Mines produced 46,163 net tons of copper in 1983, compared with 53,326 net tons in 1982 and 111,267 in 1981. Ores mined and treated dropped to 4,346,000 tons in 1983, compared with 4,786,000 tons in 1982 and 14,816,000 tons in 1981. The average ore grade increased to 1.187% copper in 1983, compared with 1.071% in 1982 and 0.969% in 1981.

Ray Mines Div. was shut down from May 1982 until September 1983 when the mine and concentrator were reopened. Its silicate ore vat leach, electrowin refinery, and Hayden smelter, however, remained closed, and concentrate production of about 25,000 tons per month, was sold to Asarco for treatment at its Hayden smelter. The multimillion-dollar modification project initiated at Kennecott's Hayden smelter at Hayden in 1982 was completed in January 1983. Other changes included shipment of eight 170-ton trucks and two 12-yard front-end loaders from Ray Mines to Kennecott's Utah Copper Div.

When the operations resumed, approximately 575 workers were recalled, bringing the division's work force up to 750; an estimated 1,600 were employed when the operations were shut down in 1982. Kennecott and 13 international labor unions signed a new agreement calling for a wage freeze and benefit reductions, but maintained the COLA. The contract also allowed the company flexibility to change technology and work methods for improved productivity.

Kennecott reduced its 1983 operating losses at all properties in five States to $91 million from $187 million in 1982.

Newmont owned two subsidiaries in Arizona: Magma Copper and the newly acquired Pinto Valley Copper Co. Magma Copper operated the San Manuel Div. at San Manuel, Pinal County, 43 miles northeast of Tucson; and the Superior Div. at Superior, Pinal County, 60 miles east of Phoenix. Pinto Valley Copper, formerly the Miami operations of Cities Service, was headquartered near Globe and the operations located in the Miami area, Gila County.

Magma's San Manuel Div. comprised an underground mine, a 64,000-ton-per-day concentrator, a smelter with a 200,000-ton annual capacity of copper anode, and a 125,000-ton-per-year continuous-cast rod plant.

According to the 1983 Newmont annual report, the San Manuel Mine operated at 83% of capacity, slightly lower than in 1982. Ore production, however, increased to 18.3 million tons averaging 0.64% copper, compared with 18.2 million tons averaging 0.66% in 1982. In addition to 109,249 tons of copper contained in concentrate, 26,687 ounces of gold, 466,425 ounces of silver, and 3,140 tons of molybdenum sulfide were recovered at San Manuel. Magma Copper estimated San Manuel proven reserves at yearend were 328.9 million tons averaging 0.694% copper, 0.028% molybdenum sulfide, 0.029 ounce silver, and 0.00158 ounce gold. At the deeper Kalamazoo ore body, ore reserves were 354.9 million tons of 0.715% copper, with byproducts the same grade as the San Manuel ore body. The San Manuel and Kalamazoo ore reserves included 108 million and 101 million tons, respectively, contained in a shaft pillar; removal of these reserves would require additional shaft entries.

Magma Copper reached 3-year labor agreements with seven unions representing its workers. Similar to the Kennecott contracts with its unions, effective July 1, the agreements froze wages, COLA provisions, and reduced fringe benefits. The new con-

tract covered approximately 5,000 active and laid-off workers; 3,000 at San Manuel and the remainder at Superior.

In other developments, a major research project was started to determine the feasibility of recovering copper from a large quantity of copper oxide ores overlying the San Manuel sulfide ore body.

The Superior Div.'s high-cost underground Magma Mine and concentrator, which were shut down in August 1982, remained on a care-and-maintenance status in 1983. Magma Copper reported that because the mine was inactive, ore reserves remained at 4.4 million tons and averaged 5.69% copper, 0.026 ounce per ton gold, and 0.71 ounce per ton silver.

Newmont completed its $75 million purchase of Cities Service's Miami Div. on March 1, 1983. The operations acquired included the Pinto Valley open pit copper mine, a 50,000-ton-per-day concentrator, and a 33,000-pound-per-day SX-EW plant about 6 miles west of Miami; the old Miami underground copper mine that was converted to a leach operation in 1959; another SX-EW plant at Miami for treating leach solutions from the Miami Mine; the old Copper Cities inactive open pit mine and its leaching facilities; and the Miami East underground mine.

The 1983 Newmont annual report showed that, because of depressed copper prices and markets, production at the Pinto Valley Copper operation was limited to low-cost leaching and SX-EW operations. The mining and milling operations shut down in July 1982 remained closed throughout 1983. The planned 12,000-ton-per-year Miami East project, under development since 1969, was shut down on January 5, 1983; production had been scheduled for July 1983. The Pinto Valley SX-EW operation recovered 6,442 tons of copper, and the Miami SX-EW plant, 3,822 tons in 1983. At yearend, Pinto Valley Copper estimated reserves of 384.2 million tons of 0.404% copper at the Pinto Valley Mine at nearly 6 million tons of 3.14% copper at the Miami East Mine. Under full production, the Pinto Valley operations could yield 70,000 tons per year of copper in concentrates and an additional 10,000 tons per year from the electrowinning facilities.

Pinto Valley Copper planned to truck its concentrates to Newmont's San Manuel operation for smelting and refining as soon as its contract with Inspiration expired in September 1984. A 10- to 15-cent-per-pound reduction in refined copper production costs was expected. Under the toll-smelting and refining contract with Inspiration, about 90 cents per pound was the reported break-even cost.[11]

In July, Pinto Valley Copper entered a 3-year labor agreement following the pattern set by Kennecott. Since August 1982, 400 employees had been on a 4-day workweek; in January 1983, 170 salaried employees accepted a 3-day workweek. During normal operations, the company employed about 1,000 workers.

In 1983, Newmont posted a $28.7 million loss, compared with a $30.8 million loss in 1982 at its Magma Copper properties; Pinto Valley Copper's losses were $1.3 million.

Noranda Lakeshore Mines Inc., a subsidiary of Noranda Mines Ltd., Toronto, Canada, operated the Noranda Lakeshore Mine 28 miles southwest of Casa Grande, Pinal County, on the Papago Indian Reservation.

In its 1983 annual report, Noranda reported treating 1,297,000 tons of ore and recovering 18,760 tons of copper, compared with 1,668,000 tons of ore and 22,800 tons of copper in 1982. At yearend, oxide ore inventories were estimated at 13 million tons of 1.16% copper. Inventory estimates of sulfide ore in the tactite zone remained at 9 million tons of 1.35% copper and in the porphyry zone at 41 million tons of 0.65% copper.

In 1983, the Lakeshore operation comprised an underground mine, a vat-leach system, an in situ leaching program, and a SX-EW plant. Plans were to operate the underground mine and vat leach until yearend while converting to the in situ system. In September, however, low copper prices, depressed market conditions, and heavy ground conditions associated with the Lakeshore Fault effected high costs and loss of ore, forcing the early shutdown of the underground mine and vat-leach facility. During the year, the operation was being converted to the in situ method of mining copper, whereby a weak solution of sulfuric acid was introduced into low-grade ores remaining after block caving. Percolated solutions were then pumped to the surface for production of cathode copper at the SX-EW plant constructed in 1980.

With the shutdown of the mine, about 250 workers were laid off and the remaining 65 retained to operate the in situ leach and the SX-EW plant. Before the underground mine was closed, the production rate was 23.5 million pounds of copper per month; afterward, Noranda expected to reach 2 million

pounds per month using just the in situ process.[12]

Phelps Dodge ranked first in copper production with about 29% of the State's total. The company owned and operated the Morenci-Metcalf open pit mines in Greenlee County, 169 miles northeast of Tucson; the New Cornelia open pit mine at Ajo, Pima County, 106 miles southwest of Phoenix; the Copper Queen Branch leaching and precipitate operation at the permanently shutdown Lavender Pit Mine and underground Copper Queen Mine at Bibsee, Cochise County; and the Douglas Reduction Works at Douglas, Cochise County. The Safford Branch underground mine being developed near Safford, Graham County, has remained shut down since April 1982. Development of the low-grade copper sulfide deposit at Copper Basin southwest of Prescott awaited a proposed property exchange with the Federal Government for land the company owned in northern Arizona.

The corporation reported a net loss of $63.4 million in 1983, down from the $74.3 million loss shown for 1982. Primary metal operating losses, though improved over those of 1982, were attributed to sharply lower copper prices, labor strikes, and competition with imports of copper. Startup of the Morenci-Metcalf and New Cornelia Mines increased Phelps Dodge's production of copper in Arizona to 218,100 tons, compared with 126,800 tons in 1982 but under the 233,800 tons in 1981.

In its 1983 annual report, the company estimated ore reserves at its Morenci-Metcalf Mines as 869.2 million tons of 0.76% copper; at its Western Copper property adjoining Morenci-Metcalf, 184 million tons of 0.64% copper; at its Ajo Mines (under reevaluation), 214.1 million tons of 0.5% copper; at Safford (development suspended), 262.4 million tons of 0.88% copper; and at Copper Basin, 175 million tons of copper-bearing material averaging 0.55% copper and 0.021% molybdenum.

At Morenci, the Phelps Dodge operation included the Morenci open pit copper mine, second largest in the Nation; a 60,000-ton-per-day concentrator; leaching and precipitation plants; a 160,000-ton-per-year smelter and sulfuric acid plant; and the adjacent Metcalf open pit and 40,000-ton-per-day concentrator. Production averaged 100,000 tons per day of ore containing 0.8% copper in the form of chalcocite with byproducts of gold, silver, and molybdenite.

Stripping for the Morenci open pit began in 1937; as of 1983, 1.9 billion tons of material, including 683 million tons of ore averaging 0.86% copper, had been extracted. From rim to rim, the pit reached 1.8 miles from north to south and 1.5 miles east to west; it was mined on uniform 50-foot benches from 5,050 feet above mean sea level to 4,200 feet. Plans were to mine down to the 3,350-foot elevation. At the Metcalf, after prospect drilling in the 1960's and development completed in 1974, 43 million tons of ore averaging 0.76% copper was extracted from the 242 million tons of ore and waste removed. Bench heights of 50 feet and widths of 100 to 150 feet were used for the Metcalf pit. At the Morenci operations, ore and waste materials were mined with 9- to 22-cubic-yard electric shovels and hauled in 100- or 170-ton trucks or 1,200- to 2,000-horsepower diesel electric locomotive trains to the crushers, mills, or waste and leach dumps.[13]

Production at the Morenci operations was temporarily reduced when 1,480 of 2,009 workers walked out on strike on July 1. Striking workers were replaced by supervisors, nonstriking employees, laid-off workers, and gradually new hires. With the startup of the Metcalf concentrator at the onset of the strike and later startup of the Morenci mill, production rose from 30,000 tons per day to 70,000 tons per day. However, on August 9 output was suspended at the Governor's request to prevent further violence, and the National Guard and Department of Public Safety moved into the Clifton-Morenci area. Production resumed on August 22, and by September 3, operations were at full capacity.[14]

Under the 1981 consent decree that Phelps Dodge and the EPA agreed upon, the company was committed to convert two reverberatory furnaces to oxygen smelting at Morenci and to install additional pollution equipment to increase the capture of sulfur dioxide and particulate matter.[15] In May 1983, Phelps Dodge authorized $57.6 million to complete constructing air pollution control facilities at the Morenci smelter; more than $73 million had already been spent on the project. Encountering problems at the Morenci smelter in 1983, the company and EPA agreed to amend the 1981 decree; emissions allowable for the smelter would be 10,505 pounds per hour, and the smelter would come into compliance by yearend 1984. However, commercial testing of the reverberatory furnaces being retrofitted to use the oxygen-fuel

sprinkle system had not been completed by yearend. A matte spill on October 30 damaged the electrical equipment, placed the acid plant out of commission for about 20 days, and caused nearly $1 million in damage. The mountainous terrain, 600 feet higher than the top of the smelter stack, also aggravated the problem of air pollution emissions. The Morenci smelter had 80 violations of ambient-air standards for sulfur dioxide emissions by November 1983. Phelps Dodge was fined $5,000 for each occurrence before July 1, and $7,500 from that time to the end of the year.

Other problems were related to polluting Chase Creek waters. Heavy runoff, more than 20,000 gallons per minute during the rainy season, carried excessive levels of acid-dissolved copper, manganese, zinc, and arsenic from dump material into normally dry Chase Creek. A small diversion dam and a 3,000-gallon-per-minute pump to capture the waters for use in the leaching system usually controlled water flowing into Chase Creek. To resolve the problem, the company was considering water-retention structures on King Creek and Chase Creek, but by yearend, had not incorporated these structures into mining plans.

At Ajo, Phelps Dodge operated the New Cornelia open pit copper mine, a 28,000-ton-per-day concentrator, and a smelter with an annual capacity of 50,000 tons of copper anode. On April 17, 1982, all operations at the New Cornelia Branch were shut down until February 28, 1983, when production was resumed at the mine and concentrator. Instead of reopening the Ajo smelter, the company shipped copper concentrates by rail to its Douglas smelter in Arizona and the Hidalgo smelter in New Mexico for processing. Of the 1,100 workers normally employed at the Ajo operations, 800 were laid off in 1982; however, in 1983, about 525 were recalled to join 275 maintenance and security workers, and about 135 smelter employees were considered for other work. On July 1, 544 workers at Ajo joined Morenci union employees on strike. As at other Phelps Dodge installations, supervisory personnel, nonstriking union workers, and newly hired employees handled operations. By mid-September, Ajo was operating with a full staff of 475 workers, and production reached 26,000 tons per day.

Preparation for reopening the Ajo smelter began in October 1983 with repairs to the acid plant. Phelps Dodge and the EPA agreed to modify the 1981 consent decree that would bring the smelter into compliance with the Federal Clean Air Act by limiting sulfur dioxide emissions by the end of 1984 and of particulate matter by the end of 1985.

At the Douglas Reduction Works, two of three reverberatory furnaces were refired on March 29, and smelting resumed on April 6 to handle concentrates from its New Cornelia Branch. The smelter was idled in November 1982 when the closure of the Cyprus Pima Mine caused a shortage of concentrates for the Douglas works. Normally, approximately 550 to 600 workers were employed; however, in April 1983 when operations resumed, 260 workers were rehired, bringing the total to 330 including maintenance and security personnel.

In environmental matters, Phelps Dodge maintained that costs of bringing the Douglas smelter into compliance with air pollution regulations could not be economically justified and that unless the then current law was changed, the smelter would be closed by 1987 at the latest. Modifying the 1981 consent decree affected only the Morenci and Ajo smelters.

Table 4.—Arizona: Production and value of copper in Arizona and the United States

Year	Arizona copper production		U.S. copper production		Arizona
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Percent of U.S. copper production
1979[r]	949,031	$1,946,427	1,446,586	$2,966,891	65.6
1980	770,118	1,738,908	1,181,116	2,666,931	65.2
1981	1,040,813	1,953,142	1,538,160	2,886,440	67.7
1982[r]	769,521	1,235,055	1,146,975	1,840,856	67.1
1983	678,216	1,144,285	1,038,098	1,751,476	65.3

[r]Revised.

Table 5.—Arizona: 15 leading copper-producing mines in 1983, in order of output

Rank in 1983	Rank in 1982	Mine	County	Operator	Source of copper in 1983
1	2	Morenci	Greenlee	Phelps Dodge Corp	Copper ore and precipitates.
2	3	San Manuel	Pinal	Magma Copper Co	Copper ore and tailings (slag).
3	4	Bagdad	Yavapai	Cyprus Bagdad Copper Co	Copper ore.
4	5	Inspiration	Gila	Inspiration Consolidated Copper Co.	Do.
5	6	Sierrita	Pima	Duval Corp	Do.
6	8	Ray	Pinal	Kennecott	Copper ore and precipitates.
7	9	Eisenhower	Pima	Eisenhower Mining Co	Copper ore.
8	--	New Cornelia	do	Phelps Dodge Corp	Copper ore and precipitates.
9	1	Twin Buttes	do	Anamax Mining Co	Copper ore.
10	10	Mission	do	ASARCO Incorporated	Do.
11	12	Lakeshore	Pinal	Noranda Lakeshore Mines Inc.	Do.
12	14	Sacaton	do	ASARCO Incorporated	Do.
13	15	San Xavier	Pima	do	Do.
14		Silver Bell	do	do	Copper ore and precipitates.
15	7	Pinto Valley	Gila	Pinto Valley Copper Corp	Copper ore.

Table 6.—Arizona: Material handled and copper produced at 16 leading copper open pit and underground mines

Mine	Ore mined (thousand metric tons)		Waste material removed (excluding material placed in leach dumps) (thousand metric tons)		Material placed in leach dumps (thousand metric tons)		Total copper produced[1] (metric tons)	
	1982	1983	1982	1983	1982	1983	1982	1983
OPEN PIT								
Morenci	14,069	31,209	5,346	8,216	5,782	11,731	103,061	161,646
Bagdad	17,468	W	22,671	NA	2,663	NA	78,583	W
Inspiration	6,473	6,426	7,523	7,498	19,589	20,608	58,226	63,697
Sierrita	16,142	18,804	7,922	6,072	1,331	67	47,417	59,149
Ray	4,343	3,943	--	--	9,993	7,317	47,688	35,097
Eisenhower	6,174	5,623	15,698	6,995	--	--	37,024	34,616
New Cornelia	1,873	7,278	1,134	2,151	--	--	9,588	33,807
Twin Buttes	10,439	653	21,601	753	137	18	107,113	28,719
Mission	4,831	3,622	8,707	9,132	--	--	30,683	21,755
Sacaton	3,778	3,596	2,636	1,287	--	--	18,953	17,957
San Xavier	2,283	2,526	7,126	2,416	--	--	11,616	10,236
Silver Bell	--	787	--	845	--	454	4,777	8,174
Pinto Valley	8,799	--	--	--	15,289	--	47,378	6,962
Johnson	1,727	1,781	2,293	62	1,727	1,781	4,400	4,408
UNDERGROUND								
San Manuel	16,514	16,576	--	--	--	--	102,774	100,419
Lakeshore	1,471	965	--	--	1,513	--	20,689	17,019

NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Gross metal content.

Table 7.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1981, total	49	--	197,069,041	100,339	$46,119,820	8,055,231	$84,727,902
1982, total	33	--	r123,098,309	61,050	22,949,307	r6,309,327	r50,159,151
1983:							
Cochise	2	--	W	W	W	W	W
Gila	5	--	W	--	--	8,916	101,999
Greenlee	3	--	W	W	W	W	W
Mohave	1	1	W	W	W	W	W
Pima	9	--	43,029,306	W	W	2,201,738	25,187,882
Pinal	6	--	24,348,564	W	W	661,251	7,564,711
Yavapai	1	--	W	W	W	W	W
Total	27	1	[3]122,743,740	[3]61,991	[3]26,284,184	[3]4,491,532	[3]51,383,123

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1981, total	1,040,813	$1,953,141,534	993	$799,837	138	$135,270	$2,084,924,363
1982, total	r769,521	r1,235,054,884	359	202,414	--	--	r1,308,365,756
1983:							
Cochise	W	W	--	--	--	--	W
Gila	W	W	--	--	--	--	W
Greenlee	W	W	--	--	--	--	W
Mohave	W	W	W	W	--	--	W
Pima	197,563	333,328,159	67	32,159	--	--	W
Pinal	164,783	278,022,439	W	W	--	--	W
Yavapai	W	W	--	--	--	--	W
Total	[3]678,216	[3]1,144,284,633	[3]144	[3]68,598	--	--	[3]1,222,020,538

rRevised. W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Operations at which metals were recovered only from tailings or precipitates are not counted as producing mines.
[2]Does not include gravel washed.
[3]Includes items indicated by symbol W.

Table 8.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Gold	1	45,359	1,750	7,000	--	--	--
Gold-silver	2	W	W	W	W	W	--
Silver	7	W	W	W	W	W	--
Total	10	W	W	[2]278,887	W	W	--
Copper	17	122,144,118	54,534	4,131,928	[3]621,639	57	--
Other lode material:							
Gold-silver tailings	--	W	W	W	W	W	--
Silver tailings	--	W	W	W	--	--	--
Copper precipitates	5	75,807	--	--	51,201	--	--
Copper tailings	1	W	--	--	W	--	--
Total	6	W	W	[2]80,717	W	W	--
Total lode	27	[2]122,743,740	W	[2]4,491,532	[2]678,216	[2]144	--
Placer	1	--	W	--	--	--	--
Grand total	28	[2]122,743,740	[2]61,991	[2]4,491,532	[2]678,216	[2]144	--

W Withheld to avoid disclosing company proprietary data.
[1]Detail may not add to totals shown because some mines produce more than one class of material. Operations from which metals are recovered only from tailings or precipitates are not counted as producing mines.
[2]Includes items indicated by symbol W.
[3]Includes copper recovered from precipitates of ore leached.

Table 9.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Cyanidation	1,750	7,000	--	--	--
Acid leaching (vat, tank, heap)	--	--	[1]97,343	--	--
Smelting of concentrates	[2]54,616	[2]4,133,840	[2]529,296	W	--
Direct smelting of:					
Ore	W	270,623	W	W	--
Precipitates	--	--	51,201	--	--
Tailings	W	[3]80,069	W	W	--
Total	W	[3]350,692	[3] [4]51,576	W	--
Placer	W	--	--	--	--
Grand total	[4]61,991	4,491,532	678,216	[4]144	--

Withheld to avoid disclosing company proprietary data.
[1]Includes copper recovered by electrowinning process.
[2]Includes metal recovered from tailings.
[3]Does not include metal recovered from tailings by concentration.
[4]Includes items indicated by symbol W.

Gold.—In Arizona, gold output was closely tied to copper production and, although several copper properties were shut down, eight large-scale copper operations recovered more than 95% of the gold produced in the State. The precipitous fall of gold output in 1982 ended with a 1.5% increase in 1983, and the rise in the price of the metal, an average of $375.91 per troy ounce in 1982 to $424 in 1983, brought a more than 14.5% increase in its value of production. Leading gold operations, in descending order of output, included San Manuel, Morenci, New Cornelia, Copper Queen, Sacaton, Tyro, Bagdad, Ash Peak, Ray, Diumich, Sierrita, Schuylkill, Tiger, Gold Hill, and Hel-Roc. The number of small operations (under 100,000 tons per year of material treated) reporting production declined from nine to seven in 1983. Pinal County yielded the most gold, followed by Greenlee, Pima, Cochise, Mohave, and Yavapai Counties.

Lead.—Lead production declined almost 60% as the copper industry remained in the doldrums. Although Arizona's lead ores are often found as accessory minerals in copper deposits, the economics of processing the material may preclude its recovery. In 1983, more than two-thirds of the State's lead output came from copper operations; the drop in copper production and declining lead prices contributed to the nearly 66% plunge in value of lead output. The average price of lead slumped from $0.2554 per pound in 1982 to $0.2168 in 1983. The McFarland & Hullinger Tiger Mine tailings continued to be the leading producer, followed by Asarco's Mission Unit, Eisenhower Mining's Eisenhower Mine, Paradise Mines Inc.'s Gold Hill Mine, Hel-Rock Mining Co.'s Hel-Roc Mine, Asarco's Silver Bell, and Lee Mining Corp.'s Schuylkill Mine. The number of small mines producing lead dropped from seven in 1982 to four in 1983.

Molybdenum.—Molybdenum was recovered as a coproduct and/or byproduct of copper production in Arizona. Output declined another 5% in 1983 because some copper operations remained closed and others shut down molybdenum circuits or produced the metals at a reduced rate. However, shipments of molybdenum, in part from last year's inventory, increased 17%; their total value declined 12% as molybdenum prices continued to fall. The average producers price per pound of molybdenum in technical-grade molybdic oxide dropped from about $4.45 in 1982 to about $3.65 in 1983. Molybdenum exports increased 8%; however, only two companies exported the metal in 1983, compared with eight in 1982. Domestic shipments from nine operations rose almost 50%. Inventories rose from 3,642,520 pounds at the beginning of 1982 to 6,143,322 pounds at the beginning of 1983.

Copper operations producing and shipping molybdenum ore and concentrates were, in descending order of value, Sierrita, Bagdad, San Manuel, Twin Buttes, Morenci, Eisenhower (Anamax), Inspiration, and New Cornelia. Cyprus Pima had no production, but shipped out its remaining stockpile. The Pinto Valley, Mineral Park, Mission, Eisenhower (Asarco), and Ray Mines shipped molybdenum concentrates in 1982, but not in 1983. About 65% of Arizona's

molybdenum production originated in Pima County.

Silver.—Recovered principally as a by-product of copper production, silver output continued to decline as some important copper producers shut down or reduced output. Although silver output fell nearly 29%, its value rose 2% because of a price increase. The average unit value of silver climbed from $7.95 per ounce in 1982 to $11.44 in 1983. Listed in descending order of output, the following mines recovered silver in Arizona: Morenci, Eisenhower (Palo Verde), Sierrita, Bagdad, San Manuel, Mission, New Cornelia, San Xavier, Sacaton, Ash Peak, Copper Queen, Ray, Twin Buttes, Diumich, Silver Bell, Reymert, Schuylkill, Four Bagger and Silver Mary, Tyro, Tiger, Gold Hill, Hel-Roc, Bracco, Precious Metal Exploration, and Gold Dust. Of these, 12 large-scale copper mines produced more than 92%. Twelve small operations reported silver production, two as precious metals and the rest as precious and base metal operations. Seven small mines recovering silver in 1982 shut down in 1983, and five new operations started up.

NONMETALS

Asbestos.—Although asbestos production in the State ceased in 1982, controversy continued over mill tailings remaining in the Globe area. Arizona asbestos is of the chrysotile variety. The Arizona Bureau of Geology and Mineral Technology, in describing the asbestos problem, its mineralogy, production, consumption, and health hazards, suggested that before the chrysotile is classified with the more dangerous asbestos minerals, crocidolite and amosite, additional studies of the fiber types and exposure levels should be made.[16] Nevertheless, the EPA decided to buy out a mobile home subdivision in Globe, Gila County, that was built on the tailings site of the old Metate Asbestos Co. mill. From $4.2 to $4.6 million in Federal Superfund monies were earmarked for this purchase.[17]

Cement.—Finished portland cement production increased almost 18%. The volume of gray finished portland cement sold gained about 26% as the economy recovered. Value of those sales, however, rose only 9% because of a drop in prices. Masonry sales increased about 35% in quantity and more than 16% in value.

Arizona Portland Cement Co., a division of California Portland Cement Co., and the Phoenix Cement Co., a division of Gifford-Hill and Co., produced cement in Arizona. The Arizona Portland Cement plant at Rillito was a four-kiln, dry-process plant with a 1,170,000-metric-ton-per-year cement-grinding capacity and a 450-metric-ton-per-day clinker capacity. The Phoenix Cement plant at Clarkdale was a three-kiln, dry-preheater process plant with a 630,000-metric-ton-per-year cement-grinding capacity and a 600-metric-ton-per-day clinker capacity.[18] Both companies sold a general-purpose and moderate-heat gray portland cement; Phoenix Cement also marketed a portland pozzolan cement.

Phoenix Cement improved two kilns in 1982 and planned to upgrade a third by completing a two-stage preheater in 1984.[19]

Blue Circle Arizona Inc., a subsidiary of Blue Circle Industries PLC, London, United Kingdom, established its southwestern regional offices in Phoenix and Tucson and acquired ready-mixed concrete plants in the Phoenix and Tucson areas. The plants were to be supplied with cement from Empresas Tolteca's (49% owned by Blue Circle Industries) new 1-million-metric-ton-per-year cement plant at Hermosillo, Mexico, 240 miles south of Tucson.[20]

Clays.—Arizona's clay production in 1983 recovered slightly; however, the value of its output rose 42%. Common clay output increased about 4%, and bentonite, 14%. Common clay producers, in order of quantity mined, included Phoenix Brick Yard from its Tolleson Mine in Maricopa County and Pantano pit in Pima County; Phoenix Cement, Yavapai County; Magma Copper from its mine at Superior, Pinal County; and McKusik Mosaic Co. from its Weary Lode, Gila County. Leading uses for common clay included face brick, portland cement, common brick, ceramic floor and wall tiles, and terra cotta. Harshaw/Filtrol Partnership mined a nonswelling pit in Apache County; United Catalysts Inc., at its Cheto No. 1 pit in Apache County; and Arizona Gypsum Corp., at its Verde pit in Yavapai County. The bentonite was used for filtering, clarifying, and decolorizing animal, mineral, and vegetable oils, and for animal feed. McKusick Mosaic mined montmorillonite fuller's earth at its Weary Lode Mine, Gila County, for medical, pharmaceutical, and cosmetic purposes. The average unit value of clay and shale was $6.31, compared with $6.98 in 1982.

Gem Stones.—Arizona continued to rank first nationally in gem stone production. Most important was turquoise recovered at

several copper mines. Turquoise and peridot output, however, declined in 1983. The Mineralogical Record published two special issues on the mines and minerals of Arizona. The New Cornelia Mine, Pima County; the Glove Mine, Santa Cruz County; the Ray Mine, Gila County; the Magma Mine, Pinal County; the old Yuma Mine, Pima County; and the Hilltop Mine, Cochise County, were among the famous mineral localities described.[21]

Gypsum.—Crude gypsum output increased about 51% in quantity and nearly 60% in value as residential construction rebounded because of lower interest rates the latter half of the year. Calcined gypsum production also increased in amount and value. National Gypsum Co. quarried and crushed crude gypsum at Feldman, near Winkelman, Pinal County, and calcined gypsum for manufacturing wallboard at its plant in Phoenix. Pinal Mammoth Gypsum Co. quarried gypsum for agricultural use at its Thunderbird Mine 6 miles north of Mammoth, Pinal County. Superior Companies quarried gypsum for use as a cement additive 4 miles southeast of Camp Verde, Yavapai County, and near Winkelman, Pinal County.

Arizona Portland Cement completed reclamation work on a 1977 gypsum exploration site in the Whetstone Mountains about 40 miles south of Tucson. Trenches were filled, and the area was contoured and seeded with native grasses. Cost of reclaiming the 5-acre site was about $40,000.[22]

Lime.—Production of lime increased 4% in quantity and dropped 2% in value, narrowly maintaining the depressed level of output reached in 1982. Although the construction sector improved, the copper industry, a major user of lime, remained in a slump, and lime-producing companies dropped in number from five to three. Genstar Lime Co., Yavapai County, was the leading producer of quicklime, followed by Can-Am Corp. near Douglas, Cochise County; and Magma Copper at San Manuel, Pinal County. Amstar Corp.'s plant at Chandler, Kennecott's Ray Mines Div. plant near Hayden, and the Phelps Dodge plant near Morenci remained idle.

Perlite.—Output and sales of crude perlite declined. Arizona ranked third nationally in crude perlite production, after New Mexico and California.

Harborlite Inc. mined perlite from open pit mines near Superior, Pinal County, sized the product at its plant 2 miles west of Superior, and shipped to markets in California, Michigan, and Wyoming. Sil-Flo Inc. mined perlite from an open pit 2 miles southwest of Superior, treated the material in its plant at Superior, and marketed the product in Illinois, Louisiana, Texas, and Wyoming. Perlite was used as a filtering aid in pharmaceuticals, chemicals, sugar, and beverages, and as an agriculture fertilizer carrier.

Therm O Rock Industries Inc. produced expanded perlite for plaster aggregate, insulation, and horticultural aggregate at Maricopa, Maricopa County.

Pumice and Pumicite (Volcanic Ash).—Gila Valley Block Co. continued to quarry pumice and volcanic ash 25 miles east of Safford, Graham County. Sales increased more than one-half, and value more than doubled. The materials were used mainly for building and decorative block, followed by landscaping and insulation.

Pyrites.—Sales of pyrite by Magma Copper, Superior Div., from its Magma Mine, increased during the year.

Salt.—Southwest Salt Co. solution mined the Luke Salt deposit at Glendale, Maricopa County, and recovered the product in solar evaporation ponds. About 1,500 tons of salt per acre of pond was harvested; peak production was in the hottest months, between May and September. Salt was marketed for agriculture, industrial uses, and water softeners. The caverns created by salt mining were leased for storing propane and butane.[23] Salt production and value were unchanged in 1983.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel production in 1983 was estimated to have gained over 21% in output and over 28% in value over 1982 levels. Arizona Sand and Rock Co. sold its Phoenix and Sun City sand and gravel operations to Conroc Co. of Arizona, a subsidiary of Conroc Co. of Los Angeles, CA, the third largest producer of construction sand and gravel in the United States.

Allied Concrete and Materials Co. operated an 800-ton-per-hour total capacity plant at Mesa, Maricopa County. In 1983, Allied installed a water clarification and recirculating system to salvage up to 1,400 gallons

per minute of clean water in anticipation of new water regulations expected to limit the ground water pumped in the State. Thirty-five workers were employed at the sand and gravel plant and 100 at the nearby mix operation.[24]

Industrial.—Output of industrial sand and gravel slumped in quantity and value when the copper industry failed to recover. Principal uses for the product included hydraulic fracturing in the petroleum industry, flux in the copper industry, and smaller amounts for blasting and filtration. Industrial sand and gravel producers in Arizona were the Arizona Silica Sand Co. in Apache County and Paradise Mines in Pinal County. Ninty-eight percent of Arizona's output was shipped by truck; the remainder by rail.

Table 10.—Arizona: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	5,294	$17,370	$3.28	NA	NA	NA
Gravel	12,336	37,568	3.05	NA	NA	NA
Sand and gravel (unprocessed)	1,494	3,438	2.30	NA	NA	NA
Total or average	19,124	[1]58,375	3.05	[e]23,200	[e]$75,000	[e]$3.23
Industrial sand and gravel	107	1,617	15.15	W	W	17.51
Grand total or average	[1]19,230	59,992	3.12	W	W	W

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Although total stone output declined to its lowest point since 1976, its production value increased, but did not attain the record high of 1981.

Crushed.—Limestone and dolomite comprised 76% of crushed stone output; limestone was mined in Yavapai, Pima, Cochise, Greenlee, Coconino, and Gila Counties, and dolomite, in Mohave County.

Limestone for cement was quarried by Phoenix Cement in Yavapai County and by Arizona Portland Cement in Pima County. Lime used in copper operations was manufactured from limestone by Genstar Lime in Yavapai County, Paul Lime Div. of Can-Am in Cochise County, and McFarland & Hullinger in Pinal County. Superior in Apache County crushed limestone for treating sulfur dioxide in stack gases. Paul Lime also crushed limestone for use as a flux, for use in sugar refining, for treating stack gases, and for use as terrazzo and exposed aggregate. Robert E. McKee Inc. continued to mine and crush dolomite for use as railroad ballast.

Granite, comprising about 11% of crushed stone production, was mined by the U.S Forest Service in Gila County, and by Arizona Granite, Madison Granite Supplies, Red Mountain Mining Inc., Choctaw Materials Inc., and Sunrise Granite Co. in Maricopa County for use as terrazzo and exposed aggregate and for fine aggregate and fill. Volcanic cinder, totaling nearly 9% of the crushed stone production, was mined by Superlite Builders Supply, the leading producer, Flagstaff Cinder Sales Inc., and Olson Bros. in Coconino County; by Gila Valley Block in Graham County; and by M. R. Bowers Cinder Co. in Navajo County. The product was used for aggregate, terrazzo and exposed aggregate, and road construction. Marble was quarried and crushed by the Andrada Marble Co. and Catalina Marble Co. in Pima County for such uses as fine aggregate, poultry grit, roofing granules, and terrazzo and exposed aggregate.

In other applications, Magma Copper mined a sandstone for a flux. Magic Mountain Mining Co. mined a tuff in Yavapai

County for use as an oil sweep and for kitty litter. Local and Federal government agencies also mined and used crushed limestone, volcanic cinder, and granite for road construction.

Twenty-three private companies and three State and Federal entities mined crushed stone at 41 quarries; about 45% was transported by rail and 33%, by truck. The average unit value of the product in 1983 was $5.06 per ton.

Table 11.—Arizona: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Other coarse aggregate	27	72
Coarse aggregate, graded:		
Concrete aggregate, coarse	2	15
Railroad ballast	W	3,636
Other graded coarse aggregate	30	226
Fine aggregate (-3/8 inch):		
Stone sand, concrete	W	15
Stone sand, bituminous mix or seal	43	W
Screening, undesignated	54	137
Other fine aggregate	2	29
Coarse and fine aggregate:		
Unpaved road surfacing	79	270
Terrazzo and exposed aggregate	298	911
Crusher run or fill or waste	9	17
Agricultural: Poultry grit and mineral food	W	1
Special: Other[2]	4,211	18,750
Total	4,755	24,079

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes limestone, dolomite, granite, marble, sandstone, volcanic cinder and scoria, and miscellaneous stone.
[2]Includes graded road base or subbase, cement manufacture, lime manufacture, flux stone, sugar refining, sulfur oxide removal, uses not specified, and uses indicated by symbol W.

Dimension.—Hazel Bowman quarried a sandstone for flagging in Coconino County.

Sulfuric Acid.—Arizona ranked first in producing sulfuric acid recovered as a byproduct in copper smelters. The State's copper industry supplied almost 23% of the Nation's byproduct sulfuric acid. The total domestic supply of the acid increased slightly in 1983; however, output of the product in Arizona declined about 18% in quantity and 45% in value because of the continued downturn in the copper industry. Sulfuric acid production in the State was 638,588 tons valued at $8,702,000.

Vermiculite (Exfoliated).—W. R. Grace & Co. produced exfoliated vermiculite at its plant in Phoenix, Maricopa County; the vermiculite concentrate was shipped in from out of State. Production and sales increased in quantity and value in 1983. The product was marketed for use principally in fireproofing, concrete aggregates, and block insulation, followed by soil conditioning, horticultural applications, loose-fill insulation, and plastic aggregates.

Zeolites.—Total production of zeolites from the Bowie chabazite deposit from 1961 to yearend 1983 was estimated to be 14,000 short tons valued at about $32 million. Union Carbide Corp. continued to ship the natural zeolite from its Bowie deposit and marketed a pollution control system that used natural and synthetic zeolite products.[25]

[1]State Liaison Officer, Bureau of Mines, Denver, CO.
[2]Greeley, M. N., and N. J. Niemuth. Directory of Exploration and Mineral Development in Arizona. AZ Dep. Min. Res. Pub. D-10, 1984, 33 pp.
[3]Arizona Pay Dirt. Globe Miami Contamination Could Prove Costly To Cleanup. No. 529, July 1983, p. 34A.
[4]University of Arizona, Division of Economic Business Research. Arizona's Economy. Mar. 1984, p. 5.
———. Arizona Economic Indicators. V. 1, No. 1, Spring-Summer 1984, p. 4.
[5]Arizona Pay Dirt. Cyprus Bagdad Wins LME Listing for Its Electrowon Cathode. No. 534, Dec. 1983, p. 8A.
[6]———. Cyprus Pima Fading, Komadina Retiring. No. 534, Dec. 1983, p. 4A.
[7]———. Anamax Says It Doesn't Need CAP Water. No. 531, Sept. 1983, p. 43A.
[8]Intermountain Pay Dirt. Asarco's New Flash Furnace at Hayden Ready To Go On Line. No. 532, Oct. 1983, p. 24A.
[9]Industrial Minerals (London). DuPont To Sell Asarco Acid. No. 194, Nov. 1983, p. 18.
[10]Engineering and Mining Journal. In-Pit Crushing Draws Attention of Cost-Conscious Mine Operators. V. 184, No. 1, Jan. 1983, pp. 65-67.
Iles, C. D., and G. A. Perry. Sierrita Incremental Pit Design. Min. Eng., v. 35, No. 2, Feb. 1983, pp. 152-155.
Long, W. H. Belt Design Helps Mining Companies Stay Competitive. Min. Eng., v. 36, No. 1, Jan. 1984, pp. 16-17.
[11]American Metal Market. Newmont Plans To Cut Copper Costs at Pinto Valley. Mar. 4, 1983, p. 6.
[12]Intermountain Pay Dirt. Noranda Lakeshore Halting Work. No. 47, Aug. 1983, p. 21A.
Skillings' Mining Review. Noranda Lakeshore To Close Mine and Vat Leaching Plant. V. 72, No. 36, Sept. 1983, p. 4.

[13]Schern, E. M., and F. J. Menzer. Application of Geological Science at the Morenci Branch, Phelps Dodge Corp. Pres. at Soc. Min. Eng. AIME Fall Meeting, Salt Lake City, UT, Oct. 19-21, 1983. Soc. Min. Eng. AIME preprint 83-393, 9 pp.
[14]World Mining. Phelps Dodge Continues in Spite of Strike. V. 36, No. 10, Oct. 1983, p. 101.
[15]Sassos, M. P. Oxygen Sprinkle Smelting at Morenci. Eng. Min. J., v. 184, No. 6, June 1983, p. 80.
[16]Peirce, H. W., and M. M. Garcia. Asbestos; Toward a Perspective. AZ Bur. Geol. and Miner. Technol., v. 13, No. 1, Spring 1983, pp. 1-9.
[17]Arizona Pay Dirt. EPA Decides Buyout Answer at Globe Mobile Home Subdivision. No. 528, June 1983, p. 18A.
[18]Smith, M. North American Cement. Ind. Miner. (London), No. 196, Jan. 1984, pp. 51-65.
[19]Rock Products. Forecast '84: Cement. V. 86, No. 12, Dec. 1983, p. 39.
[20]———. Blue Circle Arizona Expands U.S. Holdings. V. 86, No. 5, May 1983, p. 9.
[21]The Mineralogical Record. ARIZONA-IV. V. 14, No. 2, Mar.-Apr. 1983, pp. 65-136.
———. ARIZONA-V. V. 14, No. 5, Sept.-Oct. 1983, pp. 265-352.
[22]Arizona Pay Dirt. Whetstone Reclamation. No. 532, Oct. 1983, p. 6A.
[23]———. Southwest Salt Pioneered a New Resource. No. 536, Apr. 1984, pp. 3A-4A.
[24]Kuennen, T. Arizona Producer Solves Water Restriction Problems. Rock Prod., v. 86, No. 5, May 1983, pp. 34-36.
[25]Eyde, T. H. Zeolites. Min. Eng., v. 36, No. 5, May 1984, p. 537.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Arizona Portland Cement Co.,[1] a division of California Portland Cement Co.	Box 338 Rillito, AZ 85246	Quarry and dry-process, 4-rotary-kiln plant.	Pima.
Phoenix Cement Co.,[2] a division of Gifford-Hill and Co.	2505 West Beryl Box 35395 Phoenix, AZ 85069	Quarry and dry-process, 3-rotary-kiln plant.	Yavapai.
Cinder (volcanic):			
Flagstaff Cinder Sales Inc	Old Highway 66 Box 2796 Flagstaff, AZ 86003	Quarry	Coconino.
Superlite Builders Supply, a subsidiary of U.S. Industries Inc.	4150 West Turney Box 23163 Phoenix, AZ 85063	Open pit mine and crushing plant.	Do.
Clays:			
Harshaw/Filtrol Partnership, of Kaiser Aluminum & Chemical Corp. and Gulf Oil Corp.	Box 155 Sanders, AZ 86512	Open pit mine	Apache.
Phoenix Brick Yard	1814 South 7th Ave. Phoenix, AZ 85007	do	Maricopa.
Copper:			
Amoco Minerals Co., a subsidiary of Standard Oil Co. (Indiana), Cyprus Mines Corp.:			
Cyprus Bagdad Copper Co.[3 4 5]	Box 245 Bagdad, AZ 86321	Open pit mine, mill, dump leach, solvent extraction-electrowinning plant.	Yavapai.
Cyprus Johnson Copper Co	Drawer R Benson, AZ 85602	Open pit mine, heap leach, solvent extraction-electrowinning plant.	Cochise.
Anamax Mining Co., Twin Buttes Mine.[3 4]	Box 127 Sahuarita, AZ 85629	Open pit and underground mines and mill.	Do.
ASARCO Incorporated:			
Hayden Unit	Box 98 Hayden, AZ 85235	Smelter and acid plant	Gila.
Mission Unit[4 6]	Box 111 Sahuarita, AZ 85629	Open pit mine and mill	Pima.
Sacaton Unit[4 5]	Box V Casa Grande, AZ 85222	do	Pinal.
San Xavier Unit[4]	Box 111 Sahuarita, AZ 85629	Open pit mine	Pima.
Silver Bell Unit[4 6]	Silver Bell, AZ 85270	Open pit mine, mill, leach dumps, precipitation plant.	Do.
Cities Service Co., Miami Operations, Pinto Valley Mine.	Box 100 Miami, AZ 85539	Open pit mine, mill, leach dumps, in-place leaching, precipitation plants, solvent extraction-electrowinning plants.	Gila.
Duval Corp., a subsidiary of Pennzoil Co.:			
Mineral Park Mine	Box 3009 Kingman, AZ 86401	Open pit mine, mill, leach dumps, precipitation plant.	Mohave.
Sierrita Mine[3 4 5]	Box 125 Sahuarita, AZ 85629	Open pit mines, mills, leach dumps, precipitation plant.	Pima.
Eisenhower Mining Co., Eisenhower (Palo Verde) Mine.[4 6]	Box 39 Sahuarita, AZ 85629	Open pit mine	Do.

See footnotes at end of table.

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Copper —Continued			
Inspiration Consolidated Copper Co.[3]	Box 4444 Claypool, AZ 85532	Open pit mines, mill, dump leaching, solvent extraction plant, electrowinning-electrorefining tankhouse, custom smelter, sulfuric acid plant, continuous-cast-rod fabrication plant.	Gila.
Ox Hide Mine	Box 4444 Claypool, AZ 85532	Open pit mine and heap leach.	Do.
Kennecott, a subsidiary of Kennecott Corp., Ray Mines Div.[4 5]	Box 9 Hayden, AZ 85235	Open pit mine, leach dumps, precipitation, vat-leaching, solvent extraction-electrowinning plants, smelter.	Gila and Pinal.
Magma Copper Co., a subsidiary of Newmont Mining Corp.: San Manuel Div.[1 3 4 5]	Box M San Manuel, AZ 85631	Underground mine, mill, smelter, refinery, continuous-rod casting plant.	Pinal.
Noranda Lakeshore Mines Inc., a subsidiary of Noranda Mines Ltd.	Box C-6 Casa Grande, AZ 85222	Underground mine, mill, vat-leach, and solvent extraction-electrowinning plants.	Do.
Phelps Dodge Corp.: Copper Queen Branch[4 5]	Highway 92 Bisbee, AZ 85603	Underground mine, leach dumps, in-place leaching, precipitation plant.	Cochise.
Douglas Reduction Works	Drawer E Douglas, AZ 85607	Smelter	Do.
Morenci Branch[3 4 5]	Morenci, AZ 85540	Open pit mines, mills, tailings leach plant, leach dumps, precipitation plant, smelter.	Greenlee.
New Cornelia Branch[3 4 5]	Drawer 9 Ajo, AZ 85321	Open pit mine, mill, and smelter.	Pima.
Gypsum: National Gypsum Co.: Gold Bond Building Products Div.	Box 20863 Phoenix, AZ 85036	Plant	Maricopa.
Winkelman Gypsum Pit	Star Route, Box 3990 Winkelman, AZ 85292	Open pit mine and crushing plant.	Pinal.
Pinal Mammoth Gypsum Co	Box 1208 Coolidge, AZ 85228	Open pit mine	Do.
Superior Companies[7]	2402 South 19th Ave. Phoenix, AZ 85005	Quarries and plant	Apache, Pinal, Yavapai.
Lime: Can-Am Corp., Paul Lime Div	Drawer T Douglas, AZ 85607	Quarry and 3 lime kilns	Cochise.
Genstar Lime Co., a division of Genstar Corp.	Box 197 Peach Springs, AZ 86434	Quarries and plant	Yavapai.
Perlite: Harborlite Inc	Box 960 Superior, AZ 85273	Open pit mine and plant	Pinal.
Sil-Flo Inc	Box 127 Superior, AZ 85273	do	Do.
Pumice: Gila Valley Block Co	Box 465 Safford, AZ 85546	Open pit mine	Graham.
Salt: Southwest Salt Co	Box 1237 Litchfield Park, AZ 85340	Solar evaporation of brine from wells.	Maricopa.
Sand and gravel: Arizona Sand and Rock Co., a division of California Portland Cement Co.	Box 20067 Phoenix, AZ 85036	Plants	Do.
Paradise Mines Inc.[4 5 6 8]	Box 332 Oracle, AZ 85623	Open pits and plants	Pinal.
Tanner Co., United Metro Div	3640 South 19th Ave. Box 20128 Phoenix, AZ 85036	do	Coconino, Maricopa, Pima, Pinal, Yuma.
Union Rock and Materials Corp	2800 South Central Ave. Box 8007 Phoenix, AZ 85066	do	Maricopa.

See footnotes at end of table.

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Andrada Marble Co	4901 East Drexel Rd. Tucson, AZ 85706	Quarry	Pima.
Arizona Granite	7401 West Villa Rita Dr. Peoria AZ 85345	do	Maricopa.
Madison Granite Supplies	7050 Grand Ave. Glendale, AZ 85301	Quarry and plant	Do.
Red Mountain Mining Inc	4250 North Bush Highway Mesa, AZ 85205	do	Do.
Dolomite:			
Robert E. McKee Inc	Box 107 Peach Springs, AZ 86434	Quarry and crushing plant	Mohave.
Vermiculite (exfoliated):			
W. R. Grace & Co., Construction Products Div.	4220 West Glenrosa Phoenix, AZ 85019	Plant	Maricopa.

[1]Also lime.
[2]Also clays.
[3]Also molybdenum.
[4]Also silver.
[5]Also gold.
[6]Also lead.
[7]Also clays and limestone.
[8]Also copper.

The Mineral Industry of Arkansas

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Arkansas Geological Commission for collecting information on all nonfuel minerals.

By James R. Boyle[1]

The value of Arkansas' nonfuel mineral production in 1983 was $246.4 million, a decrease of $3.9 million from that of 1982; the decrease continued a downward trend that started in 1980. Since 1979, the value of nonfuel mineral production has dropped 19.2%. Output of most nonfuel minerals declined, with two, barite and vanadium, having no reported production during 1983. The leading nonmetallic commodities, valuewise, were bromine, cement, stone, and sand and gravel.

Arkansas remained a major producer of several nonfuel minerals, ranking first nationally in output of bauxite, bromine, and special silica stone for natural abrasive applications (grindstones, oilstones, and whetstones). The State was one of three that produced tripoli.

Table 1.—Nonfuel mineral production in Arkansas[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Abrasives[2]	short tons	1,085	$469	W	W
Clays	thousand short tons	629	6,658	879	$9,956
Gem stones		NA	200	NA	200
Sand and gravel:					
Construction	thousand short tons	r6,936	r18,700	e6,900	e19,600
Industrial	do.	r471	r5,625	386	4,796
Stone:					
Crushed	do.	e13,100	e48,500	13,448	51,267
Dimension	do.	e5	e290	9	573
Talc	do.	13	92	7	66
Combined value of barite (1982), bauxite, bromine, cement, gypsum, lime, tripoli, vanadium (1982), and value indicated by symbol W		XX	169,754	XX	159,972
Total		XX	r250,288	XX	246,430

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Includes grindstones, oilstones, and whetstones.

Table 2.—Value of nonfuel mineral production in Arkansas, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Ashley	(2)	$154	Sand and gravel (construction).
Baxter	W	(3)	
Benton	$1,512	(3)	
Boone	557	(3)	
Bradley	(2)	5	Sand and gravel (construction).
Calhoun	(2)	W	Sand and gravel (construction), sand and gravel (industrial).
Carroll	W	127	Sand and gravel (construction).
Chicot	(2)	--	
Clark	W	W	Sand and gravel (construction), clays.
Clay	(2)	186	Sand and gravel (construction).
Cleburne	295	1	Do.
Cleveland	(2)	--	
Columbia	W	W	Bromine.
Conway	W	1	Sand and gravel (construction).
Craighead	65	W	Sand and gravel (construction), clays, sand and gravel (industrial).
Crawford	W	W	Sand and gravel (construction), sand and gravel (industrial).
Crittenden	W	W	Clays.
Cross	(2)	261	Sand and gravel (construction).
Dallas	(2)	24	Do.
Drew	(2)	13	Do.
Faulkner	W	W	Do.
Franklin	(2)	W	Do.
Fulton	289	44	Do.
Garland	W	5,988	Vanadium, abrasives, tripoli, sand and gravel (construction).
Grant	(2)	162	Sand and gravel (construction).
Greene	(2)	283	Do.
Hempstead	W	W	Sand and gravel (industrial), clays, sand and gravel (construction).
Hot Spring	W	3,859	Barite, clays, sand and gravel (construction), sand and gravel (industrial), abrasives.
Howard	27,624	W	Cement, gypsum, sand and gravel (construction).
Independence	W	W	Lime, sand and gravel (construction).
Izard	W	W	Sand and gravel (industrial), sand and gravel (construction).
Jefferson	(2)	W	Sand and gravel (construction).
Johnson	W	W	Clays.
Lafayette	(2)	180	Sand and gravel (construction).
Lawrence	4,949	W	Do.
Lincoln	(2)	169	Do.
Little River	W	W	Cement, sand and gravel (construction).
Logan	444	(3)	Sand and gravel (construction).
Lonoke	W	(3)	
Madison	(2)	W	Sand and gravel (construction).
Marion	48	483	Do.
Miller	W	W	Sand and gravel (construction), sand and gravel (industrial), clays.
Mississippi	(2)	20	Sand and gravel (construction).
Montgomery	W	W	Barite, sand and gravel (construction).
Nevada	(2)	33	Sand and gravel (construction).
Newton	--	7	Do.
Ouachita	W	W	Sand and gravel (construction), clays.
Perry	827	1	Sand and gravel (construction).
Pike	W	1,481	Gypsum, sand and gravel (construction).
Poinsett	(2)	W	Sand and gravel (construction), sand and gravel (industrial).
Polk	(2)	16	Sand and gravel (construction).
Pope	237	(3)	
Pulaski	W	W	Clays, sand and gravel (construction).
Randolph	(2)	5	Sand and gravel (construction).
St. Francis	(2)	W	Sand and gravel (construction), sand and gravel (industrial).
Saline	26,271	12,305	Bauxite, lime, sand and gravel (construction), talc.
Scott	(2)	18	Sand and gravel (construction).
Searcy	--	(4)	Do.
Sebastian	W	W	Sand and gravel (construction), clays.
Sevier	W	295	Sand and gravel (construction).
Stone	(2)	W	Do.
Union	W	W	Bromine.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Arkansas, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Van Buren	$216	(3)	
Washington	729	$1	Sand and gravel (construction).
White	1,420	13	Do.
Woodruff	(2)	—	
Yell	(2)	W	Sand and gravel (construction).
Undistributed[5]	183,965	175,368	
Sand and gravel (construction)	e22,400	XX	
Stone:			
Crushed	XX	e48,500	
Dimension	XX	e290	
Total	271,848	6250,288	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]No nonfuel mineral production was reported for Arkansas, Desha, Jackson, Lee, Monroe, Phillips, Prairie, and Sharp Counties. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Less than 1/2 unit.

[5]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[6]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Arkansas business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,005.8	1,009.0	+0.3
Unemployment	do	130.0	109.7	-15.6
Employment (nonagricultural):				
Mining[1]	do	5.3	5.2	-1.9
Manufacturing	do	188.5	205.0	+8.8
Contract construction	do	26.3	26.1	-.8
Transportation and public utilities	do	41.5	43.9	+5.8
Wholesale and retail trade	do	154.5	165.5	+7.1
Finance, insurance, real estate	do	32.7	33.9	+3.7
Services	do	122.9	130.0	+5.8
Government	do	140.1	139.8	-.2
Total nonagricultural employment[1]	do	711.8	749.4	+5.3
Personal income:				
Total	millions	$19,408	$21,046	+8.4
Per capita		$8,424	$9,040	+7.3
Construction activity:				
Number of private and public residential units authorized		6,385	9,833	+54.0
Value of nonresidential construction	millions	$253.2	$260.3	+2.8
Value of State road contract awards	do	$88.3	$115.4	+30.7
Shipments of portland and masonry cement to and within the State	thousand short tons	584	696	+19.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$250.3	$246.4	-1.6
Value per capita, resident population		$112	$106	-5.4
Value per square mile		$4,828	$4,633	-4.0

pPreliminary.

[1]Includes bituminous coal and oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

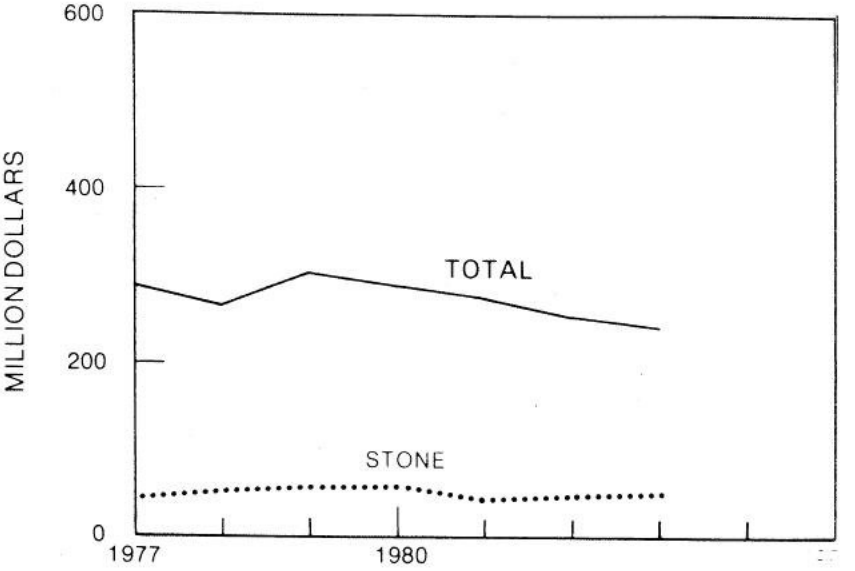

Figure 1.—Value of stone and total value of nonfuel mineral production in Arkansas.

Trends and Developments.—Adverse economic conditions continued to impact severely on most industries within the State with some recovery by yearend. The unemployment rate increased during the year but dropped to 10.1% by the end of 1983; the rate was still higher than the 9.7% at yearend 1982. Employment in mining, after increasing the previous 3 years, dropped in 1983. However, with both residential and nonresidental construction activities increasing late in 1983, employment in mining was expected to increase to meet the demand for construction aggregates.

According to the Arkansas Industrial Development Commission, Arkansas had been shifting from an agricultural economy through a light manufacturing base to a heavier, more technical manufacturing base. This transition has continued through two recessions in the last decade. Recovery from the latest recession has been more rapid than that of the 1975 recession. Manufacturing employment dropped from a high of 223,000 in mid-1978 to a low of 191,000 in February 1983, but regained one-half of the loss by December 1983. Output from mineral producers has paralleled this recovery. One negative effect has occurred along with the recovery: It appears that a major restructuring of industry has been taking place with emphasis shifted to overseas operations. This restructuring of industry could have an adverse impact on mineral producers supplying raw materials to the affected industries.

The Arkansas State Chamber of Commerce reported that $1.0 billion in investments for industrial growth was announced in 1983, a $300 million decrease from that of 1982. The announced investments, however, were expected to create an estimated 11,000 jobs, compared with only 5,600 created in 1982. Among the announced expansions were $2 million at Aluminum Co. of America's (Alcoa) alumina chemicals plant in Bauxite and $50 million at Norton Co.'s sintered bauxite proppant facility at Fort Smith.

Total tonnage on the McClellan-Kerr Arkansas River Navigation System decreased from 8.3 million tons in 1982 to 8.0 million tons in 1983. Inbound traffic increased 26% while outbound traffic decreased 19%. Waterborne traffic included vanadium slag, barite, granite, potash, stone, and sand and gravel. Bauxite for Reynolds Metals Co., handled in the past by barge,

was shipped by rail from facilities in Texas.

Legislation and Government Programs.—In 1983, the legislature passed and the Governor signed into law a bill that would split revenues from mineral, oil, and gas revenues on all Federal public domain lands equally between the State and counties where the land is located. Federal law specifies the way money from land acquired by the Federal Government must be distributed, which is all to the counties, but revenue from public domain lands would be subject to the provisions of the new State law.

Also enacted was a bill to increase severance taxes of several minerals. A 3-year phased-in increase in severance taxes on stone, clays, and sand and gravel will begin in 1984, which will go mostly to counties for schools and highways; the increase would be 1 cent per ton per year. Excluded from the tax was limestone used for agricultural purposes. The tax on brine, a byproduct of oil production, would increase from $2 to $2.45 per thousand barrels and be used for operation of the State Oil and Gas Commission. During fiscal year 1982-83, the State received $672,755 in severance taxes from production of nonfuel minerals.

The Governor also signed into law a provision containing a heavy truck axle-weight distribution formula for crossing bridges. The law pertained to trucks weighing more than 73,280 pounds, but specifically exempted trucks hauling crushed stone or sand and gravel.

The Arkansas Geological Commission (AGC) continued its program that focused on the prudent development and use of the mineral, water, and energy resources of the State. Interest in oil and gas, lignite, base metals, hydrology, and diamond exploration highlighted the activities for the AGC in 1983. Two new oil and gas charts were published in a series for the Lower Atoka Formation in the subsurface of the Arkansas Valley. Drilling continued by the AGC to determine lignite resources in the State. A report, "Chemical Analyses of Lignite from the Wilcox and Claiborne Groups, Southern and Eastern Arkansas," was published. A coal data report for the U.S. Bureau of Land Management was also issued. In addition to providing information to the public on flood and earthquake risks, staff geologists reviewed mining, reclamation, and landfill plans for other State agencies. Technical assistance was also provided concerning source, quality, and quantity of water supplies for residential, commercial, and agricultural uses.

During the year, two publications concerning minerals in Arkansas were published. The Arkansas Energy Office published "Minerals in Arkansas," which is basically an update of the U.S. Bureau of Mines Bulletin 645, "Mineral Resources and Industries of Arkansas." In addition, the Arkansas Mining and Mineral Resources Institute published "Productive and Potential Mineral Resources in Arkansas."

The U.S. Geological Survey (USGS) conducted studies to update its National Coal Resources Data System and also made chemical analyses of coal and lignite samples for use in future reports on fuel sources. USGS continued studies on silica resources in the State and regional geology of the Northern Arkansas Structure. Delineation and analysis of the Mississippi Valley Seismotectonics included investigation of earthquake rates in the area. USGS and the U.S. Bureau of Mines jointly prepared mineral resource potential maps of Roadless Area Review and Evaluation (RARE II) areas. The areas covered included the Black Fork Mountain Roadless Area (MF-1599), the Little Blakely Roadless Area (MF-1562), and the Richland Creek Roadless Area (MF-1525). In addition, USGS Bulletin 1551, "Mineral Resources of the Caney Creek Wilderness, Polk County, Arkansas," was published, also a joint venture with the U.S. Bureau of Mines.

The U.S. Department of Agriculture's Forest Service announced that certain areas of the Ouachita National Forest studied for wilderness potential, and encompassing 61,000 acres, were being reevaluated. The reevaluation became necessary because of a court decision that RARE II environmental statements were inadequate. Four areas in Arkansas were to be returned to nonwilderness management and three areas were recommended for further planning. The draft environmental impact statement for the Ouachita National Forest was scheduled for release in 1984.

The U.S. Bureau of Land Management reported that $651,715 in mineral lease payments were made to the State in 1983. The Federal Government divides bonuses, rentals, and royalties received from Federal mineral leasing activities on public lands equally with the States in which the minerals occur.

The U.S. Bureau of Mines Tuscaloosa Research Center entered into an agreement

with the Silica Products Co. Inc., Guion, to conduct small-scale continuous dewatering tests in 1984. The U.S. Bureau of Mines Salt Lake City Research Center worked on technology to recover columbium and associated coproduct materials from Arkansas resources. Two Arkansas ores were beneficiated to obtain feed concentrates suitable for hydrometallurgical testing. Since 1981, the U.S. Bureau of Mines has completed mineral assessment surveys and/or reports on 34,100 acres of wilderness and wilderness suitable lands. Other research activities of interest to the mineral industry in the State included the development of a lightweight miner's battery to reduce weight miners must carry and development of software for a computerized coalbed methane data base that permits operators to more effectively design mine ventilation systems.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—During 1983, four companies mined novaculite for oilstone and whetstone products with mine production and value decreasing 18.0% and 15.8%, respectively, over that of 1982. Arkansas ranked first nationally in output of special silica stone abrasives. Finished stone production accounted for 65% of the total value and 46% of the total quantity of special silica stone products sold or used by domestic producers. Novaculite, a dense, hard, fine-grained material of virtually pure silica, was mined in Garland County by Norton Co. Oilstones Inc. and Hiram A. Smith Whetstone Co. Inc., and in Hot Spring County by Arkansas Whetstone Co. Inc. and Wallis Whetstones Inc. Mining methods varied depending on end uses for the material, but output was relatively low. Waste material ranged up to 95% of material mined, with only some of the waste utilized. Four main grades of whetstone were produced for uses ranging from rapid sharpening to polishing. Several firms did not mine abrasive materials but finished small quantities obtained from other sources. These companies included American Trails Whetstone Co., Buffalo Stone Corp., Dans Whetstone Cutting Co. Inc., Frontier Whetstone Cutting Co., Hall's Arkansas Oilstones Inc., Wallis Natural Hones Inc., Pioneer Whetstone Co., Poor Boy Whetstones, Walls Whetstones Inc., and Washita Mountain Whetstone Co.

Barite.—Output of Arkansas barite, used principally in the manufacture of drilling muds for the oil and gas industry, was severely affected by the economic downturn that resulted in lower oil and gas well drilling activities. Arkansas, which ranked third in the Nation in 1982 in barite production, had no reported output in 1983. NL Baroid/NL Industries Inc., which closed its Magnet Cove Mine and plant in 1982, closed its McKnight Mine in Montgomery County permanently in 1983. Milchem Inc., which shut its Fancy Hill Mine and plant down in 1982, remained closed. The new plant reportedly handled only 200 tons prior to shutdown. In 1983, only a skeleton crew remained at the 200,000-ton-per-year plant. It was anticipated the plant would remain closed in 1984 because of reduced demand and increased imports of barite through the Port of New Orleans.

Bromine.—Arkansas remained the largest domestic bromine producer and accounted for about one-half of the world's output in 1983. Production and value remained at about the same level as that of 1982. The bromine industry in Arkansas was adversely affected by imports of brominated compounds from Israel. Bromine occurs in salt brines in the south-central part of the State in Columbia and Union Counties. Two companies, Dow Chemical U.S.A. and Ethyl Corp., operated in Columbia County and two others, Arkansas Chemicals Inc. and Great Lakes Chemical Corp., operated in Union County.

Great Lakes dedicated its new Halon facility at El Dorado late in the year. Halon is used as a fire extinguishing agent. Ethyl continued construction of two plants at Magnolia with bromine as their feedstock. A sodium and calcium bromide plant was completed during the year with a rated capacity of 160 million pounds per year. Also under construction was a tetrabromobisphenol (TBBPA) and methyl bromide

facility. The facility will have a capacity of 8 million pounds per year of methyl bromide, a soil fumigant, and 15 million pounds per year of TBBPA, a flame retardant for epoxy resins. Dow was reissued a permit by the State to resume construction of a 120-million-pound-per-year calcium bromide production facility at Magnolia with a scheduled completion date early in 1985. Calcium bromide is used in clear fluids for the oil and gas well industry.

Cement.—Two companies, Ideal Cement Co., a subsidiary of Ideal Basic Industries Inc., and Arkansas Cement Corp., a subsidiary of Arkla Inc., produced portland and masonry cement at plants in Saratoga and Foreman, respectively. Both plants, with a total of five kilns, used the wet process. Portland cement shipments increased 1.5% while value decreased slightly from that of 1982, indicating a decrease also in unit prices. Masonry cement shipments increased 16.2% while value increased 14.8% from that of 1982. Major end uses for portland cement were ready-mix concrete, concrete products, building materials, and highway construction. Alcoa's plant at Bauxite was one of three plants nationally that produced aluminous cement, a nonportland hydraulic cement.

Construction activity was down most of the year, but increased late in the year with cement output following demand. Some increase in use was noted in oil well applications. Although output increased to some degree, shipments into Arkansas of portland cement increased 18.9% while that of masonry cement increased 32.3% over that of 1982. Apparently, out-of-State producers, in order to reduce inventories, lowered prices and increased shipments into the State.

Arkansas Cement, in a $1.4 million project at its 1-million-ton-per-year plant at Foreman, modified its existing grate cooler and installed a new heat exchanger and dust collection system. Completed late in 1983, the modification of the cooler included automatic removal of fines, new stationary partition plates, and a new cooler vent system, which will serve three kilns.

Clays.—In 1983, Arkansas' clay industry produced common clay and kaolin with total clay output increasing 39.7% while value increased 49.5% over that of 1982. Common clay was mined by 7 companies at 17 pits in 10 counties; leading counties were Crittenden, Hot Spring, and Montgomery. Production and value of common clay increased 41.4% and 56.4%, respectively, over that of 1982. Major uses were in brick and lightweight aggregate. Kaolin was mined by two companies at three pits in Pulaski County. Arkansas ranked third in the Nation in output of kaolin. Production increased 28.2% with value increasing 48.3% over that of 1982. Output included unprocessed and calcined high-temperature kaolin.

With the increase in housing starts, Acme Brick Co. reopened its Malvern plant at midyear. Its Fort Smith plant also recalled workers and went into full production earlier in the year.

The City of West Memphis, Arkansas, issued $8.5 million in industrial revenue bonds to finance major improvements at Arkansas Lightweight Aggregate Corp.'s facilities in West Memphis. The company transferred existing properties to the city and will lease them back. The company will be responsible for real estate taxes, insurance, and other costs incidental to ownership and upon repayment of the bonds may reacquire the improved property for $100.

Gem Stones.—Park authorities at the Crater of Diamonds Park in Pike County reported that 87,000 people visited the park in 1983, about the same as in 1982. Visitors recovered 1,501 diamonds, the highest number in several years, compared with 1,382 diamonds in 1982. The largest diamonds recovered included a 6.20-carat and a 5.63-carat stone. Over one-half of the diamonds recovered were white with the rest mainly brown and yellow. Improved screening techniques enabled the visitors to recover more of the smaller stones. Turquoise was recovered from the Mona Lisa Mine, some 30 miles southeast of Mena. The turquoise was sold for prices ranging from $10 to $800 per pound, depending on grade. Some of the material was shipped overseas for cutting and polishing in jewelry applications.

Graphite (Synthetic).—Great Lakes Carbon Corp. manufactured graphite at its plant in Ozark, Franklin County. Production and value increased 28.2% and 25.0%, respectively, over that of 1982. Arkansas ranked fifth nationally in output of synthetic graphite. The facility has a capacity of 35 million pounds of graphite electrodes annually. The electrodes were used in electric arc furnaces to melt scrap for production of steel. Dow Chemical Co. closed its graphite department at its Russellville facilities at the end of the year, eliminating 65 positions.

Gypsum.—Crude gypsum was produced

by Weyerhaeuser Co. in Howard County and Harrison Gypsum Co. in Pike County; Weyerhaeuser's Briar Mine was 1 of the top 10 producing units in the Nation. Total State output increased 6.0% while value decreased 20.7% from that of 1982. Calcined gypsum was produced by Temple-EasTex Inc., Crittenden County, and Weyerhaeuser, Howard County. Production and value increased 23.8% and 38.1%, respectively, over that of 1982. Weyerhaeuser's wallboard plant is reportedly one of the largest in the world and produced about 3% of the Nation's output.

Lime.—Quicklime was produced by Arkansas Lime Co., Independence County, and by Alcoa in Saline County. Output and value decreased about 15% from that of 1982. Arkansas Lime produced hydrated lime with output and value increasing slightly over that of 1982. Alcoa permanently closed its plant in August. Output of total lime was at its lowest level in over 10 years.

Perlite (Expanded).—Strong-Lite Products Corp. expanded perlite from out of State at its plant in Pine Bluff, Jefferson County. Output increased 37.5% while value increased 29.3% over that of 1982. Expanded perlite was used in horticultural applications and concrete aggregates.

Quartz.—Various grades of natural quartz were surface mined and processed by Coleman Crystal Inc. at Jessieville, and by Ocus Stanley and Burrow Mining Co. at Mount Ida. Coleman was the major domestic producer of lascas for electronics. Estimated production of lasca increased significantly because of increased markets. Geomex Mines Services Inc. purchased the old Coleman Mine during the year.

Sand and Gravel.—Arkansas produced both construction and industrial sand and gravel in 1983. Total sand and gravel production was estimated to have decreased slightly from that of 1982, with both construction and industrial output decreasing. Unit values of construction and industrial sand and gravel increased slightly, while that of industrial sand decreased. The State legislature passed a bill increasing the severance tax on sand and gravel from 1 to 4 cents per ton over a 3-year period starting in 1984.

Construction.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Although construction activities increased late in the year, high inventory levels kept output at about the same level as in 1982. Many sand and gravel facilities operated intermittently during the year, depending on proximity and extent of construction activities. Most operations were relatively small with no one pit producing over 750,000 tons. Opposition to dredging sand and gravel from waterways has been increasing. Major objections centered on loss of water quality, deleterious effect on fish, and loss of recreation utilization.

Table 4.—Arkansas: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	NA	NA	NA
Gravel	NA	NA	NA	NA	NA	NA
Sand and gravel (unprocessed)	NA	NA	NA	NA	NA	NA
Total or average	r6,936	r$18,700	r$2.70	e6,900	e$19,600	e$2.84
Industrial:						
Sand	W	W	12.80	W	W	12.40
Gravel	W	W	W	W	W	37.36
Total or average	r471	r5,625	r11.94	386	4,796	12.42
Grand total or average	r7,407	r24,325	r3.28	e7,286	e24,396	e3.35

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total or average."

Industrial.—Four companies produced industrial sand and gravel from four counties during 1983, with output and value decreasing; total unit values increased. Producers were Silica Products, Gifford-Hill & Co. Inc., Ideal Cement, and Arkhola Sand & Gravel Co. No one operation produced in excess of 500,000 tons and none produced less than 25,000 tons each. Major uses for industrial sand and gravel were blasting abrasives, foundry molds, and glassmaking, with most of the output shipped by truck.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Output and value of crushed stone increased, reversing a 3-year decline in market demand. Material mined included limestone, granite (syenite), sandstone, slate, and dolomite. Arkansas led the Nation in output of crushed sandstone and was one of the top three States in crushed slate production. Crushed stone was produced by 33 companies at 50 quarries in 28 counties; leading counties were Pulaski, Lawrence, and Independence. Three quarries each produced in excess of 1 million tons in 1983 and accounted for 28.8% of all crushed stone produced. The top 11 companies produced 80% of the crushed stone output. Shipments were mainly by truck with the material being used for cement manufacture, ballast, and aggregate. Most operations were intermittent or at reduced workweeks during the year with an increase in demand matching the increase in construction activities late in the year. Minnesota Mining and Manufacturing Co. planned to install a portable crushing plant at its roofing granule facility at Little Rock. Included would be a crusher, two screens, a mill, and baghouse.

Table 5.—Arkansas: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	747	2,833
Filter stone	25	100
Coarse aggregate, graded:		
Concrete aggregate, coarse	416	1,624
Bituminous aggregate, coarse	537	2,012
Bituminous surface treatment aggregate	121	567
Railroad ballast	655	2,435
Fine aggregate (-3/8 inch):		
Stone sand, concrete	9	42
Screening, undesignated	162	451
Other fine aggregate	10	30
Coarse and fine aggregate:		
Graded road base or subbase	1,504	5,329
Unpaved road surfacing	336	983
Crusher run or fill or waste	367	2,627
Other coarse and fine aggregate	19	65
Agricultural: Agricultural limestone	96	440
Chemical and metallurgical:		
Cement manufacture	1,027	2,003
Dead-burned dolomite manufacture	57	171
Special:		
Other fillers or extenders	97	891
Other[2]	7,264	28,663
Total[3]	13,448	51,267

[1]Includes limestone, dolomite, granite, sandstone, slate, and miscellaneous stone.
[2]Includes stone sand (bituminous mix or seal), poultry grit and mineral food, other agricultural uses, lime manufacture, flux stone, glass manufacture, paper manufacture, and uses not specified.
[3]Data do not add to totals shown because of independent rounding.

Arkansas Power & Light Co., in attempts to eliminate a $2 million per year disposal cost for fly ash, was emphasizing its use as a partial substitute for crushed stone. Areas of substitution would be as a low-cost alternative for agricultural lime and as partial cement replacement in concrete and production of lightweight aggregate. The State Highway and Transportation Department approved use of fly ash as a mineral filler in asphaltic hot and cold mix paving. Sources of the fly ash were the power company's facilities at White Bluff and Independence.

Dimension.—Dimension stone output in-

creased and value doubled compared with that of 1982. Dimension sandstone was quarried by four companies at four quarries in Independence and Logan Counties.

Sulfur (Recovered).—Two companies recovered sulfur from their operations with output and value increasing over that of 1982. Phillips Petroleum Co., Lafayette County, recovered sulfur as a byproduct of petroleum refining at its McKamie plant while Ethyl, Columbia County, recovered sulfur during bromine extraction at its facility near Magnolia.

Talc.—The Milwhite Co. Inc. mined talc from its Congo Pit northwest of Benton and processed the ore at its mill at Bryant. Production decreased significantly because of reduced demand in roofing materials and as an industrial filler.

Tripoli.—Malvern Minerals Co. Inc., Garland County, was the State's sole producer of tripoli with output decreasing 13.6% and value decreasing 13.1% over that of 1982. Malvern opened a new pit, the South Mine, in April, which was expected to have a life of 4 to 5 years. Output was used primarily as a filler with some used as an abrasive. The company installed new equipment at its mill to double output. The plant uses a hammer mill, dryers, and air classifiers; the system is basically a dry process.

Vermiculite (Exfoliated).—Strong-Lite, Pine Bluff, and W. R. Grace & Co., North Little Rock, exfoliated crude vermiculite from out of State with output increasing 11.2% over that of 1982. Strong-Lite reportedly imported vermiculite from the Palabora deposit in the northeast Transvaal, Republic of South Africa. Exfoliated vermiculite was used for texturing paints and in aggregate, insulation, agriculture, and fireproofing.

METALS

Aluminum.—Arkansas was 1 of 17 States with primary aluminum production facilities, ranking 10th nationally in output. Production and value increased 22.6% and 26.0%, respectively, over that of 1982 indicating an increase in unit price. Reynolds operated the Jones Mills and Patterson facilities during the year with the Patterson facility operating at full capacity. The Jones Mills plant operated at 40% capacity early in the year and by October was at full capacity. During the year, the Public Service Commission approved lower electric rates by Arkansas Power & Light, which had a direct bearing on restarting potlines at Jones Mills. The Patterson facility operated on low-cost hydroelectric power. Reynolds' Hot Spring County continuous-rolling plant remained in operation while the Malvern cable plant remained closed. The future of the Malvern plant depended on wage concessions including a 3-year wage freeze. Raw materials for Reynolds' plants were shipped by rail from Texas.

Bauxite.—Arkansas remained the leading State in output of bauxite with production decreasing from that of 1982, continuing a downward trend started in 1977. Production was from two operations in Saline County. Alcoa, which mines bauxite for its chemical facility at Bauxite, operated as low as 40% of capacity during the year, increasing to 60% by yearend. The plant produced various chemicals for use in refractories, ceramics, coatings, and other uses. Although shipments of chemicals increased over that of 1982, output was still below the 1979 level. Employee levels have dropped from a high of 1,600 in 1979 to 1,250 at the end of 1983. Two projects for new products were initiated. One was the conversion of facilities for the production of high-purity alumina and the other was conversion of the lime plant facilities for production of calcined bauxite used in production of proppants. Business conditions improved, ending a steady decline that started in 1980.

Reynolds closed its Hurricane Creek alumina plant, but maintained its chemical products facilities. Reynolds announced that the facilities, including related mining operations, would be sold.

Norton and Alcoa agreed to a partnership to increase production capacity for man-made proppants. The sintered bauxite proppants are used in hydraulic fracturing of deep oil and gas wells. The partnership will undertake a $50 million expansion to increase capacity at the Fort Smith plant from 100 to 300 million pounds per year. The expansion was expected to take 18 months to complete. Alcoa was expected to deliver its first shipment of calcined bauxite to Fort Smith early in 1984.

American Cyanamid Co. operated the Quapaw Mine and plant near Bryant, producing calcined bauxite. The company opened the Globe 28 Mine in January to eventually replace the Quapaw Mine. New milling units and improved dust control facilities were installed to upgrade product lines. Output was adversely affected more by construction activities than reduced de-

mand.

Iron and Steel.—Although Arkansas was not a significant producer of iron and steel products, announced development plans could alter that concept.

York-Hanover Seamless Tube Inc. announced plans to construct a 250,000-ton-per-year seamless tube mill at Little Rock. The $280 million facility was scheduled to be operational late in 1986.

Quanex Corp., which deferred construction of its Fort Smith specialty bar mill in February, announced late in the year plans to resume construction if financing plans are approved. The project, scheduled for completion in 1985, would require $40 million in addition to $75 million already spent on construction. The plant will produce bars primarily for the forging industry making automotive and machinery parts. The 280,000-ton-per-year facility will utilize a unique process of vacuum degassing, ladle injection, argon stirring, and a rotary continuous caster to go from molten to rolled steel.

Ferrous Foundries.—According to the "Arkansas Directory of Manufacturers," seven gray iron and three steel foundries were in operation in the State. The foundries were relatively small, with only two gray iron foundries employing over 200 employees and one steel foundry employing over 100 employees.

Vanadium.—Arkansas' sole vanadium producer, Union Carbide Corp., which closed its mine and mill in Garland County in June 1982, remained on a standby basis throughout 1983. The facility is capable of producing vanadium oxide from the vanadiferous clays in the area, which was converted to ferrovanadium at other locations. The chief market was in steel alloys, but with the slump in the steel industry and increased imports, market demand was down. By yearend, no firm plans for restart of the facilities were announced.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, AL.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Oilstones and whetstones:			
Hiram A. Smith Whetstone Co. Inc	1500 Sleepy Valley Rd. Hot Springs, AR 71901	Quarry	Garland.
Tripoli:			
Malvern Minerals Co. Inc	Box 1246 Hot Springs, AR 71901	Mine	Do.
Barite:			
NL Baroid/NL Industries Inc.	Box 1675 Houston, TX 77001		
McKnight Mine		Open pit	Montgomery.
Magnet Cove plant		Plant	Hot Spring.
Bauxite:			
Aluminum Co. of America[1]	1501 Alcoa Bldg. Pittsburgh, PA 15219	Mine and plant	Saline.
American Cyanamid Co	Berdan Ave. Wayne, NJ 07470	do	Do.
Reynolds Metals Co.[1]	Box 97 Bauxite, AR 72011	Mines and plant	Pulaski and Saline.
Bromine:			
Arkansas Chemicals Inc	Route 6, Box 98 El Dorado, AR 71730	Brine wells and plant.	Union.
Dow Chemical U.S.A., Magnolia plant	2030 Dow Center Midland, MI 48640	do	Columbia.
Ethyl Corp., Arkansas Div	Box 729 Magnolia, AR 71753	do	Do.
Great Lakes Chemical Corp	Box 2200 West Lafayette, IN 47906	do	Union.
Cement:			
Arkansas Cement Corp., a subsidiary of Arkla Inc.[1]	Box 130 Foreman, AR 71836	Plant	Little River.
Ideal Cement Co., a subsidiary of Ideal Basic Industries Inc.[1]	Box 8789 Denver, CO 80201	do	Howard.
Clays:			
Acme Brick Co., a division of Justin Industries Inc.	Box 425 Fort Worth, TX 76101	Pits and plants	Hot Spring and Sebastian.
A. P. Green Refractories Co., a subsidiary of United States Gypsum Co.	Box 6057 Little Rock, AR 72216	Pit and plant	Pulaski.
Arkansas Lightweight Aggregate Corp	El Dorado, AR 71730	do	Crittenden.
Eureka Brick & Tile Co	Box 379 Clarksville, AR 72830	Mine	Johnson.
Gypsum:			
C. W. Harrison Sr., d.b.a. Highland Gypsum.	Box 336 Lindsay, OK 73052	do	Pike.
Weyerhaeuser Co., Dierks Div	Route 4, Box 78 Nashville, AR 71852	Mine and plant	Howard.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lime:			
Arkansas Lime Co., a subsidiary of Rangaire Corp.[1]	Box 2356 Batesville, AR 72501	Quarry and plant	Independence.
Perlite (expanded):			
Strong-Lite Products Corp	Box 8029 Pine Bluff, AR 71611	Plant	Jefferson.
Sand and gravel:			
Construction (1982):			
Jeffrey Sand Co	Box 998 Fort Smith, AR 72901	Pits	Faulkner, Pulaski Sebastian.
St. Francis Materials Co., a division of B. M. Hogan Co.	Box 999 Forrest City, AR 72335	Pits and plants	Calhoun, Craighead, Cross, Poinsett, St. Francis.
Industrial (1982):			
Gifford-Hill & Co. Inc.[2]	Box 6615 Shreveport, LA 71106	Pits	Miller.
Silica Products Co. Inc	Box 248 Guion, AR 72540	Pit	Izard.
Stone:			
Granite:			
Freshour Construction Co. Inc	Drawer AF Cabot, AR 72023	Quarry	Pulaski.
McGeorge Contracting Co. Inc	Box 7008 Pine Bluff, AR 71611	Quarries	Do.
Minnesota Mining and Manufacturing Co.	3M Center, 223-4N-05 St. Paul, MN 55144	Quarry	Do.
Limestone:			
McClinton-Anchor Co., a subsidiary of Ashland Oil Inc.	Box 756 Fayetteville, AR 72701	do	Benton, Madison, Washington.
Midwest Lime Co	Box 2608 Batesville, AR 72501	do	Independence.
Sandstone:			
Arkhola Sand & Gravel Co.,[1] a subsidiary of Ashland Oil Inc.	Box 1627 Fort Smith, AR 72901	Quarries	Crawford and Sebastian.
Ben M. Hogan Co. Inc.[1]	Box 2860 Little Rock, AR 72203	do	White.
H M B Construction Co	Box 5606 Texarkana, TX 75501	Quarry	Sevier.
M & M Rock Co. Inc	Box 1190 Conway, AR 72032	Quarries	Faulkner, Perry, White.
Slate:			
Bird & Son Inc	Drawer 151 Glenwood, AR 71943	Quarry	Montgomery.
Sulfur (recovered):			
Ethyl Corp., Arkansas Div	Box 729 Magnolia, AR 71753	Sulfur recovered in bromine extraction.	Columbia.
Phillips Petroleum Co	724 Adams Bldg. Bartlesville, OK 74004	Sulfur recovered as a byproduct of petroleum refining.	Lafayette.
Talc:			
The Milwhite Co. Inc	Box 15038 Houston, TX 77020	Mine and plant	Saline.
Vanadium:			
Union Carbide Corp., Metals Div	Route 6, Box 943 Hot Springs, AR 71901	Mine and mill	Garland.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Pulaski.
Strong-Lite Products Corp	Box 8029 Pine Bluff, AR 71611	do	Jefferson.

[1]Also produced limestone.
[2]Also produced construction sand and gravel in Ouachita County.

The Mineral Industry of California

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the California Department of Conservation, Division of Mines and Geology, for collecting information on all nonfuel minerals.

By F. V. Carrillo,[1] J. F. Davis,[2] and J. L. Burnett[3]

California was the leading State in the Nation in production of nonfuel minerals for 1983. Production value totaled $1.8 billion, an increase of 10% from that reported in 1982. The increase in value was attributed to an economic recovery in the construction industry and the generally rebounding economy of the State following 1982's recession, as well as slightly higher prices for some commodities.

California ranked first among the States in the production of asbestos, diatomite,

Table 1.—Nonfuel mineral production in California[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Boron minerals thousand short tons	1,234	$384,597	1,303	$439,181
Cement (portland) do.	6,464	401,883	7,567	420,949
Clays do.	1,762	15,642	[2]1,816	[2]18,255
Diatomite do.	340	68,139	W	W
Gem stones	NA	250	NA	300
Gold (recoverable content of ores, etc.) troy ounces	10,547	3,965	38,443	16,300
Gypsum thousand short tons	1,088	10,614	1,213	10,668
Lime do.	364	23,000	358	22,994
Peat do.	W	W	13	612
Pumice do.	59	1,285	65	1,582
Sand and gravel:				
Construction do.	81,147	270,995	e91,000	e308,700
Industrial do.	r2,167	r27,528	2,150	34,066
Silver (recoverable content of ores, etc.) thousand troy ounces	34	271	27	308
Stone:				
Crushed thousand short tons	e28,500	e105,400	35,582	146,289
Dimension do.	e29	e1,895	20	2,839
Talc and pyrophyllite do.	85	1,699	71	1,289
Combined value of asbestos, calcium chloride, carbon dioxide (1982), cement (masonry), clays (fire clay, 1983), copper, feldspar, iron ore, lead, magnesium compounds, molybdenum (1982), perlite, potassium salts, rare-earth metal concentrate, salt, sodium carbonate, sodium sulfate, tungsten ore and concentrate, wollastonite, and values indicated by symbol W	XX	r293,851	XX	340,069
Total	XX	r1,611,014	XX	1,764,401

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes fire clay; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in California, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Alameda	W	W	Sand and gravel (construction), salt, clays.
Alpine	$242	--	
Amador	W	W	Sand (industrial), clays, sand and gravel (construction).
Butte	(2)	$1,814	Sand and gravel (construction).
Calaveras	50,739	28,447	Cement, asbestos, clays, talc.
Colusa	(2)	51	Sand and gravel (construction).
Contra Costa	14,872	8,489	Sand (industrial), lime, clays, sand and gravel (construction).
Del Norte	58	W	Sand and gravel (construction), gold.
El Dorado	W	112	Gold, sand and gravel (construction), talc.
Fresno	623	12,244	Sand and gravel (construction), gold, clays, silver.
Glenn	W	W	Sand and gravel (construction), lime.
Humboldt	207	1,081	Sand and gravel (construction).
Imperial	W	W	Gypsum, lime, sand and gravel (construction).
Inyo	52,871	25,076	Boron minerals, tungsten, talc, perlite, clays, sand and gravel (construction), silver, pumice, molybdenum, gold, copper, lead, pyrophyllite.
Kern	129,495	410,487	Boron minerals, cement, sand and gravel (construction), clays, gypsum, carbon dioxide, silver, gold, tungsten.
Kings	W	W	Gypsum.
Lake	1,033	1,322	Sand and gravel (construction).
Lassen	303	W	Sand and gravel (construction), diatomite.
Los Angeles	4,936	54,405	Sand and gravel (construction), lime, clays, tungsten.
Madera	9,514	W	Tungsten, pumice.
Marin	W	W	Sand and gravel (construction), clays.
Mariposa	73	W	Sand and gravel (construction).
Mendocino	(2)	964	Do.
Merced	(2)	1,342	Do.
Modoc	W	W	Peat, sand and gravel (construction), pumice.
Mono	1,427	979	Pumice, gold, pyrophyllite, silver, sand and gravel (construction), clays, tungsten.
Monterey	19,407	21,981	Lime, asbestos, magnesium compounds, sand (industrial), sand and gravel (construction).
Napa	W	W	Salt.
Nevada	W	W	Sand and gravel (construction), clays.
Orange	6,154	14,926	Sand and gravel (construction), sand (industrial), feldspar, clays.
Placer	W	W	Sand and gravel (construction), clays.
Plumas	W	W	Sand and gravel (construction), gold.
Riverside	118,703	93,143	Cement, iron ore, sand and gravel (construction), clays, wollastonite, gypsum, sand (industrial), gold.
Sacramento	W	W	Sand and gravel (construction), clays.
San Benito	16,394	W	Sand and gravel (construction), clays, asbestos.
San Bernardino	851,888	410,433	Cement, sodium carbonate, boron minerals, rare-earth minerals, sodium sulfate, potash, sand and gravel (construction), lime, clays, calcium chloride, salt, gold, feldspar, iron ore, talc, gypsum, silver, tungsten, lead, copper.
San Diego	14,263	36,366	Sand and gravel (construction), sand (industrial), salt, gypsum, magnesium compounds, clays, feldspar, tungsten.
San Joaquin	1,155	8,582	Sand and gravel (construction), lime, gold, peat, silver.
San Luis Obispo	W	W	Sand and gravel (construction), gypsum.
San Mateo	W	19,830	Magnesium compounds, salt, sand and gravel (construction).
Santa Barbara	73,622	W	Diatomite, sand and gravel (construction), lime.
Santa Clara	W	W	Cement.
Santa Cruz	31,025	30,440	Cement, sand and gravel (construction), sand (industrial), clays.
Shasta	W	21,137	Cement, sand and gravel (construction), clays, copper.
Sierra	W	W	Sand and gravel (construction), gold.
Siskiyou	W	W	Sand and gravel (construction), pumice, gold.
Solano	W	1,250	Stone (crushed).
Sonoma	1,872	7,483	Sand and gravel (construction).
Stanislaus	266	4,891	Sand and gravel (construction), gold, clays, silver.
Sutter	W	W	Sand and gravel (construction), clays.
Tehama	208	184	Sand and gravel (construction).
Trinity	530	W	Sand and gravel (construction), gold, silver.
Tulare	W	3,271	Sand and gravel (construction).
Tuolumne	W	W	Lime, sand and gravel (construction).
Ventura	7,501	16,417	Sand and gravel (construction), sand (industrial), clays, gypsum.
Yolo	W	W	Sand and gravel (construction), lime.
Yuba	W	3,570	Gold, sand and gravel (construction), clays, silver.
Undistributed[3]	212,239	262,994	
Sand and gravel (construction)	e352,100	XX	

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in California, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Stone:			
Crushed	XX	e$105,400	
Dimension	XX	e1,895	
Total[4]	$1,973,716	1,611,014	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]No nonfuel mineral production was reported for San Francisco County. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Includes mercury (1981) and gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of California business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	12,216.6	12,357.2	+1.2
Unemployment	do	1,451.5	1,131.5	-22.0
Employment (nonagricultural):				
Mining[1]	do	46.8	47.0	+.4
Manufacturing	do	1,874.8	1,950.2	+4.0
Contract construction	do	319.3	368.4	+15.4
Transportation and public utilities	do	527.4	512.7	-2.8
Wholesale and retail trade	do	2,252.7	2,409.6	+7.0
Finance, insurance, real estate	do	642.6	664.2	+3.4
Services	do	2,295.3	2,388.9	+4.1
Government	do	1,750.8	1,737.7	-.8
Total nonagricultural employment[1]	do	9,709.7	10,078.7	+3.8
Personal income:				
Total	millions	$310,699	$333,273	+7.3
Per capita		$12,616	$13,239	+4.9
Construction activity:				
Number of private and public residential units authorized		85,704	171,843	+100.5
Value of nonresidential construction	millions	$7,496.8	$8,746.4	+16.7
Value of State road contract awards	do	$390.0	$260.0	-33.3
Shipments of portland and masonry cement to and within the State	thousand short tons	6,034	7,035	+16.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,611.0	$1,764.4	+9.5
Value per capita, resident population		$65	$70	+7.7
Value per square mile		$10,159	$11,117	+9.4

pPreliminary.

[1]Includes oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

rare-earth metal concentrate, construction sand and gravel, sodium compounds, and tungsten. It ranked second in the production of calcium chloride, perlite, portland cement, magnesium compounds, and wollastonite. It ranked third in potash and was the sole producer of boron minerals.

Industrial minerals accounted for the bulk of California's nonfuel mineral production, comprising more than 90% of the State's mineral production value. Thirty mineral commodities, including seven metallic minerals, were produced in California in 1983.

Trends and Developments.—During 1983, the mining industry showed a gradual recovery along with the rest of the State's economy. Operations were resumed in September to restock depleted inventories of ammonium paratungstate at Union Carbide Corp.'s Pine Creek tungsten mill. The Pine Creek Mine restarted operations in April but closed again in October because of the severely depressed tungsten market.

Exploration and development of precious and strategic metals deposits continued to make news in California during the year. Homestake Mining Co. began construction

at its 200,000-ounce-per-year McLaughlin gold deposit in Napa County, and Gold Fields Mining Corp. continued evaluation of its Mesquite gold deposit in Imperial County. Exploration for new ore deposits was carried on at a high rate in many parts of the State. Several recent discoveries resulted from the reexamination of old mining districts.

Recreational and full-time placer mining by individuals with small floating suction dredges was a popular pursuit in many parts of California. The recovery of several large nuggets was reported in the press, including a 53-ounce mass from a small stream near Alleghany in Sierra County.

Steel production suffered from a lack of demand. Kaiser Steel Corp. prepared to end production at yearend from its Fontana plant. The last blast furnace was shut down in October, followed by closure of the melt shop. United States Steel Corp. closed its South San Francisco fabricating plant in May. Steelmaking at the Judson Steel Corp. mill in Emeryville was discontinued when all steelmaking and rolling operations were phased out at its electric-furnace plant. The fabricating of steel and the building of structural members continued at the plant.

California cement producers attempted to limit heavy cement imports into the Western United States by foreign cement producers. Kaiser Cement Corp., Monolith Portland Cement Co., and other Western producers petitioned the U.S. Department of Commerce to impose a duty on Mexican cement in the amount of subsidies for fuel and power that the Mexican producers receive from their Government. In September 1983, the International Trade Commission reversed itself and ruled that Japanese and Australian imports did not threaten unfair injury to the domestic industry.

Legislation and Government Programs.—Acting under California's Surface Mining and Reclamation Act (SMARA), the State Mining and Geology Board designated regionally significant sand and gravel deposits in the Orange County-Temescal Valley and San Gabriel Valley regions of the Los Angeles metropolitan area and initiated this process in the western San Diego County region. Six mineral land classification reports were reviewed and transmitted to the lead agencies in Orange, Riverside, San Bernardino, Nevada, Calaveras, and Placer Counties for their action pursuant to SMARA. Classification was reviewed of a 246-square-mile area covered by the U.S. Geological Survey Placerville 15-minute map

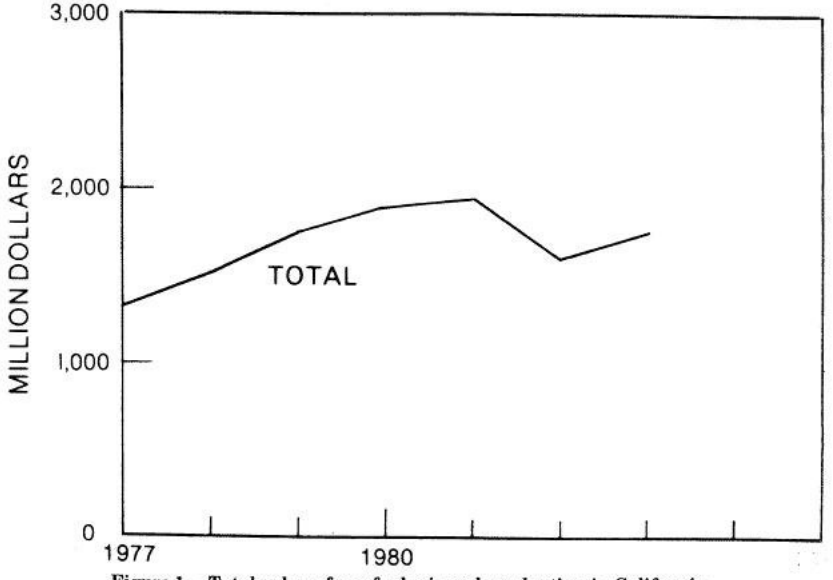

Figure 1.—Total value of nonfuel mineral production in California.

sheet in the Sierra Nevada foothill area.

The Bay Area Conservation and Development Commission was designated as lead agency for mining in the San Francisco Bay and Suisun Marsh, following a dispute over which agency should be the lead agency for mining in the Bay.

The U.S. Department of the Interior's Office of Surface Mining announced the withdrawal of the proposed Federal program regulating surface coal mining and reclamation operations for California.

The California Legislature passed Assembly bill 1807 defining regulatory steps to be taken in determining and controlling toxic air contaminants. The legislation clarifies the statutory authority of the State Air Resources Board regarding the identification and control of toxic air contaminants and defines its relationship with other State agencies.

The U.S. Bureau of Land Management distributed more than $35 million to California as its share of Federal mineral leasing receipts received during 1983 and $10,100,000 from proceeds in lieu of taxes.

The Mining and Mineral Resources and Research Institute at the University of California in Berkeley, which was created under title III of Public Law 95-87, received $254,000 from the U.S. Bureau of Mines in 1983 for operations and research.

The California Department of Conservation's Division of Mines and Geology continued work on studies to identify and evaluate sand and gravel and rock deposits suitable for production of construction aggregate in urbanizing areas of the State. Mineral occurrence and favorability studies of the Placerville and Georgetown 15-minute quadrangle maps were completed. Mineral analyses of the occurrences of zeolites and strategic minerals in the State were conducted. Compilation of a technical map of geothermal resources in California was completed, and the Santa Rosa quadrangle geologic map was published.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Asbestos.—California again led the Nation in production of asbestos from mines in Calaveras and San Benito Counties. The Copperopolis Mine of Calaveras Asbestos Ltd. and Union Carbide's Santa Rita Mine were the principal sources.

Boron Minerals.—California was the only domestic source of boron minerals, mostly in the form of sodium borate. United States Borax & Chemical Corp. operated a mine and processing plant in Kern County that continued to supply the major portion of the State's domestic production. Kerr-McGee Chemical Corp. operated its Trona and Westend plants in San Bernardino County to produce a variety of borate products. During the year, boric acid production was discontinued at the Westend plant.

U.S. Borax placed its new boric acid plant into operation and purchased leases to the Little Placer boron deposit in Kern County from Kerr-McGee. Duval Corp. tested a solution mining process at its Hector (Newberry Springs) deposit.

American Borate Co., a wholly owned subsidiary of Owens-Corning Fiberglas Corp., continued to mine colemanite, a calcium borate, and ulexite-probertite (two similar sodium-calcium borates mined and sold as one) at its Billie Mine at the Death Valley National Monument. Colemanite from this mine was ground and processed at the Walsh washing and calcining plant at Amargosa, NV (formerly Lathrop Wells). A flotation plant adjacent to existing facilities at Amargosa processed colemanite by a patented process. The colemanite product was trucked to Dunn, CA, for blending, storing, and shipping by rail, primarily to manufacturers of textile-grade glass fibers.

Calcium Chloride.—Natural calcium chloride production was reported from three operations in San Bernardino County. Leslie Salt Co., a subsidiary of Cargill Inc., reported production from its Amboy plant; National Chloride Co. of America from its Bristol Lake plant; and Hill Bros. Chemical Co. from its Cadiz plant. Leslie Salt was the largest producer.

Cement.—California ranked second in the Nation, behind Texas, in the production of finished portland cement. Nearly all of the reported cement production in the State was of that variety. A production increase of about 17% from that of 1982 was reported from 12 plants.

Genstar Cement & Lime Co.'s San Andreas cement plant remained closed during 1983. Plans for a $50 million expansion and modernization program were postponed.

Kaiser Cement's Lucerne Valley cement plant went into full production in 1983 with

an expanded capacity of 1.6 million short tons per year. Southwestern Portland Cement Co. continued the $100 million expansion and modernization of its Victorville plant. Monolith Portland Cement began engineering work on its planned expansion and conversion from wet to dry processing at its Monolith plant.

Table 4.—California: Portland cement salient statistics

(Short tons unless otherwise specified)

	Northern California		Southern California		California total	
	1982	1983	1982	1983	1982	1983
Number of active plants	4	3	8	8	12	11
Production	2,098,925	2,123,611	4,407,999	5,386,466	6,506,924	7,510,077
Shipments from mills:						
Quantity	2,038,845	2,280,755	4,425,111	5,285,972	6,463,956	7,566,727
Value	$117,990,376	$117,660,387	$283,892,542	$303,288,677	$401,882,918	$420,949,064
Stocks at mills, Dec. 31	286,051	166,352	291,693	304,633	577,744	470,985

Clays.—Production of 1.82 million short tons of clay and shale, excluding fire clay, was reported from 49 mines in 25 counties throughout the State. Common clay and shale comprised the bulk of the clays produced, with smaller amounts of kaolin, fire clay, and bentonite.

The principal uses of clays produced were in construction materials, pet absorbents, sewer pipe, and drilling mud.

Major producers of common clay and shale included Allied Chemical Co. in Amador County, Excel Minerals Co. in Kern County, Port Costa Materials Inc. in Contra Costa County, Lincoln Clay Products Co. in Placer County, Lone Star Industries Inc. in Santa Cruz County, and Lightweight Processing Co. in Ventura County. The leading bentonite producer in California was Lowes Inc. of Kern County. Standard Industrial Minerals Co. was the leading producer of kaolin from mines in Inyo and Mono Counties. Fire clay was produced by Pacific Coast Building Products Co. in Amador County.

Diatomite.—California continued as the leading diatomite producer in the Nation. All production came from three mines in Santa Barbara and Lassen Counties.

Development activities continued on deposits in northern California. American Resources Group Inc. reported completion of first-phase testing of its diatomite deposit in Shasta County. Grefco Inc. was also active in this new area. Getty Oil Co. continued development of its McKittrick diatomaceous oil deposit, although indications were that the product would more likely be used for backfilling of mined areas rather than as commercial diatomite.

Feldspar.—Feldspar-silica mixtures were reported from the Owens-Illinois Inc. Mission Viejo operation in Orange County and Calspar Inc.'s Santa Fe Springs plant in Los Angeles County.

Graphite (Synthetic).—California ranked eighth in the Nation in the production of synthetic graphite. Great Lakes Carbon Corp. produced most of the synthetic graphite from Kern County for use in electrodes and anodes. Two Los Angeles County operations produced synthetic graphite cloth and fibers.

Gypsum.—California ranked second in the Nation in the production of calcined gypsum during 1983, and fourth in the production of crude gypsum, the same as in 1982.

Crude gypsum output was reported in Imperial, Kern, Kings, Riverside, San Bernardino, San Diego, San Luis Obispo, and Ventura Counties.

United States Gypsum Co. refurbished its gypsumboard facility at Fremont and began a program to modernize its paper mill at South Gate.

Lime.—California ranked 12th among the 39 States that reported lime production in 1983. Output of 358,000 short tons was only slightly lower than that reported in 1982.

Magnesium Compounds.—Magnesium compounds were produced from hydrated dolomitic lime and sea water by Kaiser Aluminum & Chemical Corp. in Monterey County. The dolomite was quarried at the Natividad operation, 5 miles northeast of Salinas, calcined to remove CO_2, and shipped to Moss Landing for hydration. Merck & Co. Inc. produced magnesium oxide, magnesium hydroxide, and magnesium carbonate at its San Mateo County plant.

Peat.—Peat production was 30% higher in 1983 than in 1982. Radel Inc. in Modoc County, Delta Humus Co. in San Joaquin County, and Hyponex Corp. in Santa Cruz County were the principal producers.

Perlite.—Crude perlite was produced at the Inyo County Fish Springs Mine of Redco Inc. Expanded perlite was processed at seven plants in Los Angeles, San Bernardino, and San Diego Counties. American Perlite Co.'s Redco mill in Los Angeles County was the largest producer.

Potassium Salts.—Kerr-McGee produced muriate of potash (60% K_2O) and sulfate of potash (50% K_2O) from plants in San Bernardino County.

Pumice.—California was the third largest domestic producer of pumice in 1983. Siskiyou County was the leading producer of the four counties reporting pumice output. Pumice processing from Inyo, Madera, and Mono Counties was also reported.

Tionesta Aggregates Co. and Featherock Inc. processed pumicite from operations near Tule Lake in Siskiyou County.

Principal uses were in abrasives, decorative building construction, concrete mixtures, and as a pesticide carrier for crop dusting.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Industrial sand production of 2,150,000 tons was reported from 10 operations in 8 counties. Only three operators produced more than 200,000 tons. Owens-Illinois was the leading producer. Industrial sand was used principally in glass containers, fiberglass, flat glass manufacture, and blasting. California ranked fourth nationally in 1983 in the production of industrial sand.

Table 5.—California: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	31,808	$105,579	$3.32	NA	NA	NA
Gravel	45,010	155,375	3.45	NA	NA	NA
Sand and gravel (unprocessed)	4,328	10,041	2.32	NA	NA	NA
Total or average	[1]81,147	270,995	3.34	[e]91,000	[e]$308,700	[e]$3.39
Industrial sand	[r]2,167	[r]27,528	[r]12.70	2,150	34,066	15.84
Grand total or average	[r][1]83,313	[r]298,523	[r]3.58	[e]93,150	[e]342,766	[e]3.35

[e]Estimated. [r]Revised. NA Not available.
[1]Data do not add to total shown because of independent rounding.

Sodium Compounds.—California was the Nation's largest sodium sulfate producer in 1983 and the second largest sodium carbonate producer. All output came from the Westend and Argus plants in San Bernardino County operated by Kerr-McGee.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—California was among the top 10 producing States for crushed and broken stone in 1983. Production of 35,582,000 tons was up more than 1 million tons from that reported in 1981. Output of crushed stone in 1983 was reported from 196 quarries in 46 counties. More than 1 million tons of crushed stone was produced from each of 13 counties.

Kaiser Cement and California Portland Cement Co. were the leading crushed limestone producers in California. Granite Rock Co. and South Coast Asphalt Products Co. were the largest producers of crushed granite in the State.

Table 6.—California: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	3,108	17,608
Filter stone	319	1,705
Coarse aggregate, graded:		
Concrete aggregate, coarse	679	1,715
Bituminous aggregate, coarse	1,002	5,338
Bituminous surface treatment aggregate	107	226
Railroad ballast	22	91
Fine aggregate (-3/8 inch):		
Stone sand, concrete	139	2,468
Stone sand, bituminous mix or seal	113	222
Screening, undesignated	185	361
Coarse and fine aggregate:		
Graded road base or subbase	5,845	15,940
Unpaved road surfacing	994	3,349
Terrazzo and exposed aggregate	147	2,941
Crusher run or fill or waste	3,786	9,170
Agricultural: Poultry grit and mineral food	27	299
Chemical and metallurgical:		
Cement manufacture	10,618	36,357
Lime manufacture	333	4,662
Dead-burned dolomite manufacture	67	716
Special:		
Asphalt fillers or extenders	19	152
Roofing granules	38	1,244
Other[2]	8,034	41,724
Total	35,582	[3]146,289

[1]Includes limestone, dolomite, granite, sandstone, quartzite, shell, traprock, slate, volcanic cinder and scoria, and miscellaneous stone.

[2]Includes agricultural limestone, other agricultural uses, macadam, flux stone, whiting or whiting substitute, other fillers or extenders, glass manufacture, lightweight aggregate (slate), sulfur oxide removal, combined coarse and fine aggregate, and uses not specified.

[3]Data do not add to total shown because of independent rounding.

Dimension.—Dimension stone output came from 14 quarries in 13 counties. Although 1983 dimension stone production decreased nearly 9,000 short tons from that reported in 1981, value rose to more than $2,800,000. Granite quarrying was the most profitable, reporting values of $1,975,138. Limestone, sandstone, and slate were also mined.

Sulfur (Recovered).—Byproduct sulfur was recovered at 15 oil refineries—4 in Contra Costa County, 9 in Los Angeles County, 1 in Santa Barbara County, and 1 in Solano County. California's 1983 production of over 500,000 metric tons ranked third among the States for recovered elemental sulfur production. Chevron USA Inc.'s refinery at El Segundo, Los Angeles County, was the largest producer.

Talc and Pyrophyllite.—California ranked sixth among the 11 States reporting talc and pyrophyllite production in 1983. Crude talc ore came principally from five operations in Inyo and San Bernardino Counties, with some production reported from one mine in Calaveras County. Processed talc production was reported from six operations in San Bernardino, Los Angeles, Inyo, Calaveras, and Sacramento Counties.

Pyrophyllite was produced and processed in Mono and Inyo Counties. North American Refractories Co.'s Victorville operations in San Bernardino County were idle during the year.

Vermiculite (Exfoliated).—California ranked third among the 29 States reporting 1983 exfoliated vermiculite production. W. R. Grace & Co. was the sole producer from plants in Newark (Alameda County) and Santa Ana (Orange County). Almost two-thirds of the vermiculite output was used in fireproofing.

Wollastonite.—California was the only State other than New York—the major producer—to report wollastonite production during 1983. Pfizer Inc. was the State's sole producer of wollastonite from Riverside County.

Zeolites.—Phelps Dodge Corp. purchased a zeolite quarry 8 miles north of Barstow in San Bernardino County from Occidental Minerals Corp. Ore from this property was used to clean up wastes from nuclear powerplants in the United Kingdom.

METALS

Copper.—Most of the copper production reported in the State was recovered as a byproduct from gold, silver, or tungsten mining. Despite its closure during much of the year, the Pine Creek Mine in Inyo County was the principal producer of by-

product copper from its tungsten operations. Five gold and silver mines in Inyo, Kern, and Mariposa Counties also reported byproduct copper recovery. The Iron Mountain Mine in Shasta County was the only copper mine reporting production from precipitates.

California concentrates were shipped to ASARCO Incorporated's smelter in Hayden, AZ.

Gold.—Nine lode mines, three placers, and one dredging operation reported gold production in California during 1983. Gold was also recovered from sand and gravel operations. Total gold recovery of more than 38,000 ounces was 3-1/2 times that of 1982. The Picacho Mine in Imperial County and the America Mine in San Bernardino County were the major lode producers. Significant amounts were also recovered from sand and gravel operations and bucket-line dredging in Yuba County.

Site preparation and construction proceeded during the year at Homestake Mining's McLaughlin Mine in Napa County. Yuba Placer Gold Co., a joint venture with Placer Services Corp. (Placer U.S. Inc.), conducted a bucket-line dredging operation along the Yuba River in Yuba County. California Silver Ltd. completed field-scale heap leaching tests at its Zaca Mine in Alpine County. Sonora Mining Corp. acquired a group of mines along 4 miles of the Mother Lode vein system near Jamestown in Tuolumne County. Exploration was conducted by Sonora Mining at the Harvard, Dutch-App, Crystalline, and Jumper Mines. Gold Fields Mining continued evaluation of its Mesquite gold deposit in Imperial County.

Exploration was conducted at Inca Resource Inc.'s Rich Gulch property in Plumas County, Terramar Resource Corp.'s Reid Mine near Redding in Shasta County, and the San Juan Ridge placer property of Placer Services near Nevada City.

Placer gold mining by individuals with small suction dredges was a popular recreational pursuit in many California rivers. Recovery of several large nuggets was reported, including a 53-ounce mass from a small stream near Alleghany in Sierra County.

Additional exploration drilling was conducted at Great Pacific's Big Horn property near Los Angeles. Youngquist Mine Development & Construction Co. conducted exploration at the Reward-Brown Monster gold mine near Lone Pine. Pecos Resources Ltd. conducted a drilling program in the Hayden Hill area near Susanville.

Table 7.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1981, total	15	2	27,451	6,271	$2,882,403	53,286	$560,482
1982, total	11	6	35,791	10,547	3,964,725	34,048	270,683
1983:							
Fresno	--	--	--	W	W	W	W
Imperial	1	--	217,990	9,810	4,159,440	--	--
Inyo	3	--	W	W	W	W	W
Kern	1	1	W	W	W	W	W
Mariposa	1	--	49	23	9,752	4	46
Mono	1	--	W	W	W	W	W
Plumas	--	1	--	17	7,208	--	--
San Bernardino	1	--	W	W	W	W	W
San Joaquin	--	--	--	W	W	W	W
Shasta	--	--	W	--	--	--	--
Sierra	1	1	W	W	W	--	--
Stanislaus	--	--	--	W	W	W	W
Yuba	--	1	--	W	W	W	W
Total	9	4	[3]781,199	[3]38,443	[3]16,299,832	[3]26,899	[3]307,725

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1981, total	W	W	W	W	W	W	$3,993,128
1982, total	W	W	W	W	--	--	r4,433,070

See footnotes at end of table.

Table 7.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county —Continued

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1983:							
Fresno	--	--	--	--	--	--	W
Imperial	--	--	--	--	--	--	$4,159,440
Inyo	W	W	W	W	--	--	W
Kern	W	W	W	W	--	--	W
Mariposa	(4)	$58	--	--	--	--	9,856
Mono	--	--	--	--	--	--	W
Plumas	--	--	--	--	--	--	7,208
San Bernardino	W	W	W	W	--	--	W
San Joaquin	--	--	--	--	--	--	W
Shasta	W	W	--	--	--	--	W
Sierra	--	--	--	--	--	--	W
Stanislaus	--	--	--	--	--	--	W
Yuba	--	--	--	--	--	--	W
Total	W	W	W	W	--	--	[3]16,840,551

[r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Operations from which gold and silver are recovered as byproducts from sand and gravel operations and operations from which silver and copper are recovered as byproducts of tungsten ore are not counted as producing mines.
[2]Does not include gravel washed.
[3]Includes items indicated by symbol W.
[4]Less than 1/2 unit.

Table 8.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated[2] (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Dry gold[3]	5	W	W	W	W	W	--
Gold-silver	3	767	42	1,686	W	W	--
Silver	1	W	W	1,070	W	W	--
Total	9	W	W	W	W	W	--
Other lode material:							
Copper precipitates	--	W	--	--	W	--	--
Tungsten ore	--	--	--	W	W	--	--
Total lode	9	[4]708,692	W	W	W	W	--
Placer	4	--	W	W	--	--	--
Grand total	13	[4]708,692	[4]38,443	[4]26,899	W	W	--

W Withheld to avoid disclosing company proprietary data.
[1]Operations from which gold and silver are recovered as byproducts from sand and gravel operations and an operation from which silver and copper are processed as a byproduct from tungsten ore are not counted as producing mines.
[2]Does not include gravel washed.
[3]Includes material that was leached.
[4]Includes items indicated by symbol W.

Iron Ore.—Production of crude iron ore continued to decline in the State, since output was limited to small amounts of ore from the Baxter and Beck Mines in San Bernardino County. Kaiser Steel shipped concentrates and agglomerates from its Eagle Mountain plant in Riverside County.

Iron and Steel.—Kaiser Steel prepared to discontinue steel production from its Fontana plant at yearend while still looking for a buyer for the operation. The last blast furnace was shut down in October, followed by closure of the melt shop.

U.S. Steel closed its south San Francisco fabricating plant in May. Steelmaking at the Judson Steel mill in Emeryville was also discontinued when all steelmaking and rolling operations were phased out at its electric-furnace plant.

Lead.—Only a small amount of lead production was reported in the State during 1983. Lead was recovered as a byproduct from gold and silver producers in Inyo, Kern, and San Bernardino Counties.

Molybdenum.—All of California's molybdenum production was derived as a byprod-

uct from Union Carbide's tungsten ore mining at the Pine Creek Mine in Inyo County.

Rare-Earth Metal Concentrate.—The 1983 output of rare-earth metal concentrates in California was similar to that of 1982, although value dropped 10% owing to lower prices. Rare-earth oxides from Molycorp Inc.'s Mountain Pass bastnasite deposit in San Bernardino County continued to be the major source of the Nation's rare-earth metal concentrate production.

Silver.—Although the value of silver increased 14% from that of 1982, output decreased 21%. The decline was due to less byproduct silver production from Union Carbide's Pine Creek Mine in Inyo County, despite higher silver prices for the year. Small amounts of silver were recovered from sand and gravel operations in Fresno, San Joaquin, and Stanislaus Counties, and from bucket-dredging operations in Yuba County. Production was reported from seven lode mines in Inyo, Kern, Mariposa, Mono, and San Bernardino Counties.

Tungsten Ore and Concentrate.—California ranked first among the three States reporting tungsten production. Nearly all of the reported production in the United States was from California.

Tungsten ore production was reported from four mines in Inyo, Madera, and San Diego Counties. Despite several shutdowns during the year, Union Carbide remained the leading producer of crude ore and concentrates from its Pine Creek Mine in Inyo County. Teledyne Tungsten's Strawberry Mine in Madera County was the second largest producer.

---

[1]State Liaison Officer, Bureau of Mines, Spokane, WA.
[2]Director and State geologist, California Department of Conservation, Division of Mines and Geology, Sacramento, CA.
[3]Geologist, California Department of Conservation, Division of Mines and Geology, Sacramento, CA.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Calaveras Asbestos Ltd	Box 127 Copperopolis, CA 95228	Surface mine and plant.	Calaveras.
Union Carbide Corp., Metals Div.	Box K King City, CA 93930	do	San Benito.
Boron minerals:			
Kerr-McGee Chemical Corp.[1]	Kerr-McGee Center Oklahoma City, OK 73125	Evaporators and plant.	San Bernardino.
United States Borax & Chemical Corp.	Box 75128 Sanford Station Los Angeles, CA 90010	Surface mine and plant.	Kern.
Calcium chloride:			
Leslie Salt Co.,[2] a subsidiary of Cargill Inc.	7200 Central Ave. Newark, CA 94560	Solar evaporators.	San Bernardino.
National Chloride Co. of America[2]	Box 604 Norwalk, CA 90650	do	Do.
Cement:			
California Portland Cement Co.[3]	800 Wilshire Blvd. Los Angeles, CA 90017	Plants	Various.
Kaiser Cement Corp.[4]	300 Lakeside Dr. Oakland, CA 94612	do	Do.
Clays:			
Excel Minerals Co	Box 878 111 South La Patera Lane Goleta, CA 93116	Pits	Kern.
Lightweight Processing Co	715 North Central Ave. Suite 321 Glendale, CA 91203	do	Ventura.
Lone Star Industries Inc.[5]	2800 Campus Dr. San Mateo, CA 94403	do	Santa Cruz.
North American Refractories, Western Div.	Box 785 Ione, CA 95640	do	Amador.
Port Costa Materials Inc	Box 5 Port Costa, CA 94569	Pit	Contra Costa.
Diatomite:			
Manville Products Corp	2500 Miguelito Rd. Lompoc, CA 93436	Surface mine and plant.	Santa Barbara.
Feldspar:			
Owens-Illinois Inc.[6]	Box 249 31302 Ortega Hwy. San Juan Capistrano, CA 92993	Surface mine	Orange.
Gold:			
America Mine Operator[7]	Box A Temecula, CA 92390	Mine	San Bernardino.
Chemgold Inc	Box 2015 Yuma, AZ 85364	do	Imperial.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Iron ore:			
Kaiser Steel Corp	Box 158 Eagle Mountain, CA 92241	Surface mine and plant.	Riverside.
Lime:			
Kaiser Aluminum & Chemical Corp.[8]	Box 1938 Salinas, CA 93901	do	Monterey.
Perlite:			
American Perlite Co	11831 Vose St. North Hollywood, CA 91605	Surface mine and mill.	Los Angeles.
Pumice:			
American Pumice Products Inc	17992 Mitchell, South Irvine, CA 92714	do	Inyo.
Tionesta Aggregates Co	13290 Hodge Dr. Reno, NV 89511	Surface mine	Siskiyou.
Rare earths:			
Molycorp Inc	Union Oil Center 461 South Boylston St. Los Angeles, CA 91017	do	San Bernardino.
Sand (industrial):			
Ottawa Silica Co., Crystal Silica	Box 577 Ottawa, IL 61350	do	San Diego.
Unimin Corp	50 Locust Ave. New Canaan, CT 06840	do	Contra Costa.
Stone:			
Basalt Rock Co. Inc	Box 2540 Napa, CA 94558	Quarries	Marin and Napa.
Gifford-Hill Co. Inc., Riverside Cement Co.[9]	Box L Oro Grande, CA 92368	do	Riverside and San Bernardino.
Granite Rock Co	Box 151 Watsonville, CA 95076	do	Monterey and San Benito.
Koppers Co. Inc., South Coast Asphalt Products Co.	Box 1008 Carlsbad, CA 92008	do	San Diego.
Southwestern Portland Cement Co.[10]	Box 937 Victorville, CA 92392	do	San Bernardino.
Syar Industries Inc	Box 1272 Vallejo, CA 94590	Quarry	Solano.
Talc and pyrophyllite:			
Pfizer Inc.[11]	Drawer AD Victorville, CA 92394	Surface mines and plant.	Inyo.
Western Source Inc	Box 280 San Andreas, CA 95249	Surface mine and mill.	Calaveras.
Tungsten ore and concentrate:			
Teledyne Tungsten	4709 North El Capitan Ave. Suite 109 Fresno, CA 93711	Underground mine and plant.	Madera.
Union Carbide Corp., Metals Div.[12]	Route 2 Bishop, CA 93514	do	Inyo.
Vermiculite (exfoliated):			
W. R. Grace & Co	1114 Avenue of the Americas New York, NY 10036	Plants	Alameda and Orange.

[1]Also lime, potassium salts, sodium carbonate, sodium sulfate, and stone.
[2]Also salt.
[3]Also clays, gypsum, iron ore, and stone.
[4]Also stone.
[5]Also cement, industrial sand, and stone.
[6]Also industrial sand and stone.
[7]Also silver.
[8]Also magnesium compounds.
[9]Also cement, clays, and industrial sand.
[10]Also cement and clays.
[11]Also clays and wollastonite.
[12]Also copper, molybdenum, and silver.

The Mineral Industry of Colorado

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Colorado Geological Survey for collecting information on all nonfuel minerals.

By Karl E. Starch[1] and A. L. Hornbaker[2]

The value of nonfuel minerals produced in Colorado in 1983 was $337.6 million, about 22% less than in 1982. This 3d consecutive year of declining values in nonfuel mineral production in Colorado dropped the State to 22d rank among nonfuel mineral-producing States, down from its more traditional 8th to 10th ranking. Continued softness in demand for molybdenum, the State's principal nonfuel mineral, which resulted in the closing of the State's two large molybdenum mines throughout the year, was the major cause for the decline in nonfuel minerals output. The State ranked first in the Nation in producing carbon dioxide and vanadium, second in molybdenum and tungsten, third in lead, fourth in zinc, fifth in gold, and sixth in silver.

Table 1.—Nonfuel mineral production in Colorado[1]

Mineral	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
Clays thousand short tons	201	$1,124	459	$2,650
Copper (recoverable content of ores, etc.) metric tons	575	r922	W	W
Gem stones	NA	80	NA	80
Gold (recoverable content of ores, etc.) troy ounces	64,584	24,278	63,063	26,739
Gypsum thousand short tons	184	1,571	W	W
Molybdenum thousand pounds	2 39,006	2 159,925	14,244	51,850
Peat thousand short tons	47	275	W	W
Sand and gravel:				
Construction do.	r18,590	r58,465	e21,200	e81,600
Industrial do.	222	3,266	212	3,233
Silver (recoverable content of ores, etc.) thousand troy ounces	1,934	15,378	2,146	24,546
Stone:				
Crushed thousand short tons	e6,900	e27,800	6,790	22,749
Dimension do.	e1	e64	1	86
Combined value of beryllium concentrate (1982), carbon dioxide (1982), cement, iron ore, lead, lime, perlite, pyrites (1982), salt (1982), tin (1982), tungsten ore and concentrate, vanadium, zinc, and values indicated by symbol W	XX	142,049	XX	124,119
Total	XX	r435,197	XX	337,652

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Data differ from those in the Molybdenum and Statistical Summary chapters owing to receipt of later information.

Table 2.—Value of nonfuel mineral production in Colorado, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Adams	(2)	$12,456	Sand and gravel (construction).
Alamosa	W	W	Peat.
Arapahoe	$302	W	Sand and gravel (construction), sand and gravel (industrial).
Archuleta	(2)	--	
Boulder	W	32,825	Cement, sand and gravel (construction), clays, gold, tungsten, silver, peat, copper, lead.
Chaffee	1,345	139	Sand and gravel (construction), peat, lime.
Clear Creek	287,093	75,899	Molybdenum, sand and gravel (construction), gold, silver, lead, copper, zinc.
Conejos	(2)	--	
Costilla	W	(3)	
Crowley	(2)	W	Sand and gravel (construction).
Custer	W	W	Perlite.
Delta	(2)	870	Sand and gravel (construction).
Denver	(2)	W	Do.
Dolores	405	(3)	
Douglas	W	W	Sand and gravel (construction), clays, sand and gravel (industrial).
Eagle	3,423	2,419	Sand and gravel (construction).
Elbert	W	W	Clays.
El Paso	4,052	W	Sand and gravel (construction), sand and gravel (industrial), clays.
Fremont	W	W	Cement, gypsum, sand and gravel (construction), clays, tungsten.
Garfield	(2)	1,513	Sand and gravel (construction).
Gilpin	79	120	Gold, silver, lead, copper.
Grand	(2)	W	Sand and gravel (construction).
Gunnison	(2)	346	Do.
Hinsdale	14	--	
Huerfano	(2)	7	Sand and gravel (construction).
Jackson	--	41	Do.
Jefferson	7,924	7,449	Sand and gravel (construction), clays.
Kit Carson	(2)	137	Sand and gravel (construction).
Lake	399,686	110,656	Molybdenum, zinc, tungsten, gold, lead, silver, tin, pyrites, copper, sand and gravel (construction).
La Plata	(2)	W	Sand and gravel (construction), silver, lead, copper.
Larimer	W	12,321	Cement, sand and gravel (construction), sand and gravel (industrial), lime, gypsum, beryllium.
Las Animas	(2)	--	
Lincoln	(2)	--	
Logan	W	W	Sand and gravel (construction), lime.
Mesa	(2)	W	Vanadium, sand and gravel (construction).
Mineral	15,414	W	Silver, lead, copper, zinc.
Moffat	(2)	W	Sand and gravel (construction), gold.
Montezuma	W	W	Carbon dioxide, sand and gravel (construction).
Montrose	W	16,066	Vanadium, sand and gravel (construction), salt, silver, copper.
Morgan	W	W	Lime, sand and gravel (construction).
Otero	(2)	W	Sand and gravel (construction).
Ouray	1,499	W	Sand and gravel (construction), silver, gold, lead, copper.
Park	1,244	W	Silver, peat, gold, lead, copper.
Phillips	(2)	9	Sand and gravel (construction).
Pitkin	W	W	Iron ore.
Prowers	(2)	590	Sand and gravel (construction).
Pueblo	W	W	Sand and gravel (construction), lime, clays.
Rio Blanco	(2)	W	Sand and gravel (construction).
Rio Grande	(2)	W	Sand and gravel (construction), sand and gravel (industrial).
Routt	275	404	Sand and gravel (construction).
Saguache	--	W	Sand and gravel (construction), vanadium.
San Juan	24,882	25,895	Gold, zinc, lead, silver, copper.
San Miguel	(2)	W	Vanadium, gold, silver.
Sedgwick	W	W	Sand and gravel (construction), lime.
Summit	103	W	Sand and gravel (construction), gold, silver, lead.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Colorado, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Teller	$1,673	$3,303	Gold, peat, sand and gravel (construction), silver, lead.
Washington	(2)	69	Sand and gravel (construction).
Weld	W	W	Sand and gravel (construction), lime.
Undistributed[4]	144,050	103,805	
Sand and gravel (construction)	e73,300	XX	
Stone:			
Crushed	XX	e27,800	
Dimension	XX	e64	
Total[5]	966,766	435,197	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Baca, Bent, Cheyenne, Kiowa, and Yuma. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Colorado business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,617.6	1,657.3	+2.4
Unemployment	do	134.1	100.8	-24.8
Employment (nonagricultural):				
Mining[1]	do	36.8	37.3	+1.4
Manufacturing	do	175.3	183.6	+4.7
Contract construction	do	74.2	78.0	+5.1
Transportation and public utilities	do	83.7	84.6	+1.1
Wholesale and retail trade	do	313.1	325.9	+4.1
Finance, insurance, real estate	do	84.3	86.9	+3.1
Services	do	281.2	294.0	+4.6
Government	do	245.1	239.5	-2.3
Total nonagricultural employment[1]	do	1,293.7	[2]1,329.7	+2.8
Personal income:				
Total	millions	$37,400	$39,492	+5.6
Per capita		$12,202	$12,580	+3.1
Construction activity:				
Number of private and public residential units authorized		31,913	50,515	+58.3
Value of nonresidential construction	millions	$1,225.4	$1,219.1	-.5
Value of State road contract awards	do	$141.0	$137.0	-2.8
Shipments of portland and masonry cement to and within the State	thousand short tons	1,488	1,504	+1.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$435.2	$337.7	-22.4
Value per capita, resident population		$144	$108	-25.0
Value per square mile		$4,197	$3,244	-22.7

pPreliminary.

[1]Includes coal, natural gas, and petroleum.

[2]Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

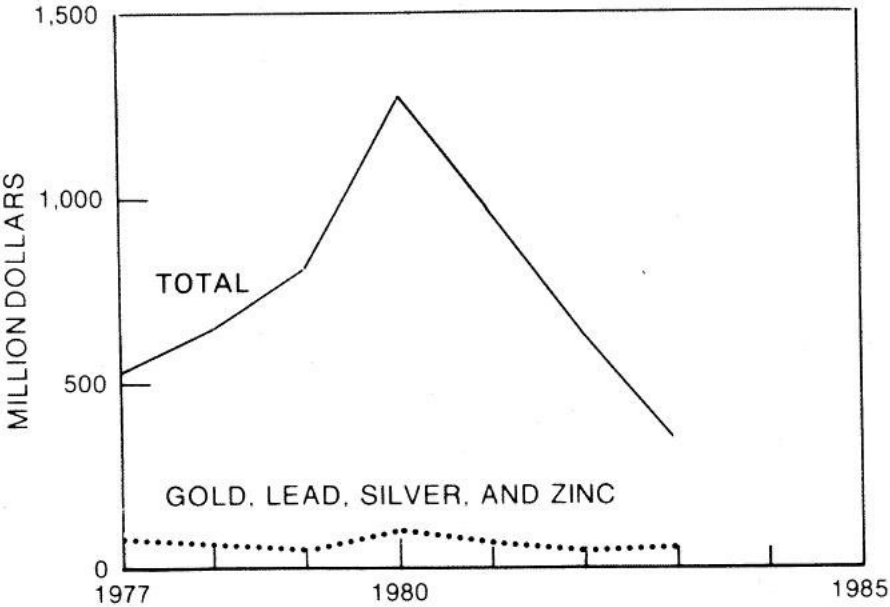

Figure 1.—Value of mine production of gold, lead, silver, and zinc and total value of nonfuel mineral production in Colorado.

Although Colorado's mining industry appeared to hit a post-war low in 1983, some signs of recovery from the recession of the past several years began to show. AMAX Inc.'s two large molybdenum mines, closed the entire year, were scheduled to be reopened early in 1984 as stockpiles were worked down. Standard Metals Corp.'s Sunnyside Mine near Silverton, the State's largest precious-metals mine, returned to full production during the year; Hecla Mining Co.'s Sherman Mine was reopened. ASARCO Incorporated's Leadville Unit, the State's major lead and zinc producer, had a stable, productive year, as did Homestake Mining Co.'s Bulldog Mountain Mine at Creede, the State's largest silver producer. Except for molybdenum, production of most nonfuel mineral commodities remained fairly stable, compared with 1982 levels. Output of construction sand and gravel and clay was up substantially; cement and stone, down slightly. In addition to molybdenum, production of tungsten and vanadium was down substantially, but gold and lead were almost even with that of 1982; and copper, silver, and zinc showed increases.

Employment in Colorado's mining sector remained relatively stable in 1983 after a loss of about 4,600 jobs in 1982. This was in contrast to increases of 14% to 18% in the 8 years preceeding 1982 when mining employment was growing faster than any other employment sector in the State.

Exploration Activities.—Mineral exploration in the State remained high in 1983, with particular interest in precious metals. Exploration occurred in nearly every established mining district. Anaconda Minerals Co. continued exploring for gold on old properties near Summitville and Rico; Sierra Resources completed an agreement with Exxon Corp. to examine its Bessie G Project in La Plata County; Mineral Enterprises Ltd. explored around the Mary Cashen Mine near Cripple Creek; Gold Fields Mining Corp. continued appraising property in the Red Cliff area of Eagle County looking for silver; Tetra Minerals acquired gold and silver claims south of Montrose; Midnight Mining Co. prospected for gold in Gunnison County, as did Independence Mine and Minerals Co. near Matchless Mountain and Bunker and Moore Mining Co. at the Enterprise Mine; LKA International continued appraising the Golden Wonder gold mine near Lake City; Hecla and AMAX launched the Hughesville Project to explore property

in the Barker mining district near Leadville; and Mallon Minerals Corp. was developing a silver project in Summit County. Bear Creek Mining Co., Sierra Resources, and Union Oil Corp.'s Molycorp Inc. explored for molybdenum in Clear Creek and Summit Counties. Z-K Resources Inc. began geological evaluation of a carbon dioxide leasehold in Huerfano County. Pioneer Nuclear Inc. and Minerals Engineering Co. continued a long-term testing program for silver near Creede, and Homestake expanded its silver exploration program in the same area, as did Todilto Exploration and Development Corp.

The U.S. Bureau of Land Management held public hearings on Earth Sciences Inc.'s proposal to develop a possible 1.5-billion-ton alunite (aluminum) deposit near Lake City, believed to be the world's largest known deposit of alunite. Two companies, Natrona Resources Inc. and Industrial Resources Inc., were exploring properties in Rio Blanco County believed to contain several billion tons of nahcolite (sodium) reserves. Cominco American Incorporated and Superior Minerals Co. continued exploring for diamonds in the Colorado-Wyoming State line area. In addition to the foregoing examples of mineral exploration in the State, nearly every other established mining company in Colorado and numerous new companies were conducting exploration and development programs.

Legislation and Government Programs.—Bills of interest to the mining industry the Colorado Legislature passed in the 1983 session included the following:

S.B. 143, effective May 10, 1983, required the State Mine Inspector to check the safety of electrical systems in mines when conducting annual inspections.

S.B. 282, effective June 3, 1983, expanded the State's hazardous waste-disposal act.

H.B. 1048, effective May 20, 1983, authorized the Department of Revenue to grant extensions for filing and paying severance taxes and established penalties for late severance tax payments.

H.B. 1179, effective May 20, 1983, continued the severance tax credit allowed for prior payment of impact-assistance contributions.

H.B. 1449, effective May 25, 1984, specified that the Colorado Mined Land Reclamation Act does not preempt other zoning and land use authority.

H.B. 1572, effective July 1, 1983, authorized the Colorado Geological Survey to collect fees for its services.

Bills introduced but defeated included the following:

S.B. 98, concerning the lapse of a mineral interest where its owner fails to exercise the mineral interest.

S.B. 34, funding the State Division of Mines with severance tax revenues.

H.B. 1136, expanding health department regulation of underground fluid disposal.

An issue that received attention during the session but remained unresolved was how undeveloped mineral reserves should be assessed for taxation. This question was assigned to an interim legislative committee for continuing study. Although shortfalls in State revenues and projected State deficits were major concerns of the 1983 legislature, the traditional issues of increasing severance taxes and tighter mining regulation were not much in evidence.

The Colorado Court of Appeals ruled September 8 that county commissioners in Colorado have the right to ban mining operations in areas designated by a county's master plan as areas of commercial mineral deposits suitable for extraction and that State law does not preempt local land use regulation.

On May 17, conservation groups proposed that another 1.2 million acres of public land in Colorado be placed in the wilderness system, enlarging the current preserve by 45%. The proposal, expected to face an uphill struggle in Congress, would expand 8 existing wilderness areas and create 15 new ones.

Colorado received a record-high $43.6 million as its 50% share of all mineral-leasing rents, royalties, and bonuses collected for mineral activity on Federal lands in the State. Colorado received the fourth highest amount among the 23 States receiving such moneys.

Under title III of Public Law 95-87, the Colorado School of Mines in Golden received $199,000 from the U.S. Bureau of Mines in fiscal year 1983. This program supported a program of graduate studies and research and a cooperative program in mined land reclamation with Colorado State University.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Cadmium.—Asarco recovered cadmium from flue dust, dross, and byproduct materials from out-of-State smelters at its Globe smelter in Denver. The output of these materials was not included in the State mineral production total because the origin of the processed materials could not be determined.

Copper.—Copper, produced in Colorado only as a byproduct of base-metal ores, was the least important of those metals, providing only 1% of the combined value. Copper output in Colorado in 1983 increased over the level produced in 1982. Yet, Colorado was ninth among 12 States that produced copper in 1983. Output was from nine mines located in eight counties in the State. Copper was not a major factor in the economics of any mine. Standard Metals' Sunnyside Mine at Silverton accounted for most of the State's output. Asarco's Leadville Unit (Black Cloud Mine) and Homestake's Bulldog Mountain Mine at Creede accounted for most of the remaining production.

Gold.—Although down very slightly from that of 1982, gold production remained at a relatively high level. Colorado was fifth among 12 gold-producing States in output, but its contribution to the Nation's total was very minor.

Interest and activity in gold mining remained high. In the Cripple Creek-Victor district, Hecla acquired 50% of Texasgulf Inc.'s interest in the joint venture with Golden Cycle Gold Corp. in the Cripple Creek and Victor Gold Mining Co., which controlled much of the original mining property in the area including the Ajax and Cresson Mines and Carlton mill and Carlton Tunnel. Hecla, which became the managing partner, paid $6 million for its share and agreed to conduct additional exploration of the venture's property and increase its production from the current 50 tons to 300 tons per day. Golden Cycle acquired a Cincinnati-based public transit management company and spun off its gold operations into Golden Cycle.

Silver State Mining Corp., Colorado's fastest growing company in 1982, continued its 2,000-ton-per-day vat-leaching operation at its Iron Clad property near Victor. The company explored a new venture through an option on the California Rand Mine property in San Bernardino and Kern Counties, CA.

Gold Ore Ltd. experienced a disappointing year with its Ruby Pad leaching operation and exploration at the Mary Nevin Mine. It shut down its seasonal leaching operation in October, somewhat earlier than usual.

Yellow Gold of Cripple Creek Inc. reopened the Moffat Tunnel in Cripple Creek and completed the first-phase exploration work on the Rittenhouse and Dolly Varden properties.

In the Clear Creek-Central City area, Saratoga Mines Inc. began heap leaching old tailings piles using a U.S. Bureau of Mines leaching process modified by adding cement kiln dust instead of more expensive prepared cement. The company anticipated a production cost of $150 per ounce of gold. Other small companies active in the area included Big Indian Resources Inc., Elk Creek Gold Mining Co., Franklin Consolidated Mining Co., Marquette Minerals Inc., Moritz Mining Co., and Saturn Energy and Resources Ltd.

In the Silverton-San Juan area, Standard Metals' Sunnyside Mine, the Nation's 2d largest underground gold mine and 13th largest overall, had a record-high production. Standard Metals entered into two exploration and option agreements with Noranda Exploration Corp. and Callahan Mining Corp., which control a large block of mining claims adjacent to the Sunnyside Mine. Independently, Standard Metals announced its internal exploration program had found a significant extension of a major vein within the Sunnyside Mine.

Federal Resources Corp. of Salt Lake City agreed to sell the Camp Bird Mine near Ouray to Gila Mines Corp. of Phoenix for $5 million plus a retained royalty.

In the Leadville area, Windsor Resources Inc. of Toronto, Canada, acquired control of the Thomas and Anthony gold-mining property near Leadville.

Power Petroleums Inc., the U.S. subsidiary of North American Power Petroleums Inc., bought a 50% interest in the Hendricks-Cross Mine near Nederland, Boulder County, for $2 million and also bought a 51% interest in the Hendricks Milling Co. In a separate transaction, Power Petroleums bought an option on the adjacent Caribou silver mine, operated by Hendricks Mining Co. Also in Boulder County, Resources International Partners of Englewood transferred its properties at Gold Hill, Sunshine, Ward, and Idaho Springs, plus an option on part of the Jamestown mining district, to Moritz for a controlling interest

in that company. Moritz planned to buy a 40% interest in the Jamestown district for $5 million and develop an integrated mining, milling, and refining operation. Gold Hill Mining Co., owned by the Charles A. Steen family, reopened the Cash Mine, once a major gold and silver producer, near Gold Hill.

Marathon Gold Corp. was granted the necessary permits and began operating its Joker Group property near Craig, Moffat County, in northwestern Colorado. The company and its major stockholders, Centennial Gold Corp. and Hampton Gold Mining Areas PLC, estimated they could recover more than 1 million ounces of gold from material averaging 0.02 to 0.06 ounce of gold per ton on 160 acres of land. In addition to gold, the company's ore was believed to contain significant amounts of recoverable monazite and other rare earths.

In an unusual operation for Colorado, Petroleum Funding Corp. and Colorado Gold Brokerage Inc. began a gold-dredging operation on 34 acres of farmland west of Las Animas in Bent County on what may be an occluded loop of the Arkansas River. Titled the Sand Bar claim, the site's reserves were estimated at about 800,000 tons averaging 0.16 ounce of fine flour gold per ton. Two other placer operations further up on the Arkansas River near Buena Vista, the Becky Ann and the Virginia Lee placer mines, were proposed by U.S. Mining International Inc. of New York and Texas Mining and Exploration Co., respectively.

Other gold-mining operations around the State included the Lake City Mines Inc.'s Golden Wonder Mine near Lake City, GED Interprizes near Naturita, Bunker and Moore Mining's Enterprise Mine near Gunnison, Cobb Resources' London Mine near Alma, and Rado Reef Resources' Emma Mine in the Dolores area.

Gold production was reported from 14 lode mines and 2 placer operations in Colorado in 1983. Gold was the most important product in 10 of these mines, second in 3, and third in 1. Gold accounted for 36% of the value produced from Colorado's complex precious-metal/base-metal ores. Most of the gold production in the State was in San Juan County, followed at considerable distance by Lake and Teller Counties. Standard Metals' Sunnyside Mine at Silverton produced more gold than all the other mines in the State combined. Second largest producer was Asarco's Leadville Unit (Black Cloud Mine), and third was Silver State Mining's Iron Clad Mine at Victor. These three operations produced more than 90% of Colorado's gold output in 1983.

Iron Ore.—Colorado's sole iron mine, Pitkin Iron Corp.'s Cooper Mine near Ashcroft in Pitkin County, did no mining in 1983 because the ironmaking blast furnaces of its primary customer, CF&I Steel Corp. of Pueblo, remained closed. The company did move previously mined ore from the minesite to stockpiles at Woody creek. Pitkin supplied a demand from cement companies for ore from those stockpiles.

Pueblo-based CF&I continued to cut back in size in 1983. The company suffered losses of more than $135 million, with a 36% decline in sales to $231 million in 1983, compared with $363 million in 1982. The work force at CF&I, the country's 12th largest steelmaker, fell from 4,600 early in the year to about 2,200; in the mid-1950's, 8,500 workers were employed at CF&I. In March, the plant's 40-inch mill, 25-inch mill, and punch mill were closed because of a soft market for steel construction beams; in August, the company's bar mill was closed. In December, four blast furnaces, two basic oxygen furnaces, lime kiln, and coke ovens, all idled for 18 months, were "permanently closed" and written off as an $80 million loss. This writeoff meant loss of one system for making steel and permanently cut in half the company's "normal" production capacity to about 1.4 million tons of steel. CF&I had fired up its first blast furnace in 1881. The plant continued to turn out rails, tubular goods, wire products, and "structurals" in a system of electric arc furnaces, continuous casters, and finishing mills using scrap steel as its raw material. Thus, the plant ceased to be an integrated steelmaker, but became a specialty mill. The entire plant was reportedly for sale by the Crane Co., parent company of CF&I.

A new union contract approved in October reduced wages $1.75 per hour and eliminated a number of paid holidays and other benefits. About 3,500 workers were certified under the Trade Act of 1974 to receive an additional 18 weeks of unemployment and free job retraining because foreign imports had affected their jobs.

Table 4.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1981, total	28	1	1,095,082	51,069	$23,473,357	3,008,994	$31,649,710
1982, total	24	4	883,700	64,584	24,277,771	1,934,312	15,377,781
1983:							
Boulder	2	--	89,983	W	W	1,698	19,425
Clear Creek	1	--	3,392	670	284,080	7,567	86,566
Eagle	1	--	W	W	W	W	W
Gilpin	2	--	W	W	W	W	W
La Plata	1	--	W	--	--	W	W
Lake	2	--	W	W	W	W	W
Mineral	1	--	W	--	--	W	W
Park	2	--	W	W	W	W	W
San Juan	1	--	W	W	W	W	W
San Miguel	--	1	--	100	42,400	25	286
Teller	2	--	W	W	W	--	--
Total	15	1	[3]1,017,259	[3]63,063	[3]26,738,712	[3]2,145,616	[3]24,545,846

	Copper		Lead		Zinc		Total[3] value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1981, total	W	W	11,431	$9,206,517	W	W	$81,827,760
1982, total	575	r$922,306	W	W	W	W	r61,016,585
1983:							
Boulder	(4)	186	1	404	--	--	W
Clear Creek	5	7,887	16	7,649	--	--	386,182
Eagle	W	W	W	W	--	--	W
Gilpin	W	W	W	W	--	--	W
La Plata	--	--	W	W	--	--	W
Lake	W	W	W	W	W	W	W
Mineral	W	W	W	W	--	--	W
Park	W	W	W	W	--	--	W
San Juan	W	W	W	W	W	W	W
San Miguel	--	--	--	--	--	--	42,686
Teller	--	--	--	--	--	--	W
Total	W	W	W	W	W	W	W

rRevised. W Withheld to avoid disclosing company proprietary data.
[1]Operations from which gold, silver, copper, or lead were recovered as byproducts from sand and gravel or from tailings are not counted as producing mines.
[2]Does not include gravel washed.
[3]Includes items indicated by symbol W.
[4]Less than 1/2 unit.

Table 5.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Amalgamation	W	W	--	--	--
Cyanidation	W	W	--	--	--
Smelting of concentrates	W	W	W	W	W
Direct smelting of ore	W	W	W	W	--
Total	W	[1]2,145,591	W	W	W
Placer	W	25	--	--	--
Grand total	[1]63,063	[1]2,145,616	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1]Includes items indicated by symbol W.

Table 6.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by class of ore or other source material

Source	Number of mines	Material sold or treated[1] (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Dry gold[2]	8	W	W	W	W	W	W
Gold-silver	1	2,893	65	1,663	(3)	1	--
Silver	5	W	198	W	W	W	W
Lead-zinc	1	W	W	W	W	W	W
Total	15	[4]1,017,259	W	[4]2,145,591	W	W	W
Placer	1	--	W	25	--	--	--
Grand total	16	[4]1,017,259	[4]63,063	[4]2,145,616	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1]Does not include gravel washed.
[2]Includes material that was leached.
[3]Less than 1/2 unit.
[4]Includes items indicated by symbol W.

Lead.—Lead was produced as a byproduct of base and precious metals in Colorado. Although the State ranked third among 12 States producing lead in 1983, its output was unimportant in the national total. Lead produced from 11 mines in 9 counties in Colorado in 1983 was second in importance among products of 2 mines, third in 1, and fourth in 3. It was of major importance to the economic stability of two mines. Lake County was the leading source of lead in Colorado, followed by San Juan and Mineral Counties. Asarco's Leadville Unit was the largest individual producer, with Standard Metals' Sunnyside Mine second, and Homestake's Bulldog Mountain Mine a distant third. These three mines produced nearly 98% of the State's lead in 1983. Lead was fourth in importance of the gold-silver-copper-lead-zinc ore products, contributing 7% of the combined total.

Molybdenum.—No molybdenum ore was mined in Colorado in 1983. All shipments were from existing stockpiles. The 14.2 million pounds of molybdenum shipped in Colorado in 1983 compared with 39 million pounds in 1982, 73.6 million pounds in 1981, and 102.5 million pounds in 1980. This dramatic plunge in output reflected the continuing molybdenum oversupply directly caused by the decline in output of the steel industry, molybdenum's major market; the U.S. steel industry was operating at about 33% capacity in early 1983. Colorado fell from the number one position in molybdenum output, a position it had held for many years, to second among the Nation's six producers. Almost all the mined molybdenum in the United States during 1983 was a coproduct of copper, as was the case in the number one producing State, Arizona. Colorado's share of the Nation's molybdenum shipments fell from about 51% in 1982 to less than 30% in 1983. Molybdenum's share of Colorado's total nonfuel mineral output value, normally about 65%, was slightly more than 37% in 1983. The value of both sand and gravel and cement produced in the State exceeded the value of molybdenum shipped. About 11 million pounds of the molybdenum shipped went to domestic markets; about 3.2 million pounds went to foreign markets. The average value of molybdenum shipped was about $3.64 per pound. The producer's price began the year at about $4.30 to $4.90 per pound, down from over $8.00 in the peak year of 1981, while "traders" prices fell from a high of about $32 in 1981 to about $2.43 in 1983.

Colorado's two large molybdenum mines, AMAX's Climax Mine near Leadville and Henderson Mine near Empire, remained closed throughout 1983. AMAX had begun reducing work forces at both mines in 1982, temporarily shutting down Climax on September 18, 1982, and Henderson on October 2, 1982, expecting to reopen them on April 4, 1983. In January 1983, the company determined that both mines would remain closed indefinitely while excess inventories were worked down.

Peak employment of about 5,000 workers at the two mines declined to about 2,200 at closure. During the shutdown, about 50 hourly workers remained at each site for maintenance work and about 200 management people continued at each site. The company worked out a rotation system permitting as many workers as possible to benefit from the work that was available,

and to requalify for unemployment compensation. Worker benefits were also extended on varying bases into the layoff period. The U.S. Department of Labor rejected claims made on behalf of the 3,900 laid-off employees for additional assistance under the Trade Act of 1974.

With the closure of Climax, unemployment in Leadville, Lake County, rose to nearly 40%, the highest in the State, and revenues declined drastically in counties receiving tax revenues from the Climax and Henderson Mines and from workers in those mines.

Although no ore was produced at the Climax or Henderson Mines in 1983, the two mines still contain significant molybdenum reserves. AMAX estimated the proven and probable ore reserves to be 144 million tons averaging 0.316% molybdenum disulfide in the open pit and 269 million tons averaging 0.307% molybdenum disulfide underground at Climax, and 246 million tons containing 0.376% molybdenum disulfide underground at Henderson. Capital expenditures at Climax were approximately $1 million in 1983, compared with $27 million in 1982; capital expenditures at Henderson were approximately $1.5 million, compared with $20 million in 1982.

AMAX reported that lower molybdenum prices and sales were partly responsible for a $1 billion decline in sales from 1982 to the 1983 total of $2.3 billion. However, the company reported earnings from operations and a positive cash flow in 1983, compared with losses from operations and cash drains in 1982. The net loss on earnings of $489 million compared with a net loss of $390 million in 1982 included a $155 million writeoff of the Mount Emmons Prospect, as the company does not anticipate developing that property in the foreseeable future. AMAX, the U.S. Forest Service, the Colorado Department of Natural Resources, and Gunnison County received a National Environmental Industry award from the President's Council on Environmental Quality for the joint review process used in planning for Mount Emmons development. The loss on molybdenum and other specialty metals decreased 25% from the 1982 loss to $105 million in 1983.

By yearend, stockpiles at both mines had been reduced significantly; and on November 16, AMAX announced that Henderson would be reopened in early January 1984 to meet continuing market demand. About 770 workers were recalled, reporting back to work beginning December 5.

Silver.—Although silver output in Colorado was only moderately higher in 1983 than in 1982, the value of output was considerably higher, reflecting an increase in silver prices. Colorado ranked sixth among the 16 States in which silver was produced in 1983, accounting for nearly 5% of the total.

Colorado's largest silver producer, Homestake's Bulldog Mountain Mine at Creede, reported significant improvement in profits over those of 1982, although on a smaller volume. This improvement resulted from lower operating costs and higher silver prices. Additional stopes were brought into production through use of a new mining method that employed load-haul-dump machines instead of the old labor-intensive slusher system; mine productivity increased 20%. The carbon-in-pulp plant at the mine, closed in July 1982, was reopened. Moderate hiring marked the first expansion in the Bulldog operation since early 1982. A strong ore development was resumed, and high-grade intercepts were encountered. Proven and probable reserves in 1982 were estimated at 751,000 tons at a grade of 16.1 ounces of silver per ton; these reserves were increased to 1,267,000 tons in 1983, with a slight decrease in average estimated silver grade. Discovery of a new vein system designated the "R-Z" vein was primarily responsible for this increase in estimated reserves.

In January, Hecla reopened the Sherman Mine near Leadville, which it operates in an agreement with the Leadville Corp.; the mine had been closed since January 1982. About 70 workers were rehired. Higher silver prices made it economic to reopen the mine. Mine output of 120 tons per day was hauled to the millsite by truck. The mill operated at about 300 tons per day using both newly mined ore and ore from a large stockpile of previously mined ore. Ore mined averaged about 15 ounces of silver per ton and about 0.5% lead as a byproduct.

Asarco, which operated the Black Cloud Mine near Leadville, recovered from its worst year ever, 1982. Estimated mineral reserves at the Leadville Unit were 1.6 million tons of ore containing 2.66 ounces of silver per ton, 0.21% copper, 4.23% lead, and 9.22% zinc.

Windsor Resources, a Canadian oil and gas company, acquired two silver properties in the Leadville area: a 97% working interest in the St. Kevin-Independent property (274 acres) with silver values of 30 to 50

ounces per ton, and the Cashier Mine where exploratory work indicated about 46 ounces of silver per ton.

Silver State Mining of Victor took an option to buy the California Rand Mine in California, the largest silver producer in the United States for several years during the 1920's, but did not exercise the option before it expired. The company delineated additional reserves at its Alma property, averaging about 13 ounces of silver per ton.

Minerals Engineering continued evaluating its holdings at Creede. Pioneer Nuclear did not exercise its option to enter a development and operating agreement with Minerals Engineering on the Amethyst Vein in Creede, but continued to work with Minerals Engineering on another project.

Apache Energy and Minerals Co. continued planning to develop the Continental Chief Mine and Norsigo mill in Leadville. The Leadville City Council approved a $3 million industrial bond issue for the project.

The Leadville Research and Development Corp. began operating its custom mill at Leadville on a trial basis.

Ranchers Exploration and Development Corp. continued development work at its Revenue-Virginius silver property near Ouray, expecting to begin production in 1984.

North American Power of Canada purchased 100% of the high-grade Caribou silver mine near Nederland for $3 million. Historical records and recent exploration show high-grade assays from the Caribou up to 271 ounces of silver per ton. Power Petroleums also purchased an interest in the adjacent Hendricks-Cross Mine and Hendricks Milling. Hendricks Mining will manage development of the mines. Silver was produced at 13 mines and 2 placer operations in 9 counties in 1983. Silver was the most important product in five of these mines, second in one, and third in two. The Bulldog Mountain Mine, owned and operated by Homestake in Mineral County, produced more than one-half of Colorado's silver in 1983. The Asarco Leadville Unit and Standard Metals' Sunnyside Mine at Silverton were the other significant producers. Contributing 33% of the combined gold-silver-copper-lead-zinc values, silver was second in importance of metals produced from Colorado's complex ores.

Tin.—No tin was produced in Colorado in 1983. The ore at AMAX's Climax Mine near Leadville contains about 0.002% tin, and tin is produced as a byproduct of molybdenum at that mine. In recent years, only Colorado and Alaska have been indigenous tin sources. The Climax Mine was closed the entire year of 1983 because of depressed molybdenum demand, and consequently, there was no tin production from that mine.

Tungsten.—Colorado was second among the three tungsten-producing States in 1983, accounting for an insignificant portion of the Nation's total. Tungsten is produced as a byproduct of molybdenum at AMAX's Climax Mine in Lake County where about 0.15 pound of tungsten is recovered from each ton of ore processed. Both molybdenum and tungsten suffered from weak market conditions. The Climax Mine was closed the entire year in 1983. The greatly reduced tungsten shipments during the year were from stockpiled material. Tungsten prices declined 26% compared with 1982 prices.

Vanadium.—Colorado remained first among the three States in which vanadium production was reported. Vanadium production was relatively small because of reduced demand for vanadium, used primarily as an alloying agent for steel, and reduced demand for uranium, traditionally produced in Colorado from the same ore as a coproduct with vanadium.

Union Carbide Corp.'s vanadium-uranium mill at Uravan, one of two mills that have produced vanadium in Colorado in recent years, was reopened in May 1983 to produce uranium-vanadium for existing orders; the mill had been closed since March 1982 and was closed again at the end of October 1983. About 80 employees were laid off and 60 retained for maintenance work. Union Carbide's vanadium-finishing mill at Rifle was closed in December 1982, reopened in conjunction with the company's Uravan mill in May 1983, and closed down again in November. Seventeen of the plant's thirty-four workers remained at the mill to provide maintenance. Union Carbide and the State Department of Health continued to work out terms of a new operating license for the Uravan mill, but the license had not been granted by yearend.

The vanadium circuit at Cotter Corp.'s Canon City uranium-vanadium mill was closed throughout the year. Some vanadium was shipped from stockpiles at the mill.

Zinc.—The most important of the base metals produced from Colorado's complex ores was zinc. Fourth among the nine States producing zinc in 1983, Colorado yielded a minor portion of the total, however.

New Jersey Zinc Co. sold its Eagle Mine at Gilman to a Canon City businessman. Operations at the Eagle Mine, once the world's largest zinc producer, were reduced in 1977 and ceased in 1981. The new owner and the Eagle County Commissioners agreed that, because the mine had never been completely shut down, a new operations permit was not required. The new owner planned to use tailings material containing copper, iron, manganese, sulfur, and zinc for producing fertilizer.

Zinc was produced at three mines in two counties during the year. The largest producer was Asarco's Leadville Unit (Black Cloud Mine) in Lake County; zinc was the most important product of that mine. The second largest producer was Standard Metals' Sunnyside Mine in San Juan County; zinc was the second most important product at that mine. Only one other mine reported zinc output in 1983, Hecla's Sherman Mine, also in Lake County, and it was a small producer. Zinc was third behind gold and silver in value produced from Colorado's gold-silver-copper-lead-zinc ores, with 21% of the total.

NONMETALS

Carbon Dioxide.—Colorado completely dominated the output total of the three States reporting carbon dioxide production in 1983. Major production in the State was from two areas, the McElmo Dome and Doe Canyon areas in southwestern Colorado where carbon dioxide reserves estimated at 8 to 9 trillion cubic feet were being developed by a joint venture of Shell Oil Co. and Mobil Oil Corp., and at Sheep Mountain in southeastern Colorado by a joint venture of ARCO Oil and Gas Co. and Exxon. In December, Shell announced that it had begun filling the Cortez Pipeline, a 30-inch-diameter, 500-mile line built to transport carbon dioxide from southwestern Colorado to aging oilfields in west Texas and southeast New Mexico. Filling the pipeline was to take about 4 months and then would carry 25 million to 30 million cubic feet of carbon dioxide per day to the Wasson Oilfield near Midland, TX, where it would be sold for about $1 per thousand cubic feet. Shell hoped to recover an additional 280 million barrels of oil from the Denver unit of the Wasson Field, extending the life of the field by 30 years. Texas' use of carbon dioxide was expected to enhance oil recovery in west Texas and New Mexico by more than 2 billion barrels. The Cortez Pipeline, operated by Shell Pipe Line Corp., was jointly owned by Shell, Mobil, and Continental Resources.

The U.S. Bureau of Land Management began hearings in December on a proposed Rangely Carbon Dioxide Pipeline, a 16-inch-diameter, 180-mile pipeline proposed to carry carbon dioxide from Exxon's planned Shute Creek natural gas treatment plant near Opal, WY, to Chevron's Rangely Unit Oilfield near Rangely. Liquid Carbonic Corp. of Chicago, a subsidiary of Houston Natural Gas Corp., announced plans to build a 300-ton-per-day carbon dioxide plant near Walden, to refine carbon dioxide for carbonation of beverages and for chilling and freezing meat, poultry, and other food products in the Rocky Mountain marketing area. The plant would use carbon dioxide from wells Conoco Inc. owned.

Cement.—Only two of Colorado's three cement plants operated in 1983—Ideal Basic Industries Inc.'s Portland plant in Fremont County, and Martin Marietta Corp.'s Lyons plant in Boulder County. Ideal's Boettcher plant in Larimer County, shut down in October 1982 because of a continuing construction recession, remained closed throughout 1983. Cement shipments were made from existing stocks at the Boettcher plant. Only the Portland and the Lyons plants produced and shipped masonry cement, a very small portion of the total. All three shipped portland cement. Types I and II, moderate-heat-resistant-type cement, comprised more than 95% of total shipments. Ready-mix companies purchased more than three-fourths of the finished portland cement. Concrete product manufacturers, building material dealers, highway contractors, and other contractors purchased the rest. More than 95% of the portland cement output was shipped in bulk form directly to consumers. Most of that amount was shipped by truck. Ideal's Portland plant, with three kilns and a productive capacity of about 885,000 tons annually, was the State's largest cement producer. Ideal's Boettcher plant and Martin Marietta's Lyons plants, with one kiln each, had productive capacities of about 460,000 tons and 430,000 tons, respectively. Natural gas was the principal fuel used in kiln operation.

Martin Marietta sold most of its cement operations nationwide during the year. The Lyons plant was also for sale, but had not been sold by yearend. Ideal had a discourag-

ing year with a net loss of $28.7 million and also sold several cement plants outside of Colorado. The company reduced its debt through the sale of a new stock issue.

Overall, cement shipments in the State were down less than 8% in 1983. Of 40 States reporting production of cement in 1983, Colorado was 17th in output.

Clays.—Output of clay in Colorado in 1983 was more than double that of 1982. About 97% of the product was common clay, with a small amount of fire clay produced in El Paso and Pueblo Counties and bentonite in Fremont County. Altogether, 13 companies produced clay at 45 operations in 7 counties in the State; all but two were Front Range counties associated with major metropolitan areas, and production was related to building construction in those areas. Manufacture of bricks consumed almost 97% of the clay produced in the State; most of the balance went into fire bricks, and such uses as animal feed, drill mud, waterproof seals, and flower pots accounted for the small amount remaining.

Jefferson County was the major source of clay, followed by Boulder and Douglas Counties. These counties accounted for 70% of the total output. Other counties producing clay were Elbert, El Paso, Fremont, and Pueblo. The average value was $4.92 per ton with prices ranging from $4 to $7 for common clay to about $20 for swelling bentonite clay.

Robinson Brick & Tile Co., operating in four counties, was by far the largest individual clay producer. Lakewood Brick and Tile Co., operating in two counties, was second largest. These two produced most of the clay in the State.

Table 7.—Colorado: Clays sold or used by producers, by county

County	1982		1983	
	Quantity (short tons)	Value	Quantity (short tons)	Value
Boulder and Douglas	53,284	$312,499	152,914	$932,968
Elbert, El Paso, Fremont	37,838	264,955	106,120	735,261
Jefferson	94,279	477,521	169,859	836,480
Pueblo	15,989	68,929	30,324	144,812
Total	201,390	1,123,904	459,217	2,649,521

Gem Stones.—Colorado produced about 1% of the value of gem stones in the Nation in 1983. Turquoise was produced on a small scale in Conejos County. Cominco and Superior Minerals continued to test the commercial potential of diamonds from kimberlite in the Colorado-Wyoming State line area.

Gypsum.—Crude gypsum was produced by one company in Fremont County and one company in Larimer County. Genstar Building Materials Co. of Florence, Fremont County, was the larger producer of crude gypsum and the only source of calcined gypsum in the State. The quantity of gypsum produced increased substantially over that of 1982.

Lime.—Two companies operating in six counties reported producing quicklime: Calco Inc. in Chaffee County, and The Great Western Sugar Co. for use in processing sugar beets into sugar at its plants in Larimer, Logan, Morgan, Sedgwick, and Weld Counties.

Peat.—Five companies produced peat in five counties, Alamosa, Boulder, Chaffee, Park, and Teller. Universal Peat Co. in Park County and Hyponex Corp. in Teller County produced most of the peat in the State. Colorado ranked fifth among the 22 States reporting peat production.

Perlite.—Persolite Products Inc. reported crude perlite production from its Rosita Mine in Custer County. Mine output was shipped to Persolite's expanding plant in Florence, 36 miles away. A second perlite-expanding plant, operated by Grefco Inc. at Antonito, treated crude perlite from No Agua, NM, several miles to the south. Most of the Grefco plant output, much the larger of the two, was used as filter aid. Other uses of output were as cavity-fill insulation, concrete aggregate, fillers, horticultural aggregate, low-temperature insulation, and plaster aggregate. Output in 1983 was about the same as that of 1982.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before

yearend. Estimates for 1983 indicate a substantial increase in production over that of 1982.

Industrial.—Industrial sand, only about 1% of total sand and gravel output, was produced by four companies from six sites in Arapahoe, Douglas, El Paso, and Larimer Counties. Major producers were Colorado Lein Co. and Colorado Silica Sand Inc. More than three-fourths of the State's industrial sand production was produced in Larimer and El Paso Counties. The value per ton of industrial sand was about $15.25, compared with $3.85 for construction sand and gravel.

Table 8.—Colorado: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	NA	NA	NA
Gravel	NA	NA	NA	NA	NA	NA
Sand and gravel (unprocessed)	NA	NA	NA	NA	NA	NA
Total or average	r18,590	r$58,465	r$3.14	e21,200	e$81,600	e$3.85
Industrial:						
Sand	W	W	14.84	212	3,233	15.25
Gravel	W	W	9.00	--	--	--
Total or average	222	3,266	14.71	212	3,233	15.25
Grand total or average	r18,812	r61,731	r3.28	e21,412	e84,833	e3.96

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

The quantity of stone produced in Colorado in 1983 was slightly less than in 1981, the last year stone was canvassed. All but an insignificant amount was crushed stone. Twenty-five companies produced crushed stone at 29 quarries in 11 counties. Five companies produced dimension stone at six quarries in two counties. More than 50% of the crushed stone produced was from granite and about 40% from limestone. The major uses of limestone were for manufacturing lime and cement. Crushed granite was used for dense-graded road base, concrete aggregate, and bituminous aggregate. Other uses included fine aggregate, riprap, filter stone, and railroad ballast. Three top-ranking counties accounted for nearly 90% of total State output. Jefferson County was the main source of crushed stone with Fremont County a close second and Boulder County a more distant third. The entire output was marketed by truck.

Ideal was the largest individual producer of crushed stone. The Cooley Gravel Co., a subsidiary of J. L. Shiely Co.; Asphalt Paving Co.; and Martin Marietta were also major producers. The 4 largest companies produced 67% of the total; the 10 largest companies, 92% of the total. The 17 operations of 100,000-ton-size or smaller accounted for less than 8% of total output; the 9 operations producing 100,000 to 500,000 short tons each were responsible for more than 40% of the total; and the 2 operations that each produced 1 million tons or more also contributed more than 40% of the total. The crushed stone value averaged $3.35 per ton, ranging from $1.88 per ton for stone used for lime manufacture to $28.00 per ton for stone used for mine dusting.

Public opposition continued to be a major obstacle to developing new stone quarries.

Dimension stone, constituting a very small portion of total stone output in Colorado, was produced by five companies at one site in Douglas County and five sites in Larimer County. Sandstone was the major type of stone quarried, followed by granite. All was produced in small operations. All the granite quarried was for monument use; sandstone was used mainly for house veneer and flagstone.

Table 9.—Colorado: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	335	2,358
Coarse aggregate, graded:		
Concrete aggregate, coarse	652	2,998
Railroad ballast	143	642
Coarse and fine aggregate:		
Graded road base or subbase	1,039	2,898
Unpaved road surfacing	52	100
Terrazzo and exposed aggregate	38	355
Special: Other[2]	4,530	13,398
Total	[3]6,790	22,749

[1]Includes limestone, granite, sandstone, traprock, volcanic cinder and scoria, and miscellaneous stone.
[2]Includes filter stone, bituminous aggregate (coarse), bituminous surface treatment aggregate, fine aggregate (-3/8 inch), crusher run or fill or waste, chemical and metallurgical uses, mine dusting or acid water treatment, roofing granules, and uses not specified.
[3]Data do not add to total shown because of independent rounding.

Sulfur (Recovered).—Continental Oil Co. recovered elemental sulfur from acid gases at its petroleum refinery in Adams County near Denver. Elemental sulfur is not included in table 1 because it is considered a byproduct.

Vermiculite (Exfoliated).—W. R. Grace & Co. exfoliated beneficiated vermiculite from Montana at its Denver plant. More than one-third of the product was used in fireproofing, a roughly similar amount in block insulation, and the balance in concrete aggregate, plaster aggregate, loose-fill insulation, and horticultural and/or agricultural uses.

[1]State Liaison Officer, Bureau of Mines, Denver, CO.
[2]Geologist, Colorado Geological Survey, Denver, CO.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ideal Basic Industries Inc.[1]	Box 8789 750 17th St. Denver, CO 80201	Plants	Fremont and Larimer.
Martin Marietta Corp.[1]	Box 529 Lyons, CO 80540	Plant	Boulder.
Clays:			
Lakewood Brick and Tile Co	1325 Jay St. Lakewood, CO 80214	Mines	Jefferson.
Robinson Brick & Tile Co	Box 5243 Denver, CO 80217	----do	Douglas, Elbert, El Paso, Jefferson.
Gold:			
Silver State Mining Corp.[2]	Box 127 Victor, CO 80860	Mine and mill	Teller.
Standard Metals Corp.[3]	Box 247 Silverton, CO 81433	----do	San Juan.
Gypsum:			
Genstar Building Materials Co	1153 State Hwy. 120 Florence, CO 81226	Mine and plant	Fremont.
Iron ore:			
Pitkin Iron Corp	105 West Adams St. Chicago, IL 60603	Mine	Pitkin.
Lead:			
ASARCO Incorporated[4]	Box 936 Leadville, CO 80461	Mine and mill	Lake.
Lime:			
The Great Western Sugar Co	1530 16th St. Denver, CO 80217	Plants	Larimer, Logan, Morgan, Sedgwick, Weld.
Molybdenum:			
AMAX Inc.[5]	13949 West Colfax Ave. Golden, CO 80401	Mines and mill	Clear Creek and Lake.
Peat:			
Universal Peat Co	1557 South Ingalls St. Lakewood, CO 80422	Bog	Park.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Perlite:			
Grefco Inc	Box 308 Antonito, CO 81120	Plant	Conejos.
Persolite Products Inc	Box 105 Florence, CO 81226	Mine and plant	Custer and Fremont.
Silver:			
Hecla Mining Co.[6]	Box D Leadville, CO 80461	Mine and mill	Lake.
Homestake Mining Co.[7]	Box 98 Creede, CO 81130	----do	Mineral.
Stone:			
Asphalt Paving Co	14802 West 44th Ave. Golden, CO 80401	Quarries	Jefferson.
Cooley Gravel Co	Box 5485 Denver, CO 80217	Quarry	Do.
Mobile Pre-Mix Concrete Inc	Box 5183 T.A. Denver, CO 80217	----do	Do.
Snider's Aggregate Inc	Box 1241 Canon City, CO 81212	----do	Fremont.
Vanadium:			
Cotter Corp	Box 352 Golden, CO 80401	Mine and mill	Fremont and Jefferson.
Union Carbide Corp	270 Park Ave. New York, NY 10017	Mines and mills	Garfield, Mesa, Montrose, San Miguel.

[1]Also stone.
[2]Also silver.
[3]Also zinc, lead, silver, and copper.
[4]Also zinc, gold, silver, and copper.
[5]Also pyrites, tin, and tungsten.
[6]Also lead, gold, zinc, and copper.
[7]Also lead, zinc, and copper.

The Mineral Industry of Connecticut

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the State Geological and Natural History Survey of Connecticut, Department of Environmental Protection, for collecting information on all nonfuel minerals.

By L. J. Prosser, Jr.[1]

The value of nonfuel mineral production in Connecticut in 1983 was $71.2 million, an increase of $15.3 million compared with that of 1982, and the first increase in value after 3 consecutive years of decline. The total value of mineral production in Connecticut in 1983 surpassed the 1979 record high of $69.2 million. Crushed stone was the leading commodity in sales, accounting for about 64% of total value. Other commodities produced were clays, feldspar, lime, mica, construction sand and gravel, industrial sand, and dimension stone.

The State ranked second nationally in feldspar production and fifth in mica. In the six-State New England region, Connecticut accounted for about 27% of the total value of mineral production and ranked second in output of construction sand and gravel, crushed stone, and clays. The State's only lime manufacturing plant, and one of only three in New England, was permanently closed during the year.

Table 1.—Nonfuel mineral production in Connecticut[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	56	$329	86	$515
Lime	do.	8	568	5	400
Sand and gravel:					
Construction	do.	r4,887	r16,237	e5,000	e17,900
Industrial	do.	80	1,746	W	W
Stone:					
Crushed	do.	e6,100	e32,700	7,692	45,890
Dimension	do.	e20	e1,046	18	1,028
Combined value of feldspar, gem stones, mica (scrap), and value indicated by symbol W		XX	3,299	XX	5,480
Total		XX	r55,925	XX	71,213

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Connecticut, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Fairfield	(2)	$1,003	Sand and gravel (construction).
Hartford	W	W	Sand and gravel (construction), clays.
Litchfield	W	2,788	Sand and gravel (construction), lime.
Middlesex	W	5,117	Feldspar, sand and gravel (construction), sand and gravel (industrial), mica, clays.
New Haven	W	2,479	Sand and gravel (construction), sand and gravel (industrial).
New London	W	W	Do.
Tolland	W	2,058	Sand and gravel (construction).
Windham	W	1,333	Do.
Undistributed[3]	$43,221	7,402	
Sand and gravel (construction)	e15,400	XX	
Stone:			
Crushed	XX	e32,700	
Dimension	XX	e1,046	
Total	58,621	4$55,925	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Connecticut business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,575.7	1,594.0	+1.2
Unemployment	do	120.3	84.2	-30.0
Employment (nonagricultural):				
Mining	do	1.4	1.3	-7.1
Manufacturing	do	400.6	410.3	+2.4
Contract construction	do	43.6	48.9	+12.2
Transportation and public utilities	do	61.1	62.2	+1.8
Wholesale and retail trade	do	294.4	308.4	+4.8
Finance, insurance, real estate	do	114.3	119.7	+4.7
Services	do	298.4	314.3	+5.3
Government	do	185.2	181.6	-1.9
Total nonagricultural employment	do	1,399.0	1,446.7	+3.4
Personal income:				
Total	millions	$43,366	$46,518	+7.3
Per capita		$13,810	$14,826	+7.4
Construction activity:				
Number of private and public residential units authorized		10,330	15,422	+49.3
Value of nonresidential construction	millions	$613.6	$640.3	+4.4
Value of State road contract awards	do	$67.1	$149.4	+122.6
Shipments of portland and masonry cement to and within the State	thousand short tons	624	641	+2.7
Nonfuel mineral production value:				
Total crude mineral value	millions	$55.9	$71.2	+27.4
Value per capita, resident population		$18	$23	+27.8
Value per square mile		$11,195	$14,192	+26.8

pPreliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Trends and Developments.—The State's major mineral commodities, construction sand and gravel and crushed stone, annually account for nearly 90% of the total value of production. In 1983, these commodities were extracted at about 100 of the 115 mining operations in Connecticut. Output of these commodities increased in 1983 after declining each year since 1979. The past 5 years' production totals are listed below in thousand short tons:

Commodity	1979	1980	1981	1982	1983
Sand and gravel (construction)	9,990	7,103	e6,500	4,887	e5,000
Stone (crushed)	8,271	7,977	6,837	e6,100	7,692
Total	18,261	15,080	13,337	10,987	12,692

eEstimated.

The increased production of sand and gravel and crushed stone reflected the increased demand for road construction aggregate and improved conditions in the State's housing industry. Demand for construction aggregate was expected to continue to increase as a result of passage of the Surface Transportation Assistance Act of 1982. The 4-year program authorized $57 billion in funding nationally, of which Connecticut's apportionment for 1983 was about $48 million.[2]

Connecticut's brass mill industry continued to decline in 1983. Employment in the brass industry dropped from 7,900 of the State's 414,000 manufacturing workers in 1973 to 3,700 of the 402,100 manufacturing employees in 1983. In 1947, 29,600 of the State's 426,800 manufacturing workers were employed in the brass industry.[3] Slow economic recovery in the United States and competition from abroad continued to shrink the industry's market. Substitution of aluminum, plastic, and steel for copper and brass mill products also has increased. The replacement of copper by aluminum in the transmission of electricity has somewhat reduced the market for copper products.

As a result of the declining market, segments of Connecticut's brass mill industry continued to restructure, in particular, seeking an increased share of the specialty alloy strip market. Plume & Atwood Brass Mill developed the flexibility to adjust to increased demand from the electronics industry when demand is depressed from the housing and automotive industries. Demand for phosphor-bronze and nickel-silver, two alloys used mainly by the electronics industry, remained relatively strong during the 1981-82 recession and increased in 1983. Century Brass Products Inc., Waterbury, invested $2 million to increase specialty strip production capacity, purchasing a $1.2 million continuous-casting machine from Technica Cuss of the Federal Republic of Germany. Two other casters were also upgraded for manufacture of phosphor-bronze, tin-bronze, copper-nickel, nickel-silver, and leaded-bronze, primarily for use in the electronics industry.

Also during the year, Bridgeport Brass Co. closed its Norwalk plant. Accurate Forgings Inc., Bristol, a producer of brass, aluminum, and copper forgings, purchased the equipment for an undisclosed price.

Developments in Connecticut manufacturing and mineral processing industries in 1983 included an announcement by Pfizer Inc. at its Wallingford operation of new technology involving the injection of calcium metal in the steelmaking process. Pfizer, the Nation's only producer of calcium metal, claimed the process improves the purity of steel by reducing the amount of contaminants such as sulfur and phosphorus in ferrous metals.

Dexter Corp., Windsor Locks, formed a joint venture with Courtaulds Ltd., United Kingdom, to construct a new 165-ton-per-year capacity aerospace-grade graphite fiber plant in the United States in late 1984. The joint venture, named Hysol Grafil, was expected to become the world's first vertically integrated producer of graphite fiber composites capable of manufacturing fiber, resin, and composites to specific customer needs.

Legislation and Government Programs.—During 1983, the Connecticut General Assembly enacted legislation that provides for 90 days of continued insurance coverage for workers displaced by out-of-State relocations or plant closings. The coverage will be at the employer's expense. The act also provides, under the Urban Job Act, for assistance to municipalities affected by plant closings.

Initially, the legislation included a provision requiring companies employing 50 or more workers to provide a minimum of 1 year's public notice prior to relocation of an operation outside of Connecticut. The enacted legislation deleted the advance notification provision of the original bill.

Also enacted in 1983 was legislation es-

tablishing the Connecticut Hazardous Waste Management Service. The new agency's responsibilities include preparation of an assessment of the State's toxic waste sources and locations, development of a management plan for disposal of hazardous wastes generated in Connecticut, and determination of potential sites for hazardous waste management facilities. If after January 1, 1986, the Service determines that private waste facilities are inadequate to meet the State's needs, the agency will be authorized to acquire sites for hazardous waste facilities. Following acquisition, the Service would plan, design, construct, finance, manage, own, and operate the facilities. In addition, the General Assembly passed legislation requiring the State to develop regulations classifying toxic wastes by degree of hazard for management purposes.

Other legislation that broadly affected segments of the State's varied industries is described in capsule summary form in the Classified Index of Legislation Enacted by the 1983 General Assembly. The index lists measures by bill number and includes amendments to existing statutes.[4]

The Natural Resources Center and Geological and Natural History Survey continued programs on collecting, interpreting, and disseminating information on Connecticut's natural resources. During the year, the Connecticut Survey's activities included work on development of a statewide geographic information system for base mapping, drainage basins, soils, and land use.

The Connecticut Survey continued bedrock and surficial mapping programs in cooperation with the U.S. Geological Survey. The bedrock geology map of the State is scheduled for publication in 1984. Agreements with the Minerals Management Service and Nuclear Regulatory Commission were completed for vibracoring in Long Island Sound and for deep bedrock drilling in the Moodus area. The Layman's Guide to the Geology of Connecticut, which explains geology to the general public, was completed and is scheduled for publication in 1984.

Mineral Systems Inc., Stamford, through a U.S. Bureau of Mines contract, completed a study on assessing the expected direction and extent of technological change in the copper industry for the next 25 years. Potential new technologies were comprehensively evaluated in copper production: exploration, mining, beneficiation, smelting, refining, and recycling.[5]

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—Output of clay increased 30,000 short tons in 1983 compared with that of 1982. From 1979 to 1982, clay production in Connecticut declined 50%, dropping to a record low of 56,000 tons in 1982. The rebound in 1983 reflected improved conditions in the construction industry, particularly in housing. The number of housing starts in Connecticut increased to 15,400 in 1983 compared with 10,300 in 1982.

The State's two producers, K-F Brick Co., Hartford County, and The Michael Kane Brick Co., Middlesex County, mined common clay for brick manufacture. All the brick was shipped by truck primarily to New England, New York, and New Jersey.

In December, K-F Brick began using a 75% coal-25% natural gas mixture for kiln fuel upon receiving approval from the State's Department of Environmental Protection. The conversion lowered the company's fuel costs in brick manufacturing.

Feldspar.—In 1983, Connecticut ranked second nationally in feldspar production; North Carolina ranked first, accounting for about 72% of the total U.S. output of 710,000 short tons. The Feldspar Corp. operated two open pit mines in Middlesex County. The crude ore was ground and concentrated at the company's Middletown plant. The feldspar was shipped by truck to markets in New England, New York, and New Jersey for use as a flux in glassmaking and ceramics.

Gem Stones.—Individual collectors and mineral clubs recovered mineral specimens from quarries and mine dumps primarily in the central part of the State. Estimated value of gem stones collected in Connecticut in 1983 was about $2,000.

Lime.—Pfizer Inc., the only lime manufacturing operation in Connecticut, permanently ceased production at its Canaan plant in November. Output for the year was 5,400 short tons; in 1979, 33,000 tons of lime was manufactured in the State. With the closure, only two lime operations, both in Massachusetts, remained active in the six-State New England region. Pfizer continued to mine limestone at the quarry in Canaan

for use as whiting and filler.

The firm also produced calcium metal at a plant in Canaan. The operation is the only one in the Nation that produced calcium metal.

Mica.—The Feldspar Corp. produced crude mica as a byproduct of feldspar mining operations in Middlesex County. Output remained about the same as that of 1982. The mica was recovered by flotation and sold as a filler and as an additive in well-drilling muds.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Table 4.—Connecticut: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	NA	NA	NA
Gravel	NA	NA	NA	NA	NA	NA
Sand and gravel (unprocessed)	NA	NA	NA	NA	NA	NA
Total or average	r4,887	r$16,237	r$3.32	e5,000	e$17,900	e$3.58
Industrial sand	80	1,746	21.84	W	W	33.58
Grand total or average	r4,967	r17,983	r3.62	W	W	e3.98

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data.

Production increased in 1983 for the first time in 5 years although only slightly above the 1982 level. Since 1979, output has dropped from about 10 million short tons to 5 million tons in 1983. The value per ton of construction sand and gravel has increased in Connecticut from $2.36 in 1979 to $3.58 in 1983; nationally, prices increased from $2.27 in 1979 to $2.95 in 1983. Since 1980, the number of active sand and gravel operations in Connecticut has decreased from 124 to about 90. Sand and gravel was mined in all eight counties in the State, with Hartford, New Haven, and Tolland leading in output.

Construction aggregate availability studies by the State's Department of Transportation provide preliminary estimates of the location and volume of sand and gravel in the State. Reference copies of the studies are available at the Natural Resource Center in Hartford.[6]

Industrial.—Two companies, The Feldspar Corp., Middlesex County, and Ottawa Silica Co., New London County, produced industrial sand in Connecticut in 1983.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Connecticut's crushed stone industry accounted for nearly two-thirds of the total value of mineral production in the State in 1983. The value of crushed stone production increased $13.2 million to a record high of $45.9 million. Output increased 1.6 million short tons to 7.7 million tons but was 2 million tons below the record high of 9.7 million tons reported in 1973. The difference in unit price for crushed stone in the last decade reflects the increased value in 1983. In 1973, the unit price of stone was $2.20 per ton; in 1983, the value was $5.97 per ton.

Four counties reported crushed stone production in Connecticut in 1983. New Haven County output was 4.8 million tons, about 62% of the State total. Traprock was mined in all four counties; limestone only in Litchfield County. Of the 16 quarries operating in Connecticut, 13 were traprock and 3 limestone. Traprock output totaled 7.4 million tons; limestone, 300,000 tons. Connecticut ranked fifth nationally in traprock production accounting for about 10% of the U.S. total. Tilcon Inc., the leading domestic producer of traprock, operated five quarries in the State.

Table 5.—Connecticut: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate, graded:		
Concrete aggregate, coarse	345	1,494
Bituminous aggregate, coarse	469	2,004
Coarse and fine aggregate: Terrazzo and exposed aggregate	1	W
Agricultural: Agricultural limestone	25	W
Chemical and metallurgical: Flux stone	1	W
Special: Other[2]	6,850	42,392
Total	[3]7,692	45,890

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."

[1]Includes limestone and traprock.

[2]Includes macadam, graded road base or subbase, bituminous surface treatment aggregate, unpaved road surfacing, riprap and jetty stone, cement manufacture, lime manufacture, whiting or whiting substitute, other fillers or extenders, crusher run (select material or fill), coarse aggregate (large and graded), fine aggregate, combined coarse and fine aggregate, uses not specified, and uses indicated by symbol W.

[3]Data do not add to total shown because of independent rounding.

Dimension.—Output decreased to 18,178 short tons (215,000 cubic feet) in 1983 compared with 19,786 (229,000 cubic feet) in 1982. Dimension granite was produced at three quarries, one each in New Haven, Tolland, and Windham Counties. The granite was primarily marketed as rough blocks and cut stone. Dimension sandstone was produced at one quarry in Tolland County and at two quarries in Windham County. The sandstone was sold primarily as irregular-shaped stone and as rubble.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.

[2]Block, F. Estimated Impact of the Surface Transportation Assistance Act of 1982 on the Demand for Road Construction Aggregate. Art. in BuMines Minerals and Materials. A Bimonthly Survey. June-July 1983, pp. 35-43.

[3]New England Business. The Bristol Brass Fight To Survive. Feb. 6, 1984, pp. 56-58.

[4]Greater Hartford Chamber of Commerce. The Classified Index of Legislation Enacted by the 1983 General Assembly, State Legislation Committee. Aug. 1983, 24 pp.; for more information, write to the Greater Hartford Chamber of Commerce, 250 Constitution Plaza, Hartford, CT 06103.

[5]Weiss, A., N. J. Themelis, and N. E. Guernsey. Technological Innovation in the Copper Industry. BuMines OFR 125(1)—(3)-83, 1983, 289 pp.; NTIS PB 83-227058.

[6]For information, write to the Natural Resources Center, Department of Environmental Protection, Room 533, State Office Building, Hartford, CT 06106, or call (203) 566-3540.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
The Michael Kane Brick Co	654 Newfield St. Middletown, CT 06457	Pit and mill	Middlesex.
K-F Brick Co	Box 375 East Windsor Hill, CT 06028	Mine and mill	Hartford.
Feldspar:			
The Feldspar Corp.[1 2]	Box 99 Spruce Pine, NC 28777	Mines and plant	Middlesex.
Sand and gravel:			
Construction:			
Dan Beard Inc	Box 71, Mary St. Shelton, CT 06484	Pit and plant	New Haven.
Connecticut Sand & Stone Corp	7 West Main St. Plainville, CT 06062	Pit and plants	Hartford and Litchfield.
Elm City Construction Co	400 North Frontage Rd. North Haven, CT 06473	Pit and plant	New Haven.
Roncari Industries Inc.[3]	1776 South Main St. East Granby, CT 06026	do	Hartford.
Tilcon Inc.[3]	Box 67, 909 Foxen Rd. North Branford, CT 06471	Pits and plants	Do.
Industrial:			
Ottawa Silica Co., Connecticut Div	Box 577 Ottawa, IL 61350	Pit and plant	New London.
Stone:			
Crushed and broken:			
Edward Balf Co	Box 11190 Newington, CT 06111	Quarry	Hartford.
O&G Industries Inc	112 Wall St., Box 907 Torrington, CT 06790	Quarries	Litchfield and New Haven.
York Hill Trap Rock Quarry Co	Westfield Rd. Meriden, CT 06450	Quarry	New Haven.
Dimension:			
Box Mountain Quarries Inc	1111 Mott Hill Rd. S. Glastonbury, CT 06073	do	Tolland.
Castellucci & Sons Inc	West River St. Providence, RI 02904	do	New Haven.
Wayne C. Williams General Construction Inc.	174 Kozley Rd. Tolland, CT 06073	do	Tolland.

[1]Also crude mica.
[2]Also industrial sand.
[3]Also traprock.

The Mineral Industry of Delaware

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Delaware Geological Survey for collecting information on all nonfuel minerals.

By William A. Bonin[1]

Construction sand and gravel and magnesium compounds, extracted from seawater, were the only mineral commodities produced in Delaware. Sand and gravel production, estimated at $3.2 million, remained essentially unchanged from the 1982 level. The value of magnesium compounds is excluded from the State's total to prevent disclosure of company proprietary data. Elemental sulfur was recovered as a nondiscretionary byproduct from a petroleum refinery. Gypsum, ilmenite, and magnesium oxide raw materials were shipped into the State and processed into higher value-added products. Slag was processed at the State's only steelmaking facility.

Trends and Developments.—An increasing proportion of sand and gravel, as well as all crushed stone used in construction, continued to be shipped into Delaware from Maryland and Pennsylvania even though there are many sources of undeveloped sand and gravel material still present in the State. Many areas of Delaware that are attractive for real estate development or are prime agricultural areas are also geologically suitable for sand and gravel mining and high-value water resource development. Competition for these areas has been intense, and mining has come out a distant fourth. Sand and gravel deposits, essential to the maintenance and growth of a sound economy, have become increasingly difficult to develop in the expanding and environmentally conscious Delawarean society. Urban buildup and suburban sprawl in northern New Castle County have all but eliminated the necessary space to accommodate crushed stone quarrying operations. Pressure from this expansion forced the closure of the State's last quarry in 1968. Rock aggregates have since been transported from Pennsylvania and Maryland quarries, which are 20 to 70 miles from many of the consumer areas in Delaware.

Table 1.—Nonfuel mineral production in Delaware[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel (construction) ------ thousand short tons	1,300	$3,197	e1,400	e$3,200
Total	XX	[2] 3,197	XX	[2] e3,200

eEstimated. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Partial total; excludes the value of magnesium compounds, which must be concealed to avoid disclosing company proprietary data.

Table 2.—Indicators of Delaware business activity

	1982	1983[p]	Change, percent
Employment and labor force, annual average:			
Total civilian labor force thousands	290.1	296.1	+2.1
Unemployment do	28.8	24.6	-14.6
Employment (nonagricultural):			
Mining do	.1	.1	--
Manufacturing do	66.6	67.4	+1.2
Contract construction do	14.9	15.2	+2.0
Transportation and public utilities do	11.8	11.8	--
Wholesale and retail trade do	53.3	58.0	+8.8
Finance, insurance, real estate do	14.7	15.9	+8.2
Services do	49.9	52.9	+6.0
Government do	43.5	43.1	-.9
Total nonagricultural employment do	254.8	264.4	+3.8
Personal income:			
Total millions	$7,084	$7,538	+6.4
Per capita	$11,810	$12,422	+5.2
Construction activity:			
Number of private and public residential units authorized	2,968	3,648	+22.9
Value of nonresidential construction millions	$140.7	$136.6	-2.9
Value of State road contract awards do	$68.8	$64.9	-5.7
Shipments of portland and masonry cement to and within the State thousand short tons	161	154	-4.4
Nonfuel mineral production value:			
Total crude mineral value millions	$3.2	$3.2	--
Value per capita, resident population	$5	$5	--
Value per square mile	$1,554	$1,566	+.1

[p]Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

The significant decrease in the value of construction sand and gravel produced in Delaware since 1975, as a percentage of the combined values of nonresidential and State road contract awards, indicates that Delaware's extractive industry over the past 4 years may have lost $14 million in sales because of increased shipments of construction sand and gravel and crushed stone from neighboring Maryland and Pennsylvania into the State.

Table 3.—Delaware: Values of sand and gravel production and construction activities

Year	Value of construction sand and gravel production (millions)	Value of nonresidental construction and State road contract awards[1] (millions)
1975	$1.9	$46.2
1976	1.8	54.7
1977	2.1	70.6
1978	2.4	64.3
1979	3.3	78.3
1980	2.4	180.3
1981	[e]3.0	133.0
1982	3.2	209.5
1983	[e]3.2	[e]201.5

[e]Estimated.
[1]U.S. Department of Commerce and Highway and Heavy Construction Magazine.

This development, which apparently began in 1979, has resulted in higher construction costs, accelerated deterioration of highway pavements in the south and east inbound lanes, and the further decline of the State's $3.2 million sand and gravel industry. This industry is an essential component of the State's growing economy, particularly in the maintenance, repair, replacement, and expansion of its infrastructure.

Phoenix Steel Corp., which is attempting to reorganize under Federal bankruptcy laws, wanted the State to lend it money from its 1985 budget. Company officials had

been negotiating with the administration since midyear about the possibility of getting the State to open a "revolving fund" for an unspecified amount of unsecured money. The loan, according to a Phoenix Steel representative, was needed for working capital to enable the company to avoid liquidation. Phoenix Steel has been financially hurt by the extremely depressed price for its plate products, which are produced at its Claymont mill. In August, the company filed for bankruptcy, seeking court protection from its creditors under Chapter 11 of the Federal Bankruptcy Act. At that point, Phoenix Steel lost the financial support of its French steelmaking parent company, Creusot Loire S.A. According to the Bureau of Economic and Business Research at the University of Delaware, workers earning almost $59 million annually depend on Phoenix Steel for their jobs.

The Delaware Geological Survey, in the summer of 1983, published its first issue of "First State Geology."[2] The publication, issued biannually, will provide information about the geology, water, and mineral resources of Delaware, and the activity of the Survey. It is intended to improve the Survey's service to concerned Delawareans by better communicating the practical applications of its findings.

Significant mineral-resource-related contributions by the Survey in 1983 included advisement in State and county "mining laws" and investigation of uses of glauconite. Glauconite is a distinctive green-colored, sandy textured clay mineral rich in iron and potassium. Unconsolidated greensand deposits, with greater than 85% glauconite and up to 70 feet thick, occur near the surface in southern New Castle County in the Middleton-Odessa area. Greensand has been used without processing, as a long-release source of potassium for fertilizer, and to improve the tilth of some soils. Glauconite has potential as a leachate filter in sanitary landfills and in potable and waste water treatment. Glauconite could be mined as a coproduct in "pit-run" and processed sand and gravel operations. A study of the geologic framework and oil and gas potential offshore Delaware Bay was also initiated by the Survey.

A "bottle" bill, exempting aluminum cans until January 1, 1984, went into effect at the beginning of the year. Because retailers prefer not to handle the 5-cent deposit glass soda and beer bottles, they are handling more aluminum cans and more are being recycled. In January 1983, 155,000 pounds of aluminum cans was recycled, and by March, the recycling total had more than doubled to 311,000 pounds. The number of aluminum recycling centers in the State increased from 10 prior to Delaware's 5-cent bottle deposit law to 27 in January and 42 in August 1983. Delaware is one of nine States with deposit law legislation but the first to exempt aluminum cans. The other deposit law States are Oregon, Michigan, Vermont, Connecticut, Iowa, Maine, Massachusetts, and New York. Over 50% of the aluminum cans sold in Delaware are now recycled. The exemption for aluminum cans was extended for 2 more years.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Gypsum (Calcined).—Georgia-Pacific Corp. at Wilmington calcined crude gypsum imported from Nova Scotia. The plant manufactured wallboard and "gypcrete," a floor underlayment material. Gypcrete represented about 1% of sales. The plant operated at full capacity, 168 hours weekly, throughout 1983. It was on allocation to its best customers for only a brief period as some spot shortages developed in retail outlets and contractor requirement.

Magnesium Compounds.—Barcroft Co. produced pharmaceutical-grade magnesium and aluminum hydroxide in a variety of forms from Delaware Bay seawater. The unusual pharmaceutical and specialized fine chemical manufacturing facility is in Lewes, near Cape Henlopen at the entrance to Delaware Bay. The company is a major full-line supplier of antacid materials in gel, paste, and powder forms. It ships worldwide to pharmaceutical manufacturers.

American Minerals Inc., at its new grinding plant near the Wilmington Marine Terminal, processed various grades of imported dead-burned and caustic calcined magnesium oxide. Processing began in February 1982 from raw materials received from Greece and China. When the company's Philadelphia, PA, grinding plant closed, equipment was transferred and installed alongside the existing plant at Wilmington to give the new facility a total capacity of 100,000 short tons per year. Five different

grades ranging from 86% to 95% MgO, are marketed throughout the United States. American Minerals also processes manganese dioxide, iron chromite, chrome sand, and fertilizer compounds. The major portion of its production is converted to refractory brick used in high-temperature metallurgical furnaces. The product is also used to prepare animal feeds and fertilizers. The company expects to process barites, bauxite, dolomite, fluorspar, ground glass, iron oxide, and magnetite.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

This material will continue to be the principal mineral resource to be mined in Delaware. However, shipments of sand and gravel from Maryland are increasing even though there are available sources of undeveloped deposits within the State.

The principal source of sand and gravel in Delaware is the Columbia Formation, a 20- to 200-foot-thick fluvial to marine sequence present at the surface over much of the State. This formation thickens and becomes sandier in lower Kent and Sussex Counties. It is present as far north as the Fall Line in upper New Castle County. Coarse, gravelly deposits are rare in Sussex County.

The coarser deposits are the more valuable for all types of construction. They occur in discrete channels, 5 to 50 feet thick, on or near the surface and covering several acres. Such bodies are often flat-topped and occur at higher elevations in the Coastal Plain. They are very permeable, well drained, and usually contain large amounts of clean, near-surface ground water. These characteristics make gravel bodies easily accessible mining targets, excellent building localities, and high-value ground water resource areas. Unfortunately, these are often competing and mutually exclusive end uses.

In 1980, based on a brief survey of active mining operations throughout the State, the Delaware Geological Survey estimated that there were as many as 40 sand and gravel pits either in intermittent or continuous production, and county zoning registrations received since 1970 showed 230 pits statewide. These pits comprised 18,000 acres, 75% of which are in Sussex County. Additionally, there are a number of operations owned by, or under the supervision or lease of, the Delaware Department of Transportation. These pits, in most instances, are not registered with the county zoning office.

Slag, Steel.—International Mill Service Co. processed and sold the slag produced at the two electric arc furnaces of Phoenix Steel in Claymont. The slag was used mainly for road base material. Sales once again decreased owing to reduced production of steel at the financially troubled plate mill. Beginning at midyear, the furnaces at Claymont operated only on weekends.

Table 4.—Delaware: Construction sand and gravel sold or used by producers

	1982			1983[e]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	379	$1,120	$2.96	NA	NA	NA
Gravel	618	1,413	2.29	NA	NA	NA
Sand and gravel (unprocessed)	303	664	2.19	NA	NA	NA
Total or average	1,300	3,197	2.46	1,400	$3,200	$2.29

[e]Estimated. NA Not available.

Sulfur (Recovered).—Elemental sulfur was recovered as a nondiscretionary byproduct of petroleum refining at the Getty Refining & Marketing Co. in Delaware City. The refinery also produces sulfuric acid. The new $30 million sulfur recovery plant, the second such facility at the refinery, began operations in 1983. It is expected to increase capacity to process less expensive, high-sulfur crude oils. The refinery, rated at 140,000 barrels per day, is Getty's largest. It went on-line in 1957 and is specifically designed to refine the very high sulfur crude oil imported from Venezuela and Mexico. Production of recovered elemental sulfur from petroleum refineries in the

United States was at an alltime high in 1983. Demand continued to exceed domestic production, yet prices for all sulfur decreased significantly.

The refinery also produced 1,500 to 2,000 short tons per day of petroleum coke in 1983. Under a barter-type contract with Delmarva Power & Light Co., Getty provides the coke to the adjacent powerplant (also built in 1957) for cogeneration with 10% to 15% oil in exchange for steam and electric power. Excess electric power at the refinery reenters Delmarva's power grid. Excess petroleum coke is shipped to the Port of Wilmington and stockpiled with similar coke from Pennsylvania refineries for overseas shipment or sold in Pennsylvania for electric power generation.

The 23-mile pipeline between the refinery and the coastal port at Marcus Hook, PA, was completed in 1983. The 16-inch-diameter pipeline connects to an existing pipeline to transport refinery products more efficiently to the New York City area.

METALS

Steel.—Financially troubled Phoenix Steel, under severe cost-cutting measures, continued to operate a plate mill in Claymont and a pipe mill in Phoenixville, PA. Plate and pipe were two of the steel products most adversely affected by the 1982 recession.

Phoenix Steel sought court protection from creditors' lawsuits in August, when it lost the financial support of its majority shareholder, Creusot Loire, a French steelmaker with huge losses of its own. Creusot Loire had invested over $100 million in Phoenix Steel since the two became affiliated in 1976. At yearend, Phoenix Steel was attempting to negotiate additional loans and credit extensions in an effort to stay in business until a buyer could be found.

A University of Delaware study has found that closure of the Claymont mill would cost the State $5.9 million in annual revenue and drain $4.8 million from the State unemployment fund. Phoenix Steel employs about 990 people, including 556 Delawareans at its mill in Claymont, near the Pennsylvania border. The State would also stand to lose $3.7 million that Phoenix Steel owes from the mid-1970's when the legislature issued industrial revenue bonds so that the troubled steelmaker could install a pollution control unit.

Titanium Dioxide.—E. I. du Pont de Nemours & Co. Inc. continued to operate one of its four domestic TiO_2 pigment plants in Edgemoor. The plant uses the chloride process and utilizes ilmenite rather than the higher cost rutile as the feedstock. It has an annual pigment capacity of 110,000 short tons. The ilmenite is shipped from the Du Pont operations at Starke, FL, and Eneabba, Western Australia. These white pigments are used principally in the manufacture of paint and paper. Du Pont completed expansion of its chromium dioxide facility in Newport and by late 1983 had doubled production of magnetic particles, which are used in audio and visual equipment. The company also operated a quinacridone pigment line and production plant at Newport. This red pigment can be converted to other reds and a blue pigment.

Other Metals.—North American Smelting Co., at the Wilmington Marine Terminal, was liquidated at yearend following a long and sometimes bitter strike. The plant, which converts scrap aluminum and brass into ingots for sale to casting companies, normally employed 65 to 70 hourly workers. The plant had not been operating normally since June 11, when North American's contract with the union expired.

Reclaimed Metals and Materials.—The Delaware Reclamation Project, located at Pigeon Point just north of the Delaware Memorial Bridge, is managed by the Delaware Solid Waste Authority. Financing for the project, estimated at $65 million, was secured through the sale of revenue bonds, State grants, and Environmental Protection Agency grants. In 1983, startup operations were made by Raytheon Service Co., the facility's designer and operator.

The facility, designed to simultaneously handle solid waste and sewage sludge, consists of two modules. The solid waste processing module will receive and process 1,000 short tons of solid waste per day when in full commercial operation in 1984. From resource recovery, this module will extract ferrous metals, aluminum and other nonferrous metals, glass, and sand. A fuel product, "refuse-derived fuel," will be produced to fuel the on-site energy generating facility.

The Authority anticipates burning 500 tons per day of refuse-derived fuel in a boiler to produce 13 megawatts (MW) of electricity. The reclamation project can use 3.5 MW, the energy generating facility (scheduled for completion in mid-1985) will use 2.5 MW, and the remaining 7 MW will be sold to Delmarva Power & Light Co.

After processing, some of the organic

material from the solid waste processing module will be fed into the second module—the sewage sludge processing module. The sewage sludge processing module will receive and process 350 tons per day of 20% solids digested sewage sludge. From this sludge and the water received from the solid waste processing module, the sewage sludge processing module will produce a humus product. It will be marketed as a soil conditioner, a base for pelletized and unpelletized fertilizers, and chicken litter for the poultry industry.

As a result of processing, the plant is designed to produce annually 103,000 tons (dry weight) of refuse-derived fuel (77% of which must be combustible), 47,000 tons of humus, 18,000 tons of glass, 18,000 tons of ferrous metal, and 1,300 tons of nonferrous metals. Raytheon has guaranteed revenues of $1.4 million annually from the sale of recovered products—glass, humus, and ferrous and nonferrous materials.

Feedstocks to the Delaware Reclamation Project will consist of mixed municipal solid wastes in New Castle County, which during the next 20 years is estimated at 8.9 million tons (64% of the State's total), and 2 million tons of sewage sludge (20% solids), which will be generated by the City of Wilmington Regional Wastewater Treatment Plant, which serves the major part of urbanized New Castle County.

Raytheon, under a memorandum of agreement with the U.S. Bureau of Mines, conducted pilot plant testing for the solid waste processing module at the Bureau's Avondale Research Center, Avondale, MD. The Company ran several 10- to 20-ton lots of municipal solid wastes through the Bureau's 5-ton-per-hour-capacity pilot plant. The Bureau's patented process is licensed by Raytheon.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.
[2]Copies may be obtained from the Delaware Geological Survey, University of Delaware, Newark, DE 19716.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum and brass:			
North American Smelting Co	Wilmington Marine Terminal Box 2048 Wilmington, DE 19899	Smelter (closed 12/83).	New Castle.
Gypsum (calcined):			
Georgia-Pacific Corp., Gypsum Div	Wilmington Marine Terminal Box 310 Wilmington, DE 19899	Plant	Do.
Magnesium compounds:			
American Minerals Inc	Wilmington Marine Terminal 301 Pigeon Pt. Rd. New Castle, DE 19720	Plant (grinding)	New Castle.
Barcroft Co	40 Cape Henlopen Dr. Lewes, DE 19958	Plant (pharmaceutical-fine chemical).	Sussex.
Sand and gravel (construction):			
Contractors Sand & Gravel Co	Box 794 Wilmington, DE 19805	Pit	Do.
Dover Equipment & Machine Co	113 West 6th St. New Castle, DE 19720	Dredge	Kent.
Parkway Gravel Inc	4048 New Castle Ave. New Castle, DE 19720	Pits	New Castle.
Slag, steel:			
International Mill Service Co	Philadelphia Pike Box 160 Claymont, DE 19703	Plant (processing).	Do.
Steel:			
Phoenix Steel Corp	4001 Philadelphia Pike Claymont, DE 19703	Mill (plate)	Do.
Sulfur (recovered):			
Getty Refining & Marketing Co.[1]	Wrangler Hill Rd. Delaware City, DE 19706	Refinery (petroleum).	Do.
Titanium dioxide:			
E. I. du Pont de Nemours & Co. Inc	1007 Market St. Wilmington, DE 19898	Corporate headquarters.	Do.
Do	Edgemoor, DE 19809	Plant (chemical).	Do.

[1]Also sulfuric acid and petroleum coke.

The Mineral Industry of Florida

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Florida Bureau of Geology for collecting information on all nonfuel minerals.

By James R. Boyle[1] and Charles W. Hendry, Jr.[2]

The value of nonfuel mineral production in 1983 in Florida was nearly $1.3 billion, an increase of $52 million over that of 1982. Nearly all the minerals produced in the State had increased outputs in 1983. Florida ranked fifth nationally in total value of nonfuel minerals produced, and nonmetals accounted for over 97% of the value of the State mineral output. The State ranked first in the production of phosphate rock and masonry cement; second in crushed stone, fuller's earth, and peat; and sixth in portland cement. Staurolite and zircon concentrates were produced only in Florida. Principal nonmetals, in order of value, were phosphate rock, stone, cement, sand and gravel, and clays.

Florida remained the predominant producer of phosphate rock, and for the 90th consecutive year supplied more than any other State. Florida and North Carolina supplied 84.5% of the domestic phosphate rock output, with Florida supplying most of the exports.

Table 1.—Nonfuel mineral production in Florida[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	231	$16,267	313	$19,557
Portland	do.	2,651	136,190	3,329	164,048
Clays	do.	672	[2]31,339	684	31,566
Gem stones		NA	6	NA	6
Lime	thousand short tons	103	5,828	W	13,881
Peat	do.	120	1,575	114	1,999
Sand and gravel:					
Construction	do.	r13,616	r30,081	e14,900	e31,500
Industrial	do.	341	4,257	329	3,447
Stone (crushed)	do.	e53,100	e182,300	57,282	235,700
Combined value of clays (kaolin, 1982), magnesium compounds, phosphate rock, rare-earth metal concentrate, staurolite, titanium concentrates (ilmenite and rutile), and zircon concentrate		XX	815,155	XX	773,275
Total		XX	r1,222,998	XX	1,274,979

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes kaolin; value included with "Combined value" figure.

Florida's economy eased out of the recession in 1983, resulting in an unemployment rate of 7.4% at yearend, compared with 9.5% at yearend 1982. The unemployment rate in the phosphate industry was much higher. Early in 1983, the rate was about 16%, but by midyear it was in excess of 25%, with the number of unemployed exceeding the previous high established in mid-1982. By late 1983, the rate had dropped as demand for phosphate rock improved.

Table 2.—Value of nonfuel mineral production in Florida, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Alachua	$3,429	(2)	
Bay	(3)	W	Sand and gravel (construction).
Brevard	W	W	Clays, sand and gravel (construction), sand and gravel (industrial).
Broward	29,778	$3,041	Sand and gravel (construction).
Calhoun	(3)	75	Do.
Charlotte	1,350	(2)	
Citrus	4,248	(2)	
Clay	31,954	32,069	Ilmenite, zircon, rutile, staurolite, sand and gravel (construction), clays, monazite.
Collier	9,500	(2)	
Dade	W	W	Cement, sand and gravel (construction).
Escambia	(3)	W	Sand and gravel (construction), sand and gravel (industrial).
Gadsden	20,230	W	Clays, sand and gravel (construction), sand and gravel (industrial).
Glades	W	W	Sand and gravel (construction), sand and gravel (industrial).
Gulf	W	W	Magnesium compounds, lime.
Hamilton	W	W	Phosphate rock.
Hardee	W	W	Do.
Hendry	319	--	
Hernando	W	W	Cement, lime, clays.
Highlands	W	W	Peat.
Hillsborough	139,401	81,672	Phosphate rock, cement, peat.
Jackson	W	(2)	
Lake	W	W	Sand and gravel (construction), peat, clays.
Lee	14,484	(2)	
Leon	(3)	267	Sand and gravel (construction).
Levy	4,127	(2)	
Manatee	W	W	Phosphate rock, cement.
Marion	W	W	Clays, sand and gravel (construction).
Monroe	W	(2)	
Okaloosa	(3)	--	
Orange	42	(2)	
Palm Beach	3,196	(2)	
Pasco	2,883	(2)	
Polk	869,928	W	Phosphate rock, sand and gravel (construction), sand and gravel (industrial), peat.
Putnam	W	5,670	Sand and gravel (industrial), clays, sand and gravel (construction), peat.
St. Lucie	902	W	Sand and gravel (construction).
Sarasota	660	393	Do.
Sumter	W	W	Lime.
Suwannee	957	(2)	
Taylor	2,591	(2)	
Walton	(3)	W	Sand and gravel (construction).
Undistributed[4]	557,312	917,511	
Sand and gravel (construction)	e30,600	XX	
Stone (crushed)	XX	e182,300	
Total	[5]1,727,889	1,222,998	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Baker, Bradford, Columbia, De Soto, Dixie, Duval, Flagler, Franklin, Gilchrist, Holmes, Indian River, Jefferson, Lafayette, Liberty, Madison, Martin, Nassau, Okeechobee, Osceola, Pinellas, St. Johns, Santa Rosa, Seminole, Union, Volusia, Wakulla, and Washington. County distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2]Crushed stone was produced, data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Florida business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	4,682.3	4,984.4	+6.4
Unemployment	do.	444.3	367.0	-17.4
Employment (nonagricultural):				
Mining[1]	do.	9.3	10.1	+8.6
Manufacturing	do.	450.7	493.5	+9.5
Contract construction	do.	242.5	288.0	+18.8
Transportation and public utilities	do.	230.2	229.1	-.5
Wholesale and retail trade	do.	1,012.6	1,102.4	+8.9
Finance, insurance, real estate	do.	276.3	300.9	+8.9
Services	do.	947.3	995.0	+5.0
Government	do.	647.2	640.0	-1.1
Total nonagricultural employment[1]	do.	3,816.1	4,059.0	+6.4
Personal income:				
Total	millions	$114,356	$123,804	+8.3
Per capita		$10,907	$11,592	+6.3
Construction activity:				
Number of private and public residential units authorized		103,813	186,759	+79.9
Value of nonresidential construction	millions	$3,257.7	$4,102.1	+25.9
Value of State road contract awards	do.	$391.0	$340.0	-13.0
Shipments of portland and masonry cement to and within the State	thousand short tons	4,398	5,262	+19.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,223.0	$1,275.0	+4.2
Value per capita, resident population		$117	$119	+1.7
Value per square mile		$20,891	$21,734	+4.0

[p]Preliminary.
[1]Includes oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

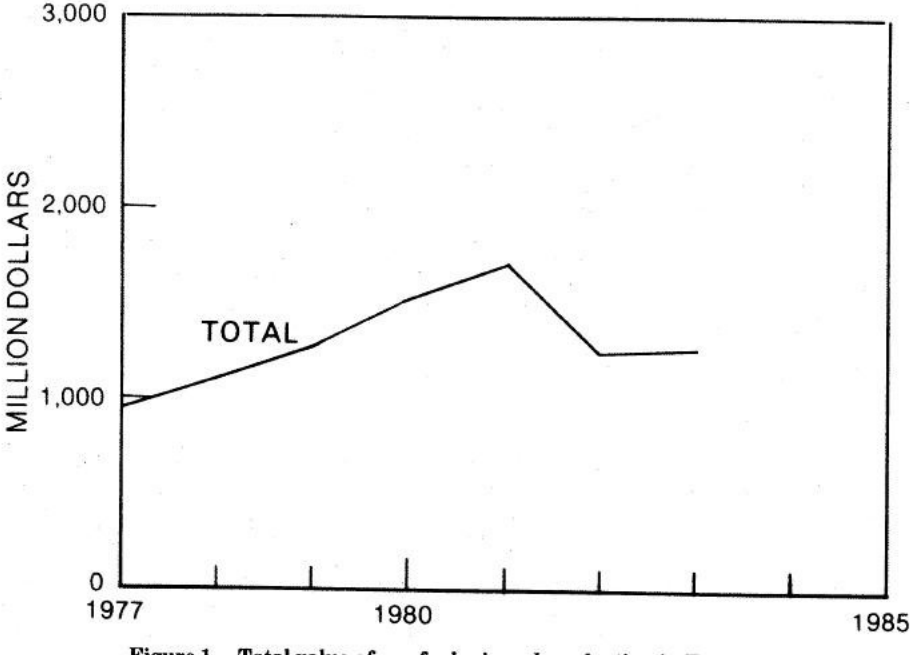

Figure 1.—Total value of nonfuel mineral production in Florida.

Trends and Developments.—During the year, nearly all phases of construction rebounded substantially, providing a strong boost to the overall economy, especially the minerals segment. According to the Federal Reserve Bank of Atlanta,[3] Florida's total capital needs for transportation, water, and waste water, including backlog requirements, total $41 billion through the year 2000. Approximately 90% of these capital needs are for transportation, mainly roads. The projections indicate a long-term high demand for construction minerals such as cement, sand and gravel, and crushed stone.

To generate revenue for education requirements, Florida's corporate income tax was increased in 1983 through changes which increase the tax base for some companies. The changes include a repeal of Florida's existing exemption of foreign source income as taxable corporate profits, a change in the definition of Florida sales, and a provision for worldwide unity apportionment for determining the corporate income tax. Among those affected would be most of the phosphate, cement, and other mineral-related companies. Under worldwide unitary apportionment, a company's worldwide operating income is included in taxable corporate profits. Companies operating primarily in Florida will experience little change in taxes, while multinationals could be heavily impacted. Review and possible modification of the unitary tax was underway because of the adverse reaction by corporations in the State.

The Port of Tampa handled nearly 44 million tons of cargo in 1983, up nearly 11% from that of 1982. The major portion of exported phosphate was shipped out of that port. Phosphate rock exports totaled nearly 15 million tons, compared with 13 million tons in 1982. Total earnings of phosphate exporters, however, were 7% lower than in 1982 because of lower world prices. Other minerals exported through the port included clay and industrial sand.

The Port of Tampa also imported about 670,000 tons of aragonite from The Bahamas for use in the manufacture of cement, up slightly from that imported in 1982. Other minerals imported included cement, coal, gypsum rock, potash, salt, and liquid sulfur.

Union Carbide Corp. announced a $9 million modernization program at its industrial gases facility at Mims. To be completed in 1984, the program will include upgrading process liquefaction and computer control. The plant has a capacity for 500 tons per day of oxygen, nitrogen, and argon.

Total oil and gas production in Florida declined for the fifth consecutive year. Oil production dropped from 25.3 million barrels in 1982 to 19.6 million barrels in 1983; gas production dropped from 26.9 billion cubic feet in 1982 to 24.2 billion cubic feet in 1983. Twenty-seven wells were drilled in 1983: 15 wildcats, all dry; 9 development wells, all producers; and 3 service wells for saltwater disposal.

Legislation and Government Programs.—The U.S. Bureau of Land Management reported $234,379 in mineral lease payments to the State in 1983. The Federal Government divides bonuses, rentals, and royalties received from Federal mineral leasing activities on public lands equally with the States in which the minerals occur.

The U.S. Geological Survey (USGS) and the U.S. Bureau of Mines conducted mineral, energy, geochemical, and marine geology studies in and offshore Florida. The studies included mineral potential in several Roadless Area Review and Evaluation (RARE II) areas, and resource studies on titanium, heavy minerals, and phosphate. During the year, the USGS published several Miscellaneous Field Studies Maps pertaining to the RARE II studies, which are a joint effort with the Bureau. The maps included "Mineral Resource Potential Map of the Savannah Roadless Area, Liberty County, Florida" (MF-1470), "Mineral Resource Potential of the Clear Lake Roadless Area, Leon County, Florida" (MF-1479), and "Mineral Resource Potential Map of the Natural Area Roadless Area, Baker County, Florida" (MF-1572-B).

Since 1972, the U.S. Bureau of Mines Tuscaloosa Research Center has been involved with various projects related to dewatering phosphate waste slimes, upgrading marginal ore, and developing means to improve the post-mining environment. In-house Bureau project activity during 1983 included research on beneficiation of dolomitic phosphate ores, dewatering of waste phosphate clay slime by flocculation utilizing a field test unit, recovery of phosphate from dewatered slimes, and procedures for reestablishment of wetland ecosystems after mining.

Bureau Reports of Investigation (RI) issued during the year pertaining to the mineral industry of Florida included RI 8731, "Recovery of Phosphate From Florida Phosphate Operations Slimes," and RI 8776,

"Evaluation of Radium and Toxic Element Leaching Characteristics of Florida Phosphogypsum Stockpiles." Information Circulars (IC) issued included IC 8914, "The Florida Phosphate Industry's Technological Environmental Problems, A Review"; IC 8926, "Minerals Availability Commodity Directory on Phosphate"; IC 8929, "Economic Evaluation of Borehole and Conventional Mining Systems in Phosphate Deposits"; IC 8932, "Costs and Effects of Environmental Protection Controls Regulating U.S. Phosphate Rock Mining"; and IC 8937, "Phosphate Rock Availability—Domestic."

During the year, the Florida Bureau of Geology continued its geologic investigations in the State. Projects underway included stratigraphy of South Florida, a summary of peat deposits, a summary of geologic parameters to be assessed for hazardous waste disposal, geomorphology of Northwest Florida, a summary of the economic minerals of Florida, and other basic geologic studies within the State. Publications released during the year included "Earthquakes and Seismic History of Florida," "The Hawthorn Formation of Northeastern Florida," "The Geology and Water Resources of the Upper Suwannee River Basin, Florida," and several map series concerning water use within the State. In September, the reclamation program, which had been assigned to the Bureau of Geology, was elevated to Bureau status and became a separate entity.

The Florida Institute of Phosphate Research continued its funding of research activities with respect to mining and processing phosphate rock and reclamation of disturbed lands. The Institute's funding for research exceeds $3 million annually with the major areas of study including utilization of byproduct gypsum, reduction of slime pond areas, evaluation of waste clay handling techniques, and reclamation of phosphate lands. Other areas of concern were innovative beneficiation and mining concepts and effects of radiation. About 50 projects were funded to some level during 1983. Florida Statute 378.101, relating to phosphate research, was amended by the legislature and approved by the Governor in May. The amendment increased the Board of Directors from three to five members, with the new members appointed in December.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of portland and masonry cement increased 25.6% and 35.7%, respectively, from those of 1982. Cement was the third leading commodity in value in the State. Production of masonry cement in Florida ranked first nationally, while that of portland cement ranked sixth. Increased construction activity impacted favorably on the cement industry with masonry cement output at its highest level in over 10 years and portland cement output approaching the record-high year production of 1980. Four companies produced portland cement at five plants; masonry was also produced at five plants. A fifth company operated a grinding plant to produce portland cement from imported clinker. Most of the output of both cement types was used within the State; Florida was a net importer of cement with about 1.5 million tons being shipped into the State, up from about 700,000 tons in 1982. Portland cement shipments, mainly in bulk form, were made by truck and rail. Principal consumers were ready-mix contractors, building materials dealers, and concrete products manufacturers, with the remainder being consumed by other contractors and governmental agencies.

Most raw materials used to manufacture cement were mined within the State and included limestone, clays, sand, and staurolite. Oolitic aragonite imported from The Bahamas was used, as were small amounts of gypsum, clinker, fly ash, iron ore, and slag; most were obtained from out-of-State sources.

Ten rotary kilns were operated at the five plants—eight were wet process and two were dry process. About 446 million kilowatt hours of electrical energy, in addition to natural gas, fuel oil, and coal, were used in the manufacture of cement.

Atlantic Cement Co. purchased 50% of Continental Cement Co.'s terminals in Cape Canaveral and Port Everglades for $9 million. Both firms will use designated silos for deliveries from oceangoing vessels. Ideal Basic Industries Inc. sold its Palm Beach terminal to Eagle Cement Co. Eagle plans to handle about 250,000 tons per year through the terminal; most of the cement will come from Mexico.

Florida Crushed Stone Co. continued with plans to build a 600,000-ton-per-year cement

plant at Brooksville for an estimated $80 million. Construction was delayed awaiting permits for the cement plant, which were received by yearend. The company was also seeking approval to construct a coal-fired 120-megawatt powerplant for the cement operation. Permission had not been received by yearend. When approved, construction was expected to take 2 years. Construction of the cement plant was contingent on approval of the powerplant. A local bond issue had been passed for financing the venture.

Clays.—Clays mined in Florida included common clay, fuller's earth, and kaolin. Total clay production increased 12,000 tons, while value decreased $1.5 million.

Common clay output and value increased 13.8% and 56.4%, respectively, over those of 1982. Common clay was produced by three companies at three pits in Clay, Hernando, and Lake Counties in the northern part of the State. The clay was used in the manufacture of cement and lightweight aggregate.

Florida ranked second in the Nation in output of fuller's earth with production and value decreasing compared with that of 1982. Fuller's earth was mined by four producers at four pits in Gadsden and Marion Counties. Main end uses were for pet waste absorbents and oil and grease absorbents, and in fertilizers, pesticides, and saltwater drilling muds. Material mined was a montmorillonite-attapulgite product, which was crushed, sized, and dried. End products were shipped nationwide. Excel Minerals Inc. constructed a packaging plant in Quincy to distribute pet waste absorbent clays supplied by the Floridin Co. in Quincy.

Kaolin was produced by one company in Putnam County with production increasing 11.5% over that of 1982. Principal uses were electrical porcelain, whiteware, and wall tile, with major markets in the Southeast. Byproduct industrial sand was recovered for glass and other industrial uses. Glass sand was shipped to plants in Alabama, Florida, and Tennessee.

Fluorine.—Fluorine in the form of fluosilicic acid was recovered as a byproduct of wet-process phosphoric acid manufacture. Fluosilicic acid was used to produce cryolite, aluminum fluoride, and sodium silicofluoride, and was also used in water fluoridation.

Gypsum.—Imported gypsum was calcined at two plants in Duval County and one plant in Hillsborough County. United States Gypsum Co., Jim Walter Corp., and National Gypsum Co. calcined gypsum in kettles, a rotary kiln, and holoflite unit, respectively, prior to wallboard manufacture. In terms of annual output, Florida ranked fourth nationally in the manufacture of wallboard. U.S. Gypsum's plant ranked third nationally in output, while National Gypsum's plant ranked seventh. Production and value increased 40% and 50%, respectively, over those of 1982. Florida gypsum wallboard was marketed primarily in southern Georgia and Florida. Byproduct gypsum was recovered by Occidental Chemical Co. at its plant in Hamilton County; output increased over that of 1982.

Lime.—Quicklime and hydrated lime were produced in Florida, with output of both increasing over that of 1982. Quicklime was produced by Basic Magnesia Inc., Gulf County; Chemical Lime Inc., Hernando County; and Dixie Lime & Stone Co., Sumter County. Hydrated lime was also produced by Chemical Lime. Production and value of lime increased significantly, over those of 1982; output was at its highest level in over 10 years. Historically, Florida markets have consumed significantly more lime than was produced in the State, with out-of-State producers supplying the markets. Lime was used in magnesia recovery from seawater sewage treatment systems and in animal food.

Magnesium Compounds.—Florida ranked second in the Nation in the recovery of magnesium compounds from seawater. Basic Magnesia, Gulf County, produced caustic calcined magnesia and refractory-grade magnesia from seawater. Shipments and value increased 4.0% and 9.6%, respectively, over those of 1982, indicating an increase in unit value.

Peat.—Florida ranked second nationally in peat sales in 1983. Reported production decreased from that of 1982. Five companies reported production of moss, reed-sedge, and humus peat from five counties. Most of the peat, shipped in bulk, was used for general soil improvement and for potting soils.

The Natural Resources Committee in the Florida House of Representatives approved a 1-year ban on the issuance of permits for peat mining for nonagricultural purposes in Florida swamps. The Department of Natural Resources (DNR) was directed to deny approval of any such activities until after July 1, 1984. The bill provided that DNR

conduct a study of the effects of peat mining on the State's wetlands and make recommendations concerning restrictions on nonagricultural peat mining.

Perlite (Expanded).—Four companies produced expanded perlite from crude ore shipped into the State. Production decreased to 21,200 tons, while value decreased to $3.5 million. Perlite was expanded at plants in Broward, Duval, Escambia, and Indian River Counties, and was used for construction aggregate, horticultural purposes, insulation, and fillers.

Phosphate Rock.—Florida ranked first in the Nation in the production of phosphate rock. The phosphate industry continued to be the principal mineral industry in the State. Marketable production of phosphate rock in 1983 increased 7.5% in quantity but decreased 6.1% in value from that of 1982. Phosphate rock production remained at a low level during the year, resulting in temporary closure of, or reduction of output from, most of the area's mines. The decreased output was caused by reduced demand for both domestic fertilizers and exports. At midyear, over 26% of the work force was unemployed with mines and plants either shut down temporarily or operating on reduced schedules. The industry rebounded late in the year, reducing the unemployment rate to about 9%, but still operated well below capacity levels.

According to the Florida Phosphate Council, 1983 output of all major finished products increased over that of 1982: phosphoric acid (80%), triple superphosphate (29%), diammonium phosphate (72%), monoammonium phosphate (103%), and animal feed supplements (3%). The council also reported that capital spending declined from $410 million in 1982 to $88 million in 1983. Employment decreased from 14,600 in 1980, the peak year, to 11,540 at yearend 1983. The industry paid nearly $110 million in State and county taxes, with severance taxes of over $67 million. The severance tax of $1.84 per ton in 1982 was increased to $2.10 per ton in 1983, with a portion (5%) returned to the individual producing counties.

During the year, Zen-Noh, a Japanese trade organization, contracted with Estech Inc. and International Minerals & Chemical Corp. (IMC) for multiyear supplies of phosphate rock. Estech will supply 460,000 metric tons per year for 8 years and IMC will supply 317,000 metric tons per year for 13 years.

To reduce power costs at their sulfuric acid plants, Conserve Inc, IMC, and The Royster Co. were retrofitting their units to recover high-pressure steam and cogenerate electricity. Increased electrical costs justified the capital expenditures. Excess generated power will be sold to the Tampa Electric Co.

The industry reduced electric power expenses from $158 million in 1982 to $150 million in 1983. Cogeneration plants allowed energy use to increase from 2.9 billion kilowatt hours in 1982 to 3.5 billion kilowatt hours in 1983 without a corresponding rise in costs.

Land-pebble phosphate was produced at 20 mines by 12 companies in Hamilton, Hardee, Hillsborough, Manatee, and Polk Counties. Of the 12 companies with facilities, 6 increased production in 1983, 5 decreased production, and 1 purchased material and utilized inventories. Seven companies increased export tonnage in 1983, two remained at about the same level, one decreased exports, and two did not export. In 1983, agricultural uses accounted for all of the production. Normal superphosphate, triple superphosphate, wet-process phosphoric acid, phosphate rock for direct application, and defluorinated phosphate rock were produced for agricultural purposes. All of the companies produced wet-process phosphoric acid, five produced triple superphosphate, four produced normal superphosphate, three produced direct application material, and one produced defluorinated rock.

Agrico Chemical Co. operated the Fort Green, Payne, and Saddle Creek Mines during the year. The Saddle Creek Mine, down since August 1981, reopened in April on a 5-day schedule which increased to a 7-day operation by December. The South Pierce chemical operations, which functioned at reduced levels during the year, were running at design capacity by yearend. Agrico announced plans to import prilled sulfur from Canada to replace liquid sulfur used to produce sulfuric acid. Permits were applied for and were pending at yearend. Agrico initiated the permitting process to continue testing borehole mining of deep phosphate in St. Johns County. Primary testing was done in cooperation with the U.S. Bureau of Mines. Phase 2, by Agrico, would include drilling six slurry wells in 1984 and continuing feasibility testing; phase 3 would be full-scale production.

AMAX Phosphate Inc. operated the Big

Four Mine intermittently during the year. The mine was closed in April 1982 and reopened in mid-1983. The Piney Point fertilizer plant, which also closed in April 1982, reopened late in 1983 and was operating at full capacity by yearend. AMAX's Pine Level Mine development in De Soto and Manatee Counties was deferred with an uncertain projected startup date. The $300 to $600 million development reportedly was planned to produce 4.5 million tons per year.

Beker Phosphate Corp. operated its Wingate Creek Mine in Manatee County using two floating dredges to remove overburden and matrix. The mine was closed for a short period early in the year. Phosphate rock was trucked to Port Manatee for shipment to Beker's fertilizer plant in Louisiana. Controversy over truck transportation to the port continued during the year as Beker had difficulty obtaining rights of way for a rail line. By yearend, county officials had denied an extension of an agreement to ship by truck.

Brewster Phosphates, a partnership between American Cyanamid Co. and Kerr-McGee Corp., operated the Haynsworth and Lonesome Mines at various work schedules during the year. Most of the output was shipped to an acid plant in Louisiana through the Port of Tampa.

CF Industries Inc.'s Hardee Complex No. 1 operated intermittently during the year. Late in the year, the company restarted its sulfuric acid plant at Bartow, which had been shut down in February.

Estech operated the Silver City and Watson Mines in Polk County, with the Silver City Mine being shut down in January for an indefinite period. The two mines have a combined capacity of about 2 million tons per year with depletion of deposits anticipated by the early 1990's. Estech continued in its attempts to develop its Duette Mine in Manatee County. Environmental concerns have delayed development of the proposed 3-million-ton-per-year mine since 1975. Estech, at yearend, reportedly needed two more permits, for a total of 31, before development of the mine. After the last permits were issued, it would still be about 3 years before mining would begin. The company has reportedly expended over $10 million in its attempts to develop the mine.

Farmland Industries Inc. continued attempts to obtain permits for its proposed 2-million-ton-per-year Hickory Creek Mine in Hardee County. Farmland has been in the permitting stage since 1977 and at yearend reportedly needed three more permits; one for dredge and fill and two watershed permits. Startup for the proposed mine remained indefinite at yearend.

Gardinier Inc. produced phosphate rock at its Fort Meade Mine in Polk County. Gardinier filed to extend its mine into 5,400 acres in Hardee County. The company plans to mine nearly 3,800 acres, leaving land around creeks undisturbed.

W. R. Grace & Co. operated its Bonny Lake and Hookers Prairie Mines in Polk County during the year. Because of depleted reserves, the Bonny Lake Mine was expected to be mined out early in 1984. W. R. Grace purchased a deposit of phosphate rock reserves from Agrico for $25 million. The addition of an estimated 16 million tons of reserves will extend the life of the Hookers Prairie Mine an additional 5 to 6 years. The startup of W. R. Grace's Four Corner Mine, a joint venture with IMC, was postponed until early 1985. W. R. Grace will operate the 5-million-ton-per-year mine with 50% of the production going to IMC.

Hopewell Land Co., a subsidiary of Noranda Inc., continued development of its 550,000-ton-per-year mine in Hillsborough County. Production was scheduled for late 1984, with about one-half of the output going to the company's fertilizer plant in Canada and the remaining output sold.

IMC, the world's largest private producer of phosphate and phosphate chemical products, operated the Clear Springs, Noralyn, and Kingsford Mines. The mines operated at reduced schedules early in the year with output increasing later in 1983. Although the mines did not operate at design capacity, IMC's production levels were not reduced by weak demand as much as those of other Florida companies. IMC's New Wales chemical complex also operated below capacity during 1983.

Mobil Chemical Corp. operated the Nichols and Fort Meade Mines in Polk County. Early in the year, the Nichols Mine was shut down, and Mobil overhauled its 40-cubic-yard dragline at a cost of $1.2 million. Mobil also shut down its elemental phosphorus furnaces at Pierce and will purchase its requirements from Monsanto Co. in Tennessee. Mobil proceeded with the permitting process to develop the 3-million-ton-per-year South Fort Meade Mine. Early in the year, the State rejected Mobil's proposed reclamation plan for the South Fort Meade Mine. Late in the year, Mobil an-

nounced it will test electroendosmosis to determine if the method can be used to shorten the time required to reclaim clay settling areas.

Occidental Chemical produced phosphate rock from its Suwannee River Mine and its Swift Creek Mine. During the year, both facilities operated intermittently with output increasing by yearend. The Swift Creek Mine closed in December.

U.S.S. Agri-Chemicals Inc., which had closed its Rockland Mine in May 1982, eliminated all maintenance activities at the mine in March 1983. United States Steel Corp. announced that its phosphoric acid plant in Bartow, inactive since 1981, would be shut down permanently in January 1984.

Sand and Gravel.—Florida produced both construction and industrial sand and gravel in 1983. Total sand and gravel production and value were estimated to have increased over those in 1982; unit values decreased.

Construction.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data are based on annual company estimates made before yearend.

Output of construction sand and gravel was estimated to have increased slightly, while unit value decreased. Many sand and gravel facilities operated at reduced levels early in the year, with demand increasing late in the year.

Industrial.—Five companies produced industrial sand and gravel, one as byproduct of kaolin operations. Production decreased 3.5% with value decreasing 19% from that of 1982. Unit value decreased 16%. Industrial sand was used for glass manufacture and for foundry sands with markets in Alabama, Florida, and Tennessee.

Table 4.—Florida: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	NA	NA	NA
Gravel	NA	NA	NA	NA	NA	NA
Sand and gravel (unprocessed)	NA	NA	NA	NA	NA	NA
Total or average	r13,616	r$30,081	r$2.21	e14,900	e$31,500	e$2.11
Industrial:						
Sand	341	4,257	r12.48	327	3,417	10.44
Gravel	--	--	--	2	30	15.00
Total or average	341	4,257	r12.48	329	3,447	10.48
Grand total or average	r13,957	r34,338	r2.46	e15,229	e34,947	e2.29

eEstimated. rRevised. NA Not available.

Staurolite.—Florida was the only State with a recorded production of staurolite, an iron-aluminum silicate low in free silica. Staurolite was recovered as a byproduct of ilmenite processing in Clay County by E. I. du Pont de Nemours & Co. Inc. and by Associated Minerals (USA) Ltd. Inc. The staurolite was recovered by electrical and magnetic separation from heavy minerals concentrates. Production and value increased 4.8% and 1.7%, respectively, over those of 1982. Staurolite was used primarily in foundry applications and in sandblasting; demand was down because of discontinuance of its use in cement.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend. Florida ranked second in the Nation in crushed stone production, which included limestone, dolomite, marl, and oystershell. Output increased, reversing a downward trend started in 1980. Unit prices increased about 20%. Increased construction activity directly affected output of crushed stone and other aggregate.

Crushed stone was produced by 81 companies at 113 quarries in 24 counties. Leading counties were Dade, Hernando, and Broward, which supplied 66.2% of the State's output. Fifteen quarries produced over 1 million tons each and accounted for 57.4% of the State's production.

Table 5.—Florida: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	40	173
Filter stone	504	3,162
Coarse aggregate, graded:		
Concrete aggregate, coarse	15,780	73,246
Bituminous aggregate, coarse	2,437	12,605
Bituminous surface treatment aggregate	W	W
Railroad ballast	459	2,603
Other graded coarse aggregate	W	W
Fine aggregate (-3/8 inch):		
Stone sand, concrete	3,523	16,200
Stone sand, bituminous mix or seal	1,026	5,744
Screening, undesignated	1,874	8,931
Other fine aggregate	W	W
Coarse and fine aggregate:		
Graded road base or subbase	12,767	33,800
Unpaved road surfacing	1,485	3,470
Crusher run or fill or waste	1,633	3,290
Other coarse and fine aggregate	W	W
Agricultural:		
Agricultural limestone	346	1,822
Poultry grit and mineral food	284	814
Other agricultural uses	W	W
Chemical and metallurgical:		
Cement manufacture	3,663	15,598
Lime manufacture	W	W
Special:		
Asphalt fillers or extenders	W	W
Whiting or whiting substitute	46	101
Other fillers or extenders	W	W
Other	11,416	54,140
Total[2]	57,282	235,700

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes limestone, dolomite, marl, and shell.
[2]Data do not add to totals shown because of independent rounding.

Crushed stone was transported mainly by truck and railroad and was used for dense-graded road base, concrete and bituminous aggregate, and cement manufacture. Eight companies processed oystershell for roadbed material.

Sulfur (Recovered).—Florida ranked eighth in the Nation in the production of byproduct elemental sulfur. Recovered sulfur from Exxon Corp.'s natural gas desulfurization plant in Santa Rosa County decreased for the fifth straight year.

Vermiculite (Exfoliated).—Exfoliated vermiculite was produced by two companies at four plants in Broward, Duval, and Hillsborough Counties from crude ore shipped into the State. Production increased 10.8% while value decreased 1%, indicating a drop in unit price from that of 1982. Principal uses were for concrete aggregate, horticulture, and insulation.

METALS

Iron and Steel.—Florida Steel Corp., one of the top 15 steelmakers in the Nation, operated minimills at Jacksonville and Tampa during the year. The company, with five plants in the Nation, was the fourth largest minimill operator, with five plants and a rated total capacity of 1.6 million tons per year. Although markets became stronger during the year, the demand was not sufficient to reopen the company's facilities at Indiantown.

According to the Directory of Florida Industries, 10 gray iron foundries and 9 steel foundries operated intermittently during 1983. With the exception of a foundry in Jacksonville and one in Tampa, all foundries were relatively small.

Shipments of ferroalloys decreased 3.5%, while value increased slightly.

Mineral Sands.—Du Pont and Associated Minerals produced concentrates from its heavy minerals operations in Clay County. Rutile and ilmenite shipments increased 28.6% and 52.2%, respectively, over those of 1982; unit prices of both decreased. Florida was the only reported State with shipments of rutile, and one of two States with shipments of ilmenite. Du Pont, which operates two dredges, was building another to replace an older unit. Du Pont expanded capacity to 72,000 tons per year by improving processing, and with the addition of a new cone section planned to boost capacity

to 77,000 tons per year by the end of 1983.[4] Union Camp Corp. planned to build an 8,000-ton-per-year humate processing plant in Jacksonville with scheduled completion in 1984. Humate is an organic byproduct of the mining of heavy mineral sands.

Rare-Earth Minerals.—Florida was the only producer of rare earths from mineral sands mining. Associated Minerals recovered monazite concentrate as a byproduct of its operation in Clay County. Production increased slightly, while value decreased from that of 1982.

Zircon.—Production and value of zircon concentrate from Du Pont and Associated Minerals operations in Clay County increased 5.2% and 0.3%, respectively, over those of 1982. Florida was the only producer of zircon in the United States; it was recovered as a byproduct of mineral sands operations. Principal markets were in the foundry, ceramic, and refractory industries. Markets in the foundry industry were down, but refractory applications picked up late in the year.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, AL.
[2]State geologist, Florida Bureau of Geology, Tallahassee, FL.
[3]Federal Reserve Bank of Atlanta. Economic Review. Feb. 1984, pp. 6-20.
[4]Industrial Minerals (London). Dec. 1983, p. 32.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
General Portland Inc	12700 Park Central Pl. Suite 2100 Dallas, TX 75251	Plants	Dade and Hillsborough.
Lonestar Florida Pennsuco Inc	Box 2035 PVS Hialeah, FL 33012	Plant	Dade.
Moore McCormack Resources Inc.	Box 23965 Tampa, FL 33622	do	Hernando.
Rinker Portland Cement Corp	Box 650679 Miami, FL 33165	do	Dade.
Clays:			
Engelhard Minerals & Chemical Corp.	Menlo Park Edison, NJ 08817	Open pit mines and plant.	Brevard.
Mid-Florida Mining Co	Box 68-F Lowell, FL 32663	do	Marion.
Pennsylvania Glass Sand Corp	Berkeley Springs, WV 25411	do	Gadsden.
Gypsum (calcined):			
Jim Walter Corp	Box 135 Jacksonville, FL 32226	Plant	Duval.
National Gypsum Co	4100 First International Bldg. Dallas, TX 57270	do	Hillsborough.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Duval.
Lime:			
Basic Magnesia Inc	Box 160 Port St. Joe, FL 32456	do	Gulf.
Chemical Lime Inc	Box 317 Leesburg, FL 32748	do	Hernando.
Dixie Lime & Stone Co.[1]	Drawer 217 Sumterville, FL 33585	do	Sumter.
Magnesia:			
Basic Magnesia Inc	Box 160 Port St. Joe, FL 32456	do	Gulf.
Peat:			
Peace River Peat Co	Box 1192 Bartow, FL 33830	Bog	Polk.
Superior Peat & Soil Co	Box 1688 Sebring, FL 33870	Bog	Highlands.
Perlite (expanded):			
Airlite Processing Corp. of Florida.	Route 2, Box 740 Vero Beach, FL 32960	Plant	Indian River.
Armstrong Cork Co	Box 1991 Pensacola, FL 35289	do	Escambia.
Chemrock Corp	End of Osage St. Nashville, TN 37208	do	Duval.
W. R. Grace & Co.[2]	62 Whittemore Ave. Cambridge, MA 02140	do	Broward.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Phosphate rock:			
Agrico Chemical Co	Box 1110 Mulberry, FL 33860	Open pit mines and plants.	Polk.
AMAX Chemical Inc	402 South Kentucky Ave. Lakeland, FL 33801	Open pit mine and plant.	Hillsborough.
Beker Phosphate Corp	Box 9034 Bradenton, FL 33506	do	Manatee.
Brewster Phosphates	Bradley, FL 33835	Open pit mines and plant.	Hillsborough and Polk.
CF Industries Inc	Box 790 Plant City, FL 33566	Open pit mine and plant.	Hardee.
Estech Inc	Box 208 Bartow, FL 33830	Open pit mines	Polk.
Gardinier Inc	Box 3269 Tampa, FL 33601	Open pit mine and plant.	Do.
W. R. Grace & Co	Box 471 Bartow, FL 33830	Open pit mines and plant.	Do.
International Minerals & Chemical Corp.	Box 867 Bartow, FL 33830	do	Do.
Mobil Chemical Corp.[3]	Box 311 Nichols, FL 33863	do	Do.
Occidental Chemical Co	White Springs, FL 32096	do	Hamilton.
U.S.S. Agri-Chemicals Inc	Box 867 Fort Meade, FL 33841	Open pit mine and plant.	Polk.
Sand and gravel (1982):			
Florida Rock Industries Inc., Shands & Baker.	Box 4667 Jacksonville, FL 32216	Pits	Clay, Glades, Lake, Marion, Polk, Putnam.
General Development Corp	1111 South Bayshore Dr. Miami, FL 33131	do	Henry, St. Lucie, Sarasota.
E. R. Jahna Industries Inc., Ortona Sand Co. Div.	First & East Tillman Lake Wales, FL 33853	do	Glades, Lake, Polk.
Silver Sand Co. of Clermont Inc.	Route 1, Box US 1 Clermont, FL 32711	Pit	Lake.
Staurolite:			
Associated Minerals (USA) Ltd. Inc.	Green Cove Springs, FL 32043	Mine and plant	Clay.
E. I. du Pont de Nemours & Co. Inc.	DuPont Bldg. D-10084 Wilmington, DE 19898	Mines and plants	Do.
Stone:			
Florida Crushed Stone Co	Box 317 Leesburg, FL 32748	Quarries	Hernando and Sumter.
Florida Rock Industries Inc	Box 4667 Jacksonville, FL 32216	do	Alachna, Collier, Hernando, Lee, Levy, St. Lucie, Taylor.
Lone Star Florida Inc	Box 6097 Fort Lauderdale, FL 33310	Quarry	Dade.
Rinker Southeastern Materials Inc.	Box 5230 Hialeah, FL 33014	Quarries	Do.
Vulcan Materials Co	Box 660097 Miami Spring, FL 33166	do	Broward and Dade.
Titanium concentrates:			
Associated Minerals (USA) Ltd. Inc.	Green Cove Springs, FL 32043	Mine and plant	Clay.
E. I. du Pont de Nemours & Co. Inc.	DuPont Bldg. D-10084 Wilmington, DE 19898	Mines and plants	Do.

[1]Also stone.
[2]Also exfoliated vermiculite.
[3]Also elemental phosphorus.

The Mineral Industry of Georgia

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources, for collecting information on all nonfuel minerals.

By Doss H. White, Jr.,[1] and Bruce J. O'Connor[2]

Georgia's nonfuel mineral production was valued at $850 million in 1983, an increase of $132 million over that reported for the previous year. The 1983 value was a record high exceeding the previous record set in 1981 by $49 million.

Nationally, the State ranked in the top five in the value of industrial mineral production. Georgia continued to lead all States in the output of clays, crushed and dimension granite, and dimension marble; ranked second in crude iron oxide pigments, kyanite, and crushed marble; and third in the production of bauxite and feldspar.

Table 1.—Nonfuel mineral production in Georgia[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	6,773	$475,768	7,859	$560,005
Gem stones		NA	20	NA	20
Sand and gravel:					
Construction	thousand short tons	3,166	8,361	e3,800	e9,400
Industrial	do.	541	6,793	539	7,298
Stone:					
Crushed	do.	e34,800	e153,500	41,100	186,192
Dimension	do.	e271	e18,510	198	21,672
Talc	do.	20	141	14	101
Combined value of barite, bauxite, cement, feldspar, iron oxide pigments (crude), kyanite, mica (scrap), and peat		XX	54,880	XX	65,536
Total		XX	717,973	XX	850,224

eEstimated. NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Georgia, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Baldwin	(2)	W	Sand and gravel (construction).
Barrow	$830	(3)	
Bartow	W	W	Barite, iron oxide pigments, clays.
Bibb	W	W	Clays, sand and gravel (construction).
Brantley	--	W	Sand and gravel (construction).
Carroll	W	(3)	
Charlton	(2)	--	
Chatham	(2)	W	Sand and gravel (construction).
Cherokee	(2)	--	
Clarke	W	(3)	
Clayton	W	(3)	
Cobb	W	W	Sand and gravel (construction).
Columbia	W	W	Clays.
Columbus (city)	W	$228	Do.
Cook	(2)	W	Sand and gravel (construction).
Coweta	W	(3)	
Crawford	W	W	Sand and gravel (construction), sand (industrial).
Decatur	W	W	Clays, sand and gravel (construction).
De Kalb	12,789	(3)	
Dougherty	(2)	192	Sand and gravel (construction).
Douglas	W	W	Clays, sand and gravel (construction).
Effingham	(2)	W	Sand and gravel (construction), sand (industrial).
Elbert	3,144	W	Sand and gravel (construction).
Evans	(2)	160	Do.
Fannin	W	(3)	
Fayette	W	(3)	
Floyd	W	W	Clays, sand and gravel (construction).
Forsyth	W	(3)	
Fulton	W	22,673	Cement, clays, sand and gravel (construction).
Gilmer	W	(3)	
Glynn	(2)	51	Sand and gravel (construction).
Gordon	3,496	(3)	
Greene	(2)	W	Sand and gravel (construction), sand (industrial).
Gwinnett	W	(3)	
Habersham	W	(3)	
Hall	5,615	(3)	
Hart	W	W	Mica.
Henry	W	(3)	
Houston	W	W	Cement, clays.
Jasper	W	W	Feldspar.
Jefferson	W	W	Clays.
Jones	W	(3)	
Laurens	(2)	--	
Lee	W	W	Sand and gravel (construction).
Lincoln	W	W	Kyanite.
Long	--	W	Sand and gravel (construction), sand (industrial).
Lowndes	--	W	Peat.
Lumpkin	W	(3)	
Madison	2,842	(3)	
Marion	4,111	W	Sand and gravel (construction).
Monroe	W	(3)	
Montgomery	(2)	W	Sand and gravel (construction).
Murray	W	141	Talc.
Newton	W	(3)	
Oglethorpe	3,946	(3)	
Paulding	W	(3)	
Pickens	W	(3)	
Pike	(2)	W	Sand and gravel (construction).
Polk	W	(3)	
Rabun	844	(3)	
Richmond	W	3,153	Clays.
Screven	W	W	Peat.
Seminole	(2)	W	Sand and gravel (construction).
Spalding	W	(3)	
Stephens	W	(3)	
Sumter	W	W	Clays, bauxite.
Talbot	(2)	W	Sand and gravel (construction).
Taylor	(2)	W	Do.
Thomas	13,155	W	Clays, sand (industrial), sand and gravel (construction).
Towns	128	(3)	
Troup	W	(3)	
Twiggs	91,343	94,203	Clays.
Union	(2)	(3)	

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Georgia, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Walker	W	(3)	
Ware	(2)	(3)	
Warren	W	W	Clays.
Washington	$195,124	$172,449	Do.
Wheeler	(2)	W	Sand and gravel (construction).
Whitfield	W	(3)	
Wilkes	W	(3)	
Wilkinson	77,418	75,902	Clays.
Undistributed[4]	377,672	176,809	
Sand and gravel (construction)	e8,308	XX	
Stone:			
Crushed	XX	e153,500	
Dimension	XX	e18,510	
Total[5]	800,763	717,973	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Appling, Atkinson, Bacon, Baker, Banks, Ben Hill, Berrien, Bleckley, Brooks, Bryan, Bulloch, Burke, Butts, Calhoun, Camden, Candler, Catoosa, Chattahoochee, Chattooga, Clay, Clinch, Coffee, Colquitt, Crisp, Dade, Dawson, Dodge, Dooly, Early, Echols, Emanuel, Franklin, Glascock, Grady, Hancock, Haralson, Harris, Heard, Irwin, Jackson, Jeff Davis, Jenkins, Johnson, Lamar, Lanier, Liberty, McDuffie, McIntosh, Macon, Meriwether, Miller, Mitchell, Morgan, Muscogee, Oconee, Peach, Pierce, Pulaski, Putnam, Quitman, Randolph, Rockdale, Schley, Stewart, Taliaferro, Tattnall, Telfair, Terrell, Tift, Toombs, Treutlen, Turner, Upson, Walton, Wayne, Webster, White, Wilcox, and Worth. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Includes gem stones and some clays that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Georgia business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,637.1	2,656.8	+0.8
Unemployment	do	230.6	176.4	-23.5
Employment (nonagricultural):				
Mining[1]	do	7.1	7.6	+7.0
Manufacturing	do	492.6	520.5	+5.7
Contract construction	do	97.2	110.9	+14.1
Transportation and public utilities	do	144.6	149.8	+3.6
Wholesale and retail trade	do	518.5	556.6	+7.4
Finance, insurance, real estate	do	118.2	122.9	+4.0
Services	do	378.3	399.5	+5.6
Government	do	440.5	438.4	-.5
Total nonagricultural employment[1]	do	2,197.0	[2]2,306.1	+5.0
Personal income:				
Total	millions	$54,011	$58,944	+9.1
Per capita		$9,573	$10,283	+7.4
Construction activity:				
Number of private and public residential units authorized		39,437	67,892	+72.2
Value of nonresidential construction	millions	$1,044.7	$1,368.9	+31.0
Value of State road contract awards	do	$425.0	$292.6	-31.2
Shipments of portland and masonry cement to and within the State	thousand short tons	1,920	2,445	+27.3
Nonfuel mineral production value:				
Total crude mineral value	millions	$718.0	$850.2	+18.4
Value per capita, resident population		$127	$148	+16.5
Value per square mile		$12,195	$14,433	+18.4

pPreliminary.

[1]Includes bituminous coal extraction.

[2]Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

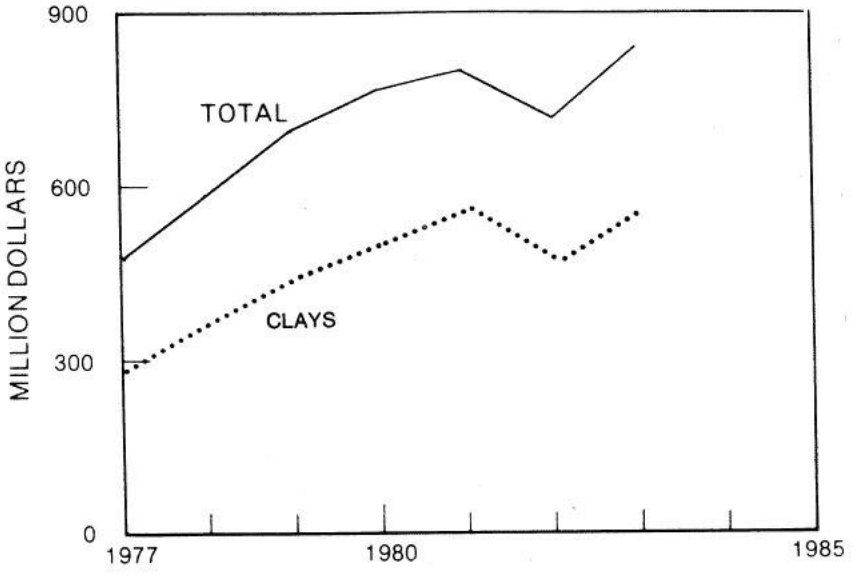

Figure 1.—Value of clays and total value of nonfuel mineral production in Georgia.

Trends and Developments.—The first 3 years in the decade of the 1980's were a period of belt tightening and budget cuts for many of the State's mineral producers. The slump in the economy, which became evident in 1979 and was classified as a recession in 1981, stifled the demand for much of the State's mineral production. The mineral commodities that experienced the brunt of the economy's downturn, the worst in 35 years, were those used in construction, as double-digit inflation and high interest rates discouraged new construction starts.

However, with the lessening of inflation and the decrease in interest rates in 1983, Georgia's construction industry made a dramatic comeback. The resurgence in construction was such that the building industry experienced a payroll increase of 17.7% through the third quarter of 1983, greatly exceeding the national average of 4.3%.[3]

Production of other mineral commodities produced instate reflected the upswing in demand that pushed the value of mineral production to a record high.

In the petroleum industry, the trend toward refining heavier and less desirable crude oil has increased the market for several Georgia kaolin producers. Fluid cracking catalyst was processed from kaolin and used to help refine the Nation's crude petroleum. To satisfy the developing catalyst market, Engelhard Minerals & Chemicals Corp. began construction of a new manufacturing facility that will be part of the company's catalyst operations in Attapulgus. The new facility, scheduled to go on-stream in late 1984, will increase production capacity by 60%.

Katalistiks International completed its 60,000-ton-per-year capacity catalyst plant in Savannah and was producing catalyst at yearend.

In other kaolin-related activity, Wilkinson Kaolin Associates Ltd. began operation of a surface mine and a 120,000-ton-per-year airfloat plant at Gordon late in the year. Principal sales for the Gordon facility were to the paper filler, rubber, fiberglass, and ceramics industries. Thiele Kaolin Co. completed a major expansion at the company's Reedy Creek plant.

American Industrial Clay Co., a division of Georgia Kaolin Co., was the winner in a contest sponsored by the Georgia Mining Association for the best example of mined land reclamation. American Industrial spent over $150,000 to develop the Lake Franklin Recreation Area on a 93-acre minesite near Deepstep in Washington

County.

In other developments, Georgia Port Authority dedicated the new Mayor's Point Terminal; the first ship was the MV *Atlantic Superior*, which used the terminal to discharge 29,000 tons of gypsum from Nova Scotia. The gypsum was trucked to Perry for use in cement manufacture. By mid-1984, the Mayor's Point dock will be 1,500 feet long and will be serviced by a gantry crane. Cargo will be marshaled in a 145,000-square-foot transit building or on 10 acres of open storage.

Environmentalists and residents of Brunswick expressed concern over plans to ship dry sulfur through the Port of Brunswick. Agrico Chemical Co. plans to build a shipping terminal on Colonels Island near Brunswick. The company would transship sulfur through the port until the terminal could be completed on the island; completion is scheduled for 1985.

Georgia's large clay resources continued to interest prospective producers. During 1983, two companies completed work or announced plans to mine and process clay.

At yearend, work was completed on a $6 million lightweight aggregate plant in Clay County in the southwestern part of the State. The facility, on the Chattahoochee River, is equipped with the largest lightweight aggregate kiln in the United States. The clay deposit was evaluated in the late 1970's by the U.S. Bureau of Mines Tuscaloosa (AL) Research Center as part of the Bureau's ongoing clay testing program in conjunction with many of the State geological surveys.

In May, Cisa American Corp., a subsidiary of Ceramiche Cisa S.p.A., finalized plans to construct a $10 million tile manufacturing plant on a 90-acre tract near the Macon Municipal Airport. Initially, the facility is scheduled to operate with one kiln using local clays as a raw material. If markets develop as projected, four additional kilns may be added.

The William Weinman Mineral Center and Museum opened midyear in the Cartersville area. The museum, funded by a $300,000 grant from the estate of William Weinman, active as a mineral producer in the Cartersville area for many years, features one of the finest mineral and gem collections in the Southeast. One facet of the museum is a "touch and feel" rock display. The center is equipped with a classroom with audiovisual facilities and has been used by student groups ranging from elementary school through college age.

The Georgia Mining Association continued to represent the Georgia mineral industry. Association activity during 1983 included (1) cosponsor of a 4-day meeting on accident prevention techniques for supervisors in the mining industry, (2) a water management survey on water use in the mineral industry, (3) providing audiovisual material for the mining museum in Cartersville, (4) an award for the best reclamation project in the State, (5) a safety awards program for member companies, (6) a mine reclamation conference including reclamation site visits, (7) cooperation with New Riverside Ochre Co. in a 1-day tour of the Cartersville-Bartow County mineral district for public officials, and (8) sponsoring a 2-day seminar and field trip through the middle Georgia kaolin belt for members of the Ways and Means Committee of the Georgia House of Representatives.

Throughout the year, the Georgia Crushed Stone Association was active in informing the public, local and State governments, and business on the role of the stone industry in the State's economy and growth. Association officials met with the State Department of Transportation, Ways and Means Committee, and Georgia Public Service Commission personnel to present crushed stone industry views on potential legislation or actions that could adversely affect the stone industry.

The association held workshops on such diverse subjects as plant management and accident prevention, as well as presenting programs on the industry to civic groups. The association prepared exhibits explaining the importance of the industry at several engineering, municipal, and public works conventions.

Legislation and Government Programs.—During the 1983 legislative session, two issues were introduced that, if enacted, would adversely affect the State's mineral industry.

The General Assembly proposed tougher rules regulating the maximum loads that multiaxle trucks could transport over State roads, which would have a direct effect on the mining and logging industries. The Georgia Mining Association filed suit against the State Department of Transportation in the Supreme Court seeking to block the proposed changes. The issue was unresolved at yearend.

In November, a mineral severance tax

was the subject of hearings conducted by a subcommittee of the Ways and Means Committee following a series of articles on the kaolin industry published by an Atlanta newspaper. In December, the Governor stated that there would be no new taxes during his term in office, which effectively deferred the severance tax issue until at least 1986.

During calendar year 1983, the Georgia Geologic Survey continued as the principal Georgia agency involved in investigating Georgia's geology and mineral resources. There were no budget cuts in 1983 as there had been in 1982; thus projects could be fully staffed and funded. During the year the following publications were released:

1. A geologic atlas of all mines, prospects, quarries, etc., was prepared for the Paleozoic region of northwestern Georgia.

2. Two circulars were prepared describing storm water management and compliance with the National Flood Insurance Program.

3. A bulletin on the ground water resources of the Dougherty Plain area of southwest Georgia. This project involved preparation of a mathematical model of a large, unconfined aquifer system.

4. A circular describing geoscience testing facilities in Georgia.

5. An information circular describing the geohydrology of the Clayton and Claiborne aquifers of southwest Georgia.

6. Three hydrologic atlases describing the geohydrology of the Jacksonian aquifer, average annual rainfall and runoff in Georgia 1941-70, and the geohydrology of the Providence aquifer.

The Survey also continued evaluations of sanitary landfill sites, assessments of hazardous waste facilities, assessments of large ground water withdrawals, assessment of radioactive waste disposal, and other environmental evaluations.

Drilling and monitoring well construction continued in coastal Georgia as part of the hydrology program; 13 wells were drilled with the deepest being over 1,200 feet deep. The majority of these wells were equipped with continuous water level recorders.

Since 1978, the Survey had concentrated its activities toward hydrologic studies, and by 1983, most of these studies were completed. With many hydrologic questions now answered, the Survey redirected its activities toward mineral resource evaluations. The following mineral resources projects were initiated:

1. An evaluation of massive sulfide deposits of the Blue Ridge.

2. An evaluation of the construction material resources of the Coastal Plain.

3. An evaluation of the granites of the Piedmont.

4. An evaluation of the mafic and ultramafic rocks of Georgia.

The Surface Mined Land Reclamation Program, under the Environmental Protection Division, Georgia Department of Natural Resources, authorized by the Georgia Surface Mining Act of 1968, as amended through 1976, is the responsible agency for permitting and inspecting reclamation activity for Georgia surface mines. In August, the agency published a report covering reclamation activity of Georgia's surface mining industry covering a 14-1/2-year period.[4]

The Georgia Institute of Technology, supported by the Federal Highway Administration and the Georgia Department of Transportation, conducted a large-scale laboratory study on crushed stone use. The project investigated the advantages of replacing costly deep-strength asphalt with thicker layers of crushed stone base and relatively thin asphalt surfacing.

The U.S. Bureau of Mines continued its support of designated mineral institutes authorized under the 1977 Surface Mine Control and Reclamation Act. The Georgia Institute of Technology, the designated mineral institute in the State, was awarded $150,000 to encourage the training of mining engineers and other scientists involved in mineral-related studies.

Other U.S. Bureau of Mines activity that had potential impact on Georgia's mineral industry continued at the Bureau's Eastern Field Operations Center (EFOC) in Pittsburgh, PA. A report on the mineral potential of the Blood Mountain-Raven Cliff Roadless Area Review and Evaluation (RARE II) area in Georgia was placed on open file and the U.S. Bureau of Mines-U.S. Geological Survey (USGS) summary report on the Rich Mountain RARE II area was published as MF 1586-C.

The Minerals Availability Branch at EFOC conducted engineering and cost evaluation studies on barite deposits in north Georgia. These reports contain confidential industry data and are for Government use only.

In October, the EFOC was closed and Mineral Land Assessment and Minerals Availability activity for the Eastern States was transferred to the Bureau's Intermoun-

tain Field Operations Center in Denver, CO. Minerals liaison responsibility for Georgia remained with personnel with offices in the Bureau's Research Center in Tuscaloosa, AL.

Geologists with the USGS Geologic Division completed mapping of the Atlanta and Griffin 1° x 30' quadrangle, and personnel of the Ground Water Division continued to monitor and evaluate the State's water resources.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Georgia ranked in the top five States, nationally, in the value of industrial mineral production. The State's top three mineral commodities, from a value standpoint, were clays, stone, and cement, which accounted for over 90% of the total value. Georgia's construction industry experienced a substantial payroll increase in 1983, which reflected the rise in construction activity and the demand for construction mineral commodities.

Barite.—The Cartersville mining district in northwestern Georgia is the center of barite mining in the State. Barite was first mined in the 1800's and approximately 6 million short tons have been produced to date. Although 23 different companies have been active in barite mining in the district, only two, New Riverside Ochre and Paga Mining Co., were operating in 1983. New Riverside Ochre operated a surface mine within the city limits of Cartersville; ore was mined by dragline and power shovels and trucked to the company mill south of the city on the Etowah River. Barite was concentrated by a combination of gravity and flotation methods. Paga Mining, a division of Cyprus Industrial Minerals Co., recovered barite by flotation; mill feed consisted of primary ore recovered by surface mining operations and barite wastes recovered from waste ponds left from past mining operations in the district.

The barite concentrates were sold for the manufacture of barium chemicals, as fillers and extenders in paint and rubber products, and as a weighting medium in drilling muds and glassmaking flux. Production and value increased approximately 19% and 17%, respectively.

In 1983, Chemical Products Corp. of Cartersville became the only major domestic producer of barium and strontium chemicals with the closure of a plant on the west coast. Chemical Products purchased barite from New Riverside Ochre and imported strontium from Mexico. At yearend, Chemical Products was considering antidumping proceedings against barium chemical imports from China.

Cement.—The State's cement industry consisted of Blue Circle Inc. in Atlanta and Medusa Cement Co. at Clinchfield in Houston County. Production of portland cement increased slightly; masonry cement production dropped substantially.

The Blue Circle facility operated four kilns—two wet-process units with an annual capacity of 193,000 short tons per year and two dry-process kilns with an annual capacity of 546,000 tons. Medusa operated two dry-process kilns with an annual capacity of 300,000 tons.

During 1983, Blue Circle Industries PLC of the United Kingdom and Cementia Holdings A.G. of Switzerland purchased Martin Marietta Corp.'s Fulton County facility. The Atlanta plant was one of five sold by Martin Marietta to reduce debts incurred when the takeover attempt by Bendix Corp. was thwarted. Blue Circle is considering the conversion of a raw mill to a finish mill at its Atlanta plant.

Clays.—The State again led the Nation in the output and sales of clays. Kaolin was the leading clay in terms of tonnage and value followed by fuller's earth and common clay and shale.

In 1983, the kaolin industry in Georgia consisted of 17 companies operating 73 mines in a 9-county area along the fall line in the east-central part of the State. Major companies, locations, capacity, and markets are given in table 4.

During the year, Thiele Kaolin completed a major expansion at the Reedy Creek facility, and Wilkinson Kaolin Associates opened a mine and airfloat kaolin plant at Gordon.

The Georgia Mining Association recognized Lake Franklin, near Deepstep, as the best reclamation project in the State in 1983. The 93-acre former kaolin mine was converted into an award-winning recreation area by American Industrial, a division of Georgia Kaolin, and Combustion Engineering Inc. The project, which began in 1969 and has cost over $150,000, contains two fishing lakes totaling 43 acres, fishing docks, a swimming beach, diving tower, picnic area, barbecue shed, two hard-surfaced tennis courts, and a 3,000-square-foot air-conditioned recreation center that will hold 130 people.

Table 4.—Georgia: Kaolin producers in 1983[1]

Company	Location	Capacity[2] (thousand short tons)	Major use
American Industrial Clay Co	Sandersville	[3]NA	NA.
Anglo-American Clays Corp	Wrens		
	Sandersville	350	Paper coating and filler.
Babcox & Wilcox Co	Hephzibah	200	Refractories, ceramics, fiberglass.
Buffalo China Clay Co	Sandersville	55	Paper.
Cyprus Industrial Minerals Co	do	200	Paper and refractories.
Engelhard Minerals & Chemicals Corp	do	[3]1,000	Paper.
	Irwinton		
	McIntyre		
	Gardner		
Evans Clay Co	Irwinton	120	Rubber, paint, insecticide.
Freeport Kaolin Co	Sandersville	[3]450	Paper (80%).
	Gordon		
General Refractories	Stevens Pottery	NA	Refractories.
Georgia Kaolin Co	Dry Branch	1,600	NA.
J. M. Huber Co	Wrens	[3]900	Paper, rubber, plastics, paint, adhesives.
	Huber		
M & M Clays Inc	Irwinton	80	Rubber.
Nord Kaolin Co	Jeffersonville	140	Paper.
Thiele Kaolin Co	Sandersville	[3]600	Paper coating and filler.
Wilkinson Kaolin Associates Ltd	Wrens		
	Gordon	120	Ceramics and fiberglass.

NA Not available.
[1]Excludes Andersonville District and kaolin used in cement manufacture.
[2]Industrial Minerals (London). Dec. 1979, pp. 31-33.
[3]All pits.

The U.S. Bureau of Mines published Report of Investigations 8834, "Leaching Aluminum From Calcined Kaolinitic Clay With Nitric Acid." This was part of the Bureau's ongoing research to aid the United States in becoming self-sufficient in several strategic and critical minerals.

The State continued to lead the Nation in fuller's earth production. Five companies in two southwestern Georgia counties produced attapulgite and montmorillonite, and a sixth, located in Jefferson County in east-central Georgia, produced montmorillonite. Companies, locations, and products are listed in table 8.

Table 5.—Georgia: Kaolin sold or used by producers, by kind

Kind	1982		1983	
	Short tons	Value	Short tons	Value
Airfloat	467,922	$16,778,096	395,422	$21,359,864
Calcined[1]	727,742	97,160,884	770,556	118,769,408
Delaminated	612,591	56,251,295	722,128	68,527,254
Unprocessed	277,245	3,856,568	360,942	4,699,555
Waterwashed	3,182,858	271,342,422	3,636,698	310,050,641
Total	5,268,358	445,389,265	5,885,746	523,406,722

[1]Includes both low-temperature filler and high-temperature refractory grades.

Table 6.—Georgia: Kaolin sold or used by producers, by use

(Short tons)

Use	1982	1983
Domestic:		
Adhesives	58,051	70,950
Chemicals	194,845	229,758
Fiberglass and mineral wool	106,447	129,129
Firebrick, block and shapes	1,066	11,308
Floor and wall tile, ceramic	21,014	19,931
Paint	97,162	112,952
Paper coating	2,026,511	2,321,663
Paper filling	866,860	994,580
Plastics	35,891	38,613
Rubber	60,319	77,218
Sanitary ware	54,024	66,517
Whiteware	20,250	18,310
Other	580,001	625,883
Exports	1,145,917	1,168,934
Total	5,268,358	5,885,746

Table 7.—Georgia: Kaolin sold or used by producers, by use

(Short tons)

Use	1982				1983			
	Air-float	Unprocessed[1]	Water-washed[2]	Total	Air-float	Unprocessed[1]	Water-washed[2]	Total
Domestic:								
Adhesives	28,086	--	29,965	58,051	14,983	--	55,967	70,950
Alum (aluminum sulfate) and other chemicals	8,708	185,440	697	194,845	8,931	219,890	937	229,758
Animal feed	--	242	200	442	--	242	509	751
Asphalt tile and linoleum	3,433	--	--	3,433	3,635	--	--	3,635
Catalysts (oil-refining)	39,272	--	94,515	133,787	56,776	--	113,392	170,168
China and dinnerware; crockery and earthenware	15,675	4,574	1	20,250	14,570	3,740	--	18,310
Electrical porcelain	7,387	7,263	--	14,650	8,462	7,263	--	15,725
Face brick	--	16,000	29,842	45,842	45	19,801	--	19,846
Fiberglass and mineral wool	57,241	11,477	37,729	106,447	70,351	11,477	47,301	129,129
Firebrick, block and shapes	140	926	--	1,066	408	10,900	--	11,308
Floor and wall tile, ceramic	21,014	--	--	21,014	19,931	--	--	19,931
Flue linings and high-alumina brick, glazes, glass, enamels	38,548	--	--	38,548	29,042	--	--	29,042
Foundry sand	--	--	501	501	--	--	685	685
Grogs and crudes, refractory	2,970	213,917	--	216,887	1,245	215,043	--	216,288
Ink	W	--	W	13,163	W	--	--	W
Kiln furniture, mortar, cement	W	W	--	19,185	W	W	--	W
Medical, pharmaceutical, cosmetic	W	--	W	1,660	--	--	1,611	1,611
Paint	28,964	--	68,198	97,162	5,285	--	107,667	112,952
Paper coating	--	--	2,026,511	2,026,511	--	--	2,321,663	2,321,663
Paper filling	63,463	--	803,397	866,860	11,533	4,035	979,012	994,580
Plastics	1,158	--	34,733	35,891	499	26	38,088	38,613
Pottery	7,210	1,117	--	8,327	7,981	699	--	8,680
Roofing granules	6,265	7,316	--	13,581	6,308	7,316	--	13,624
Rubber	29,123	--	31,196	60,319	24,943	--	52,275	77,218
Sanitary ware	29,394	18,984	5,646	54,024	25,259	41,225	33	66,517

Miscellaneous, airfloat:								
Common brick, fertilizers, gypsum products, pesticides and related products, roofing and structural tile, other uses not specified	13,473	--	--	13,473	20,509	--	--	20,509
Miscellaneous, unprocessed:								
Fertilizers, pesticides and related products, other uses not specified (1983)	--	10,968	--	10,968	--	11,086	--	11,086
Miscellaneous, waterwashed:								
Gypsum products, pesticides and related products, waterproofing and sealing, fertilizers, other uses not specified	--	--	45,554	45,554	--	--	81,663	81,663
Undistributed	7,415	13,433	13,160	--	8,715	23,855	--	32,570
Total	408,939	491,657	3,221,845	4,122,441	339,411	576,598	3,800,803	4,716,812
Exports:								
Paint	--	--	31,256	31,256	4,352	--	29,403	33,755
Paper coating	26,396	--	833,430	859,826	41,543	--	840,559	882,102
Paper filling	9,437	--	87,299	96,736	887	--	106,974	107,861
Plastics	--	--	20,572	20,572	--	--	21,116	21,116
Refractories	19,821	103,286	--	123,107	8,535	106,757	--	115,292
Rubber	2,400	--	465	2,865	188	--	595	783
Undistributed	929	--	10,626	11,555	506	--	7,519	8,025
Total	58,983	103,286	983,648	1,145,917	56,011	106,757	1,006,166	1,168,934
Grand total	467,922	594,943	4,205,493	5,268,358	395,422	683,355	4,806,969	5,885,746

W Withheld to avoid disclosing company proprietary data; included with "Domestic: Undistributed."
[1]Includes high-temperature calcined.
[2]Includes low-temperature calcined and delaminated.

Table 8.—Georgia: Fuller's earth producers in 1983

Company	Location	Product
Engelhard Minerals & Chemicals Corp	Attapulgus	Catalysts and absorbents.
GA-TN Mining and Chemical Co	Wrens	Absorbents, animal and industrial waste, agricultural carriers.
Milwhite Co. Inc	Attapulgus	Absorbents, fillers, joint compounds.
Oil-Dri Corp	Ocklocknee	Absorbents and animal and industrial waste.
Thor Mining Co	Meigs	Do.
Waverly Mineral Products Co	do	Do.

Fuller's earth was mined by surface methods and dried, crushed, milled, screened, and bagged. Thor Mining Co. closed its processing facility and shipped clay to Waverly Mineral Products Co. for processing. In June, Anshutz Minerals Corp. closed its mine and plant; the facilities were up for sale at yearend.

Common clay was produced by 9 companies operating 11 mines.

Table 9.—Georgia: Common clay production in 1983, by selected area and county

Area and county	Number		Production	
	Companies	Mines	Quantity (thousand short tons)	Value (thousands)
Northwest: Bartow, Douglas, Floyd, Fulton	5	6	572	$1,918
Central and east: Bibb and Richmond	4	5	685	1,803

During the year, Cisa American, a subsidiary of Ceramiche Cisa, finalized plans for a tile manufacturing plant near the Macon Municipal Airport in Bibb County. The $10 million facility will occupy a 90-acre tract, and local clays will be mined for tile manufacture. Depending on market conditions, up to five kilns will be operated.

At yearend, Camp Liteweight Aggregates began operation of a $6 million open pit clay mine and lightweight aggregate plant in Clay County on the Chattahoochee River. Clay is transported by conveyor from the mine to the plant, which is equipped with a $1.5 million coal-fired kiln.

Feldspar.—Georgia ranked third among six States in the mining of feldspar, an aluminum silicate used in glassmaking and ceramics. Typically, 150 to 200 pounds of ground feldspar is used to produce 1 ton of container glass.

Georgia's feldspar production was from the Monticello and Siloam areas of Jasper and Greene Counties. The Feldspar Corp., a subsidiary of Pacific Tin Consolidated Corp., operated an open pit in Jasper County to recover feldspar-bearing rock from pegmatite bodies and an open pit mine in Greene County to mine a granite saprolite. The Greene County operation concentrates and deslimes the feldspar in the saprolite before trucking the concentrate to Monticello for further processing. At the Monticello mill, material from both mines was crushed and ground, and the feldspar was separated by flotation. The feldspar concentrate was then shipped to glass and ceramic manufacturers in over 20 States, Canada, and Mexico. Output in 1983 increased over that reported for the previous year as the upswing in the housing industry increased the demand for glass and ceramic products.

Gypsum.—Gypsum was imported from Canada by three companies as a raw material for the manufacture of gypsum board, plasters, fillers, and agricultural materials. A fourth company, American Cyanamid Co., Chatham County, produced gypsum as a byproduct of titanium dioxide manufacture. A portion of the byproduct gypsum was pressed into briquets by Lemco Gypsum Inc. and sold to cement manufacturers. The following is a list of Georgia gypsum products companies:

Company	County	Source
Genstar Building Products Co.	Chatham	Newfoundland.
Georgia-Pacific Corp., Gypsum Div.	Glynn	Nova Scotia.
Goldbond Building Materials Corp.	Chatham	Do.
Lemco Gypsum Inc	do	American Cyanamid Co.

Kyanite-Mullite.—Georgia and Virginia were the only two States producing kyanite—an aluminum silicate used by the ceramic industry and to produce mullite for refractory applications.

C-E Minerals Inc. operated an open pit mine and beneficiation facility at Graves Mountain in Lincoln County in northeastern Georgia. The operation, which began in 1963, utilizes grinding, two-stage flotation, and magnetic separation to produce a marketable product.

The Mulcoa Div. of C-E Minerals produced synthetic mullite by sintering a mixture of aluminous and siliceous materials in a seven-kiln plant in Sumter County in southeastern Georgia.

Mica.—Franklin Mineral Products Co. Inc., a subsidiary of the Mearl Corp., operated an open pit mine and mill in Hart County in the northeastern part of the State. The company also imported mica from India and Brazil. Mica was wet ground and the major portion used by the parent company in the manufacture of pearlescent pigments. The company also trucked crude mica to a company-owned wet-ground plant in Franklin, NC.

Perlite.—Crude perlite, imported from Greece, was shipped to Armstrong World Industries Inc.'s plant near Macon in Bibb County. The material was expanded in a horizontal rotary furnace at temperatures of approximately 1,600° F. After the expansion step, the material passed through a cyclone classifier system and into storage bins prior to bagging and shipping. Sales during 1983 exceeded those of 1982.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Sand for industrial sales was produced by four companies: three with operations in Crawford, Greene, and Macon Counties in the central part of the State; and one in Thomas County in the southwestern part of Georgia. The three leading end uses identified to the U.S. Bureau of Mines were for (1) glass container manufacture, (2) sandblasting, and (3) roofing granules. Miscellaneous uses ranked second in the tonnage reported. Although industrial sand output fell 2,000 tons below that reported for the previous year, the value increased over $500,000 because of a $1 per ton increase in unit value.

Table 10.—Georgia: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	2,673	$7,198	$2.69	NA	NA	NA
Gravel	399	1,046	2.62	NA	NA	NA
Sand and gravel (unprocessed)	93	117	1.25	NA	NA	NA
Total or average	[1]3,166	8,361	2.64	[e]3,800	[e]$9,400	[e]$2.47
Industrial sand	541	6,793	12.55	539	7,298	13.55
Grand total or average	3,707	15,154	4.09	[e]4,339	[e]16,698	[e]3.85

[e]Estimated. NA Not available.
[1]Data do not add to total shown because of independent rounding.

Silicon Carbide.—Silicon Metals Inc. completed plant construction and began silicon carbide production in the fall of 1983. The Elberton-based company used silicon carbide-bearing sludge from the granite cutting and finishing operations around Elberton as a plant feed. Froth flotation was used to separate the silicon carbide from the stone particles. Major sales were to silicon carbide-producing companies. At yearend, the U.S. Bureau of Mines Tuscaloosa Research Center was working with company personnel to improve recovery of this strategic material.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Historically, Georgia has led the Nation in the production of crushed granite, dimension granite, and marble, and ranked third behind Maryland and Alabama in crushed marble output; this was again true in 1983. Over the past 10 years, the State's stone production has added over $1.3 billion to Georgia's economy and created thousands of jobs for the State's citizens as well as providing the foundation for a growing construction industry.

Crushed.—Georgia's crushed stone producers mined a variety of stone types including granite, marble, slate, limestone, and quartzite. Although the majority of the stone produced was used for construction aggregate, a significant amount of marble was ground and sold for extenders and fillers. The crushed granite industry, consisting of 14 companies operating 43 quarries, is situated primarily in the north-central-northeast part of the State.

Table 11.—Georgia: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	W	W
Riprap and jetty stone	145	727
Filter stone	W	W
Coarse aggregate, graded:		
Concrete aggregate, coarse	6,858	33,597
Bituminous aggregate, coarse	4,687	20,801
Bituminous surface treatment aggregate	323	1,589
Railroad ballast	3,334	13,141
Other graded coarse aggregate	W	W
Fine aggregate (-3/8 inch):		
Stone sand, concrete	2,053	8,853
Stone sand, bituminous mix or seal	1,530	6,489
Screening, undesignated	2,418	10,021
Other fine aggregate	W	W
Coarse and fine aggregate:		
Graded road base or subbase	9,455	38,499
Unpaved road surfacing	111	497
Terrazzo and exposed aggregate	W	W
Crusher run or fill or waste	4,281	16,292
Other coarse and fine aggregate	W	W
Agricultural: Agricultural limestone	W	W
Chemical and metallurgical: Cement manufacture	W	W
Special:		
Other fillers or extenders	W	W
Lightweight aggregate	W	W
Other[2]	5,904	35,687
Total[3]	41,100	186,192

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."

[1]Includes limestone, dolomite, granite, marble, quartzite, and slate.

[2]Includes uses not specified and uses indicated by symbol W.

[3]Data do not add to totals shown because of independent rounding.

The State's crushed marble production is in Gilmer and Pickens Counties in the northern part of the State where the Georgia Marble Co. operates underground mines to produce stone for the extender and filler markets. A second company in Hall County produces crushed marble from a calcareous body in the Brevard Shear Zone.

Limestone production was reported from four northwestern Georgia counties and Houston, Lee, and Miller Counties in the southern part of the State. The northwestern Georgia production was by six companies operating six quarries, while production in southern Georgia was by four companies from four mines.

During 1983, Dalton Rock Products Co. doubled capacity of its Dalton operation. The capacity increase was made without major equipment changes by maintaining a continuous flow from quarry, primary feeder, and surge bins to the crushers.[5]

One company produced slate in Polk County in northwestern Georgia for expanding into lightweight aggregate, and one company mined and crushed quartzite in Richmond County in east-central Georgia for the aggregate market. Crushed stone statistics for 1983 are given in table 12.

Table 12.—Georgia: Production of crushed stone, by type

Type	Number of quarries		Quantity (thousand short tons)		Value per ton	
	1981	1983	1981	1983	1981	1983
Granite	44	43	27,959	33,898	$3.98	$4.27
Limestone	10	10	4,974	3,459	W	W
Marble	--	--	W	W	33.23	20.91
Slate	1	1	W	W	22.69	13.77
Quartzite	1	1	W	W	W	4.41
Sandstone	4	--	1,560	W	3.96	W

W Withheld to avoid disclosing company proprietary data.

Dimension Granite.—The Elberton district in northeastern Georgia led the Nation in output of dimension granite and exported stone to many other countries. Production from quarries in Elbert, Madison, Oglethorpe, and Wilkes Counties fell 29% below that of 1982. In 1983, several quarry expansions were underway. Notable were Service Granite Co., Georgia-Carolina Quarries Inc., and Kantala Quarries Inc., which accounted for approximately 26,000 square feet of quarry area.

In other developments during 1983, Quarry Operators Inc. constructed a new road from the west quarry wall to the quarry floor to allow use of a 25-short-ton-capacity front-end loader in place of a derrick. The loader is the largest in the district.

Acme Granite Co. Inc. purchased the Silver Cloud quarry 90 miles west of Elberton. The quarry site included 25 to 30 acres of granite pavement and will be operated as a "drive-in" type operation. The level surface of the deposit permitted the use of a 35-ton-capacity mobile crane for block loading.

Boyd Granite Co. Inc. completed the installation of a new "radial arm" diamond shaping saw, the first of its type in the Elberton district. The saw utilizes a 14-inch diamond blade that can be rotated 90° to make either vertical or horizontal cuts and cuts operating time by 66%.

Puritan Granite Co. Inc. installed a computer-operated automatic polishing system produced by a West German firm, the first such installation in the United States. The system has a tracked bed 16 feet wide and 60 feet long that will accommodate a maximum of 12 granite slabs up to 14 inches thick. The system's grinding heads hold four attached abrasive bricks that grind, hone, and buff the slabs into a mirror-like finish. The abrasive bricks can be replaced in minutes, and the system is constructed so that a second grinding head can be added if a dual capacity is desired.

Dimension Marble.—Georgia led the Nation in the output of dimension marble. Long Swamp Valley in Pickens County has supplied the raw material for marble bowls and statues sculptured in prehistoric times and dimension blocks quarried for monument fabrication since 1835. Currently, marble quarrying is limited to Georgia Marble's operations east of the community of Tate. The company's Memorial Div., headquartered at Tate, fabricated personal monuments, markers, and mausoleums; and the Structural Div. at Nelson fabricated building panels for facades and interiors.

Other Dimension Stone.—Several producers in the north Georgia area quarry a variety of metamorphic rock types for flagstone. The principal stone type, metagraywacke, was used in both exterior and interior applications.

Table 13.—Georgia: Dimension stone[1] sold or used by producers in 1983, by use

Use	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Rough blocks for building and construction	25,383	277	$1,340
Monumental	130,708	1,181	6,875
Other[2]	23,952	252	471
Dressed stone:			
Monumental	10,008	110	6,524
Other[3]	7,813	79	6,462
Total	197,864	[4]1,898	21,672

[1]Includes granite, marble, and metagraywacke.
[2]Includes irregular-shaped stone, rubble, and flagging.
[3]Includes ashlars and partially squared pieces and slabs and blocks for building and construction.
[4]Data do not add to total shown because of independent rounding.

Strontium.—Celestite, a strontium sulfate mineral, was imported from Mexico by the Cartersville-based Chemical Products. The ore was processed to produce strontium carbonate used in color television picture tube face plates and other specialty applications. Work was ongoing on a strontium nitrate facility scheduled for completion in 1984; the new plant will satisfy domestic demand. Major uses are in pyrotechnics. The company also processed barite obtained from New Riverside Ochre for barium chemical production.

Talc.—The Southern Talc Co. produced talc from the Rock Cliff underground mine on Fort Mountain in Murray County in north-central Georgia. The material was trucked to a mill in Chatsworth where it was dried, crushed, and ground for use in the roofing, ceramics, insecticide, paper, and rubber industries.

METALS

Although most of Georgia's extractive mineral industry is nonmetallic, the State had a significant metal industry based on processing imported metallic materials.

Arsenic.—The Koppers Co. produced high-purity arsenic trioxide at its plant in Conley from low-grade material imported from Canada. Arsenic trioxide was processed into arsenic acid used in the production of chromated copper arsenate wood preservatives.

Bauxite.—Georgia, Alabama, and Arkansas were the only States producing bauxite in 1983. Georgia production was centered in the historic Andersonville bauxite district in the southwestern part of the State. The Mulcoa Div. of C-E Minerals operated a surface mine and processing facilities in the Andersonville area. Bauxite from the former operation was processed for use in alum manufacture, while C-E Minerals used bauxite in the manufacture of refractory grogs.

Copper.—Southwire Co., in Carrollton, west of Atlanta, operated a copper smelter, a continuous cast copper rod facility, and a wire plant. During 1983, Southwire completed a refinancing of the company's debt structure, which provided the company with "greater flexibility to better expand and move forward..."[6]

Gold.—Interest in Georgia's historic Dahlonega gold district remained high throughout 1983 although production was limited to three intermittent dredge operations and a number of part-time weekend sluicing ventures. The large number of out-of-State land owners posed a major problem to gaining control of sufficient property to allow mine development.

Iron Oxide Pigments.—Georgia, Missouri, and Virginia were the only States with crude iron oxide pigment production. New Riverside Ochre, a Cartersville barite producer, mined crude pigments that occur in lower Cambrian Age rocks in the area. The company sold pigments for use in cement and construction materials such as mortar coloring agents, brick and tile, paint and coatings, and other products requiring coloring agents.

Iron and Steel.—Atlantic Steel Co. operated facilities in Atlanta and Cartersville. The Atlanta minimill contained two 90-ton electric furnaces, bar, rod, and wire mills, and the Cartersville facility was equipped with a 100-ton electric furnace and bar mill. Early in the year, the company terminated manufacturing of bar-sized and structural angles and channels because of a slump in demand. However, at yearend, the company was operating at about 85% of capacity as the demand for steel products increased.

In April, Bull Moose Tube Co. announced plans to construct a $5 million small-diameter welded pipe and tube plant in Trenton in northwestern Georgia. The new

facility, which began operation in October, contains two electric resistance welding mills.

Slag.—Steel slag from the Atlantic Steel furnaces was processed by one company with two plant locations and sold primarily for road base and fill.

Ferrous Foundries.—In midyear, Columbus Foundries purchased the Virginia-based Lynchburg Foundry for approximately $100 million. Columbus Foundries operated two foundries in Columbus and had controlling interest in foundries in England and the Federal Republic of Germany. At yearend, Columbus Foundries was considering a diversification of products and services.[7]

Titanium.—American Cyanamid operated a titanium dioxide pigment plant at Savannah and imported a Canadian titanium-rich slag as plant feed. Annual capacity for the sulfide and chloride processes was slightly over 100,000 short tons. Principal pigment sales were to the paint, paper, and plastics industries with lesser amounts used by a myriad of industries including toothpaste and candy. The company also imported a significant tonnage of aragonite (calcium carbonate) from the Bahamas for use in acid neutralization.

---

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, AL.
[2]Senior economic geologist, Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources.
[3]Georgia Labor Market Trends. Sept. 1983.
[4]Georgia Department of Natural Resources. Georgia Surface Mining and Land Reclamation Activities. Aug. 1983, p. 39.
[5]Rock Products. Sept. 1983, p. 44.
[6]American Metal Market. June 29, 1983.
[7]———. Nov. 19, 1983.

Table 14.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
New Riverside Ochre Co.[1]	Box 387 Cartersville, GA 30120	Open pit mine and mill.	Bartow.
Paga Mining Co	Box 130 Cartersville, GA 30120	____do ___	Do.
Bauxite:			
American Cyanamid Co	Box 38 Andersonville, GA 31711	Open pit mine	Sumter.
Mullite Co. of America	Box 37 Andersonville, GA 31711	____do ___	Do.
Cement:			
Blue Circle Inc	15 South 20th St. Birmingham, AL 35233	Plant _____	Fulton.
Medusa Cement Co	Box 5668 Cleveland, OH 44101	____do ___	Houston.
Clays:			
American Industrial Clay Co	433 North Broad St. Elizabeth, NJ 07207	Open pit mines.	Warren and Washington.
Engelhard Minerals & Chemicals Corp	Menlo Park Edison, NJ 08817	____do ___	Decatur, Washington, Wilkinson.
J. M. Huber Co	Thornall St. Edison, NJ 08817	____do ___	Twiggs and Warren.
Thiele Kaolin Co	Box 1056 Sandersville, GA 31082	____do ___	Warren and Washington.
Feldspar:			
The Feldspar Corp	Box 99 Spruce Pine, NC 28777	Open pit mines and plant.	Greene and Jasper.
Gypsum (calcined):			
Genstar Building Products Co	Box 2580 Irving, TX 75061	Plant _____	Chatham.
Georgia-Pacific Corp	133 Peachtree St., NE. Atlanta, GA 30303	____do ___	Glynn.
National Gypsum Co	4100 First International Bldg. Dallas, TX 75270	____do ___	Chatham.
Kyanite:			
C-E Minerals Inc	901 East 8th Ave. King of Prussia, PA 19406	Open pit mine and plant.	Lincoln.
Mica:			
Franklin Mineral Products Co. Inc	Box O Wilmington, MA 01887	____do ___	Hart.
Perlite (expanded):			
Armstrong World Industries Inc	1010 Concord Lancaster, PA 17604	Plant _____	Bibb.

See footnotes at end of table.

Table 14.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Construction (1982):			
Atlanta Sand & Supply Co	Route 1 Roberta, GA 31078	Open pit mine	Crawford.
Brown Bros. Sand Co	Box 82 Howard, GA 31039	Open pit mines.	Talbot.
Howard Sand Co	Box 118 Butler, GA 31006	do	Talbot and Taylor.
Industrial (1982):			
Crawford County Mining Inc	Route 1 Roberta, GA 31078	Open pit mine	Crawford.
L. C. Curtis & Son Inc	Box 123 Watkinsville, GA 30677	do	Greene.
Jessie S. Morie & Son Inc	1201 North High St. Millville, NJ 08332	do	Marion.
Montgomery Sand Co., a division of Florida Crushed Stone.	Box 2117 Thomasville, GA 31792	do	Thomas.
Stone:			
Crushed:			
Florida Rock Industries Inc	Box 4667 Jacksonville, FL 32201	Quarries	Clayton, Floyd, Monroe, Spalding.
Georgia Marble Co	3460 Cumberland Pkwy., NW. Atlanta, GA 30303	do	De Kalb, Douglas, Forsyth, Gilmer, Hall, Newton, Pickens.
Martin Marietta Aggregates	Box 30013 Raleigh, NC 27612	do	Jones, Lee, Richmond, Warren.
North Georgia Crushed Stone Co., a division of Koppers Co.	Box 458 Lithonia, GA 30058	do	Clarke, De Kalb, Fayette, Fulton, Habersham, Hall, Stephens, Walker.
Vulcan Materials Co	Box 80730 Atlanta, GA 30366	do	Carroll, Cobb, Coweta, Douglas, Fulton, Gwinnett, Henry, Troup.
Dimension:			
Bennie & Harvey Inc	Box 958 Elberton, GA 30635	Quarry and finishing plant.	Oglethorpe.
Coggings Granite Industries Inc	Box 250 Elberton, GA 30635	do	Madison.
Georgia Marble Co	Box 238 Tate, GA 30117	do	Pickens.
Granite Panewall Co., a division of Florida Crushed Stone.	Box 898 Elberton, GA 30635	do	Elbert.
Talc:			
Southern Talc Co	Box F Chatsworth, GA 30705	Mines and mill.	Murray.

[1]Also produced crude iron oxide pigments.

The Mineral Industry of Hawaii

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Department of Land and Natural Resources of the State of Hawaii for collecting information on all nonfuel minerals.

By Herbert R. Babitzke[1]

Hawaii's nonfuel mineral production value was $52 million in 1983, an increase of 12% over that of 1982, but 18% less than the record high year of 1979. Nonmetals—cement, gem stones, lime, pumice, sand and gravel, and stone—accounted for the total value. Except for gem stones and lime, all of the nonmetals were used in the construction industry.

The year 1983 produced an overall modest improvement for construction in Hawaii. Some of the increase was attributed to reconstruction of the hurricane-related damages on Kauai. Although moderate growth was noted on the neighboring islands, reversing the general decline of the preceding 2 years, Oahu entered a third year of decline.

After considerable concern expressed by some local residents, the Barbers Point deep-draft harbor construction and dredging continued through the year. The State Land Use Commission approved stockpiling of the dredged coral at the Campbell Industrial Park on the island of Oahu. Stockpiled material is slated for use in agricultural purposes and for the manufacture of concrete products.

Increasing interest in deposits of polymetallic manganese crusts on the slopes of submerged seamounts and nodules on the deep ocean floor near Hawaii has prompted feasibility studies for a processing plant on the island of Hawaii. Average metal contents for the nodules are 0.27% cobalt, 0.76% nickel, 0.54% copper, and 20.1%

Table 1.—Nonfuel mineral production in Hawaii[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	6	$554	6	$641
Portland do.	227	18,122	216	20,673
Sand and gravel (construction) do.	449	1,221	e440	e1,000
Stone:				
Crushed do.	e4,500	e26,600	5,532	29,703
Dimension do.	e(2)	e4	(2)	3
Combined value of gem stones, lime, and pumice	XX	388	XX	391
Total	XX	46,889	XX	52,411

eEstimated. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Less than 1/2 unit.

manganese. Average metal contents for the manganese crusts on the slopes of submerged seamounts within the Hawaiian Archipelago are 0.90% cobalt, 0.50% nickel, 0.06% copper, and 24.7% manganese. The occurrence of manganese crusts at relatively shallow depths of less than 2,400 meters may make them more economically attractive than the deep-sea nodules for near-term development.

The Governor signed into law Act 152—High Technology Research and Development, which authorized a high-technology corporation and research center. Ocean research revolving around food, energy, and minerals will be encouraged in this program.

Table 2.—Value of nonfuel mineral production in Hawaii, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Hawaii	W	W	Sand and gravel (construction), pumice.
Honolulu	W	W	Cement.
Kauai	$2,663	$78	Sand and gravel (construction).
Maui	W	1,344	Sand and gravel (construction), lime, pumice.
Sand and gravel (construction)	e1,198	XX	
Stone:			
Crushed	XX	e26,600	
Dimension	XX	e4	
Total[2]	57,025	46,889	

eEstimated. W Withheld to avoid disclosing company proprietary data; included in "Total." XX Not applicable.
[1]County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."
[2]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

Table 3.—Indicators of Hawaii business activity

	1982	1983p	Change, percent
Employment and labor force, annual average:			
Total civilian labor force, thousands	470.9	469.1	-0.4
Unemployment, do	31.2	26.8	-14.1
Employment (nonagricultural):			
Manufacturing, do	22.1	21.9	-.9
Contract construction, do	18.1	17.5	-3.3
Transportation and public utilities, do	30.8	30.5	-1.0
Wholesale and retail trade, do	105.0	106.5	+1.4
Finance, insurance, real estate, do	31.6	31.1	-1.6
Services, do	104.6	104.8	+.2
Government, do	92.1	89.6	-2.7
Total nonagricultural employment, do	404.3	401.9	-.6
Personal income:			
Total, millions	$11,589	$12,382	+6.8
Per capita	$11,614	$12,101	+4.2
Construction activity:			
Number of private and public residential units authorized	5,790	4,754	-17.9
Value of nonresidential construction, millions	$250.3	$177.2	-29.2
Value of State road contract awards, do	$69.0	$77.3	+12.0
Shipments of portland and masonry cement to and within the State, thousand short tons	235	222	-5.5
Nonfuel mineral production value:			
Total crude mineral value, millions	$46.9	$52.4	+11.7
Value per capita, resident population	$47	$51	+8.5
Value per square mile	$7,270	$8,099	+11.4

pPreliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Kaiser Cement Corp. at Waianae and Lone Star Hawaiian Cement Corp. at the Campbell Industrial Park operated the two cement plants in Honolulu County (Oahu). Combined annual capacity for both plants is approximately 600,000 short tons of cement. The plants, in concert, operated at 36% of capacity during 1983. Sales of portland cement declined about 5% from those in 1982, while value increased 14%. Masonry cement sold during the year was 6,114 short tons, or about the same as that of 1982. Value increased 16% to $641,000.

Of the total portland cement sold, 74% was used for ready-mix concrete, 14% by concrete-product manufacturers, 7% by building-material dealers, 5% by highway and other contractors, and less than 0.5% by government agencies and other miscellaneous customers.

Raw materials consumed in the manufacture of portland cement were limestone, coral, volcanic cinder, sandstone, sand, pyrite, and gypsum. Both plants used coal and fuel oil for power, and each purchased electrical energy. As in previous years, all of the limestone, coral, and volcanic cinder was mined at nearby quarries on Oahu; other raw materials were imported, either from Australia or Mexico. Coal was imported from Australia.

Although the two cement plants operated at significantly less than capacity during 1983, some Hawaiian concrete manufacturing companies imported cement from the Republic of Korea. Two shiploads were received during the year—in March and August. Each shipment totaled 16,000 short tons.

Gem Stones.—The gem stone industry continued to draw considerable interest on nearly all of the Hawaiian Islands. Coral of pink, black, red, and gold hue mined in the waters surrounding the islands, and olivine formed by volcanic activity, were used by the local jewelry industry.

Lime.—The Hawaiian Commercial & Sugar Co. Ltd. continued to produce calcined lime from its operations near Paia, Maui County. Sufficient quantities were produced for the sugar refineries on Maui.

Brewer Chemical Corp. continued to produce fine-ground calcium carbonate at Kawaihae in Hawaii County for agricultural amendment. The raw limestone was produced from dredging operations at Kawaihae Harbor and surrounding small boat harbors.

Pumice and Volcanic Cinder.—Volcanic cinder was produced by Puna Sugar Co. Ltd. and Volcanite Ltd. on the island of Hawaii. Maui Pineapple Co. Ltd. and Maui Concrete & Aggregate Co. both produced volcanic cinder from quarries near Lahaina on the island of Maui. All material was used for road construction and maintenance, insulation, and landscaping.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Table 4.—Hawaii: Construction sand and gravel sold or used by producers

	1982			1983[e]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	W	W	$4.26	NA	NA	NA
Gravel	W	W	4.78	NA	NA	NA
Sand and gravel (unprocessed)	425	$1,111	2.61	NA	NA	NA
Total or average	449	1,221	2.72	440	$1,000	$2.27

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Table 5.—Hawaii: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	19	151
Riprap and jetty stone	336	905
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,149	7,540
Bituminous aggregate, coarse	241	1,372
Fine aggregate (-3/8 inch):		
Stone sand, concrete	529	5,282
Stone sand, bituminous mix or seal	110	911
Coarse and fine aggregate:		
Graded road base or subbase	1,240	5,357
Unpaved road surfacing	654	2,060
Terrazzo and exposed aggregate	35	162
Crusher run or fill or waste	418	1,983
Bedding material	28	112
Agricultural: Agricultural limestone	18	138
Chemical and metallurgical: Cement manufacture	496	1,852
Special:		
Other fillers or extenders	3	10
Other[2]	257	1,867
Total[3]	5,532	29,703

[1]Includes limestone, traprock, and volcanic cinder and scoria.
[2]Includes poultry grit and mineral food, filter stone, lime manufacture, chemicals, screening (undesignated), combined coarse and fine aggregate, and uses not specified.
[3]Data do not add to totals shown because of independent rounding.

Production of crushed stone in 1983 increased 23% in quantity over the estimated production in 1982, and value increased 12%. Limestone was produced as crushed and broken stone from 7 quarries, traprock as crushed and broken stone from 16 quarries, and volcanic cinder as crushed stone from 11 quarries. The largest amount of crushed stone was used for road base and in concrete aggregate. Distribution of quarries in the State are 14 in Hawaii County, 8 in Honolulu County, 7 in Kauai County, and 5 in Maui County. The three major producers—Ameron Honolulu Construction & Drayage Ltd., Pacific Concrete & Rock Co. Ltd., and Lone Star Hawaii Rock Products—produced 60% of the total crushed stone in Hawaii in 1983.

James W. Glover Ltd. was the sole producer of dimension stone from a quarry at Hilo, Hawaii County.

[1]State Liaison Officer, Bureau of Mines, Spokane, WA.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Kaiser Cement Corp	Waianae Plant 300 Lakeside Dr. Oakland, CA 94612	Cement plant	Honolulu.
Lone Star Hawaiian Cement Corp	Hawaii Plant 91-055 Kaomi Loop Ewa Beach, HI 96706	do	Do.
Lime:			
Hawaiian Commercial & Sugar Co. Ltd.	Box 266 Puunene, HI 96784	Rotary kiln and continuous hydrator.	Maui.
Pumice:			
Volcanite Ltd	Box 3000 Kailua Kona, HI 96740	Surface mine	Hawaii.
Stone:			
Ameron Honolulu Construction & Drayage Ltd.	Box 29968 Honolulu, HI 96820	Quarries	Honolulu and Maui.
Lone Star Hawaii Rock Products	91-055 Kaomi Loop Ewa Beach, HI 96706	Quarry	Honolulu.
Pacific Concrete & Rock Co. Ltd	2344 Pahounui Dr. Honolulu, HI 96819	Quarries	Honolulu and Maui (Molokai).

The Mineral Industry of Idaho

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Idaho Geological Survey, University of Idaho, for collecting information on all nonfuel minerals.

By W. L. Rice,[1] E. H. Bennett,[2] and M. M. Miller[3]

Idaho's nonfuel mineral production value rose in 1983 to $415 million, a 38% increase over the $300 million recorded in 1982. Higher silver prices and consequent increased production from Coeur d'Alene District mines and a return to full production by most southeastern Idaho phosphate operations were the primary reasons for the increase.

Silver continued to be the leading commodity in terms of value, followed by phosphate rock, gold, and lead. Metallic minerals accounted for 61% of total nonfuel mineral value for the year.

In late November, the Cyprus Thompson Creek molybdenum project west of Challis, Custer County, came on-line. The operation, owned and operated by Amoco Minerals Co. (a wholly owned subsidiary of Standard Oil Co. of Indiana), achieved about 75% of design capacity by yearend, producing 40 tons per day of molybdenite concentrates. The operation has about 500 employees and will have an annual payroll of $9 million when full production is reached.

Table 1.—Nonfuel mineral production in Idaho[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate, antimony content ____ short tons	294	W	585	W
Clays ____ thousand short tons	8	$101	6	$91
Copper (recoverable content of ores, etc.) ____ metric tons	3,074	r4,933	3,556	6,000
Gem stones	NA	75	NA	100
Lead (recoverable content of ores, etc.) ____ metric tons	W	W	25,726	12,296
Lime ____ thousand short tons	W	W	85	7,686
Sand and gravel (construction) ____ do	2,340	6,258	e3,000	e9,800
Silver (recoverable content of ores, etc.) ____ thousand troy ounces	14,830	117,901	17,684	202,308
Stone (crushed) ____ thousand short tons	e1,200	e6,000	1,935	7,480
Combined value of cement, garnet (abrasive), gold, gypsum, perlite, phosphate rock, pumice, sand and gravel (industrial), stone (dimension), tungsten ore and concentrate, vanadium, zinc, and values indicated by symbol W	XX	164,810	XX	169,318
Total	XX	r300,078	XX	415,079

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Idaho, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Ada	W	$800	Sand and gravel (construction).
Adams	W	--	
Bannock	W	W	Cement, sand and gravel (construction).
Benewah	W	W	Garnet (abrasive).
Bingham	W	18,091	Phosphate rock, vanadium, sand and gravel (construction).
Blaine	W	W	Sand and gravel (construction).
Boise	W	--	
Bonner	W	W	Sand and gravel (construction), silver, lead.
Bonneville	W	W	Sand and gravel (construction), pumice.
Boundary	$2	70	Sand and gravel (construction).
Butte	--	W	Lead.
Camas	W	W	Silver, lead.
Canyon	W	W	Lime, sand and gravel (construction).
Caribou	W	W	Phosphate rock, vanadium.
Cassia	W	W	Sand and gravel (construction).
Clark	1	W	Gold, clays, silver.
Clearwater	W	(2)	
Custer	W	653	Silver, lead, gold, copper, zinc.
Elmore	W	W	Sand and gravel (construction), clays.
Franklin	121	(2)	
Fremont	(3)	45	Sand and gravel (construction).
Gem	W	1,694	Sand and gravel (industrial).
Gooding	(3)	W	Sand and gravel (construction).
Idaho	W	W	Sand and gravel (construction), gold, silver.
Jerome	(3)	--	
Kootenai	787	W	Silver, sand and gravel (construction), gold, copper, lead.
Latah	W	W	Clays.
Lemhi	W	W	Silver, sand and gravel (construction), copper, gold, zinc, lead.
Lewis	W	(2)	
Lincoln	(3)	--	
Madison	(3)	W	Sand and gravel (construction).
Minidoka	W	W	Lime, sand and gravel (construction).
Nez Perce	137	430	Sand and gravel (construction).
Oneida	W	W	Perlite, pumice.
Owyhee	W	W	Silver, gold, lead.
Payette	(3)	--	
Power	(3)	6	Sand and gravel (construction).
Shoshone	W	128,863	Silver, lead, zinc, copper, gold, antimony.
Twin Falls	W	W	Lime, sand and gravel (construction).
Valley	W	W	Gold, sand and gravel (construction), silver, tungsten.
Washington	W	W	Gypsum.
Undistributed[4]	416,509	143,424	
Sand and gravel (construction)	e7,329	XX	
Stone (crushed)	XX	e6,000	
Total[5]	424,877	300,078	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Bear Lake, Jefferson, and Teton Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2]Crushed stone was produced; data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Idaho business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	437.2	443.1	+1.4
Unemployment	do.	53.9	38.9	-27.8
Employment (nonagricultural):				
Mining	do.	3.5	4.1	+17.1
Manufacturing	do.	47.2	49.9	+5.7
Contract construction	do.	10.3	11.2	+8.7
Transportation and public utilities	do.	18.5	18.4	-.5
Wholesale and retail trade	do.	75.3	81.3	+8.0
Finance, insurance, real estate	do.	22.5	23.2	+3.1
Services	do.	59.2	62.2	+5.1
Government	do.	67.5	66.8	-1.0
Total nonagricultural employment	do.	304.0	317.1	+4.3
Personal income:				
Total	millions	$8,713	$9,239	+6.0
Per capita		$8,937	$9,342	+4.5
Construction activity:				
Number of private and public residential units authorized		2,536	4,290	+69.2
Value of nonresidential construction	millions	$176.9	$172.7	-2.4
Value of State road contract awards	do.	$53.0	$80.2	+51.3
Shipments of portland and masonry cement to and within the State	thousand short tons	242	269	+11.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$300.1	$415.1	+38.3
Value per capita, resident population		$311	$420	+35.0
Value per square mile		$3,593	$4,967	+38.2

[p]Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

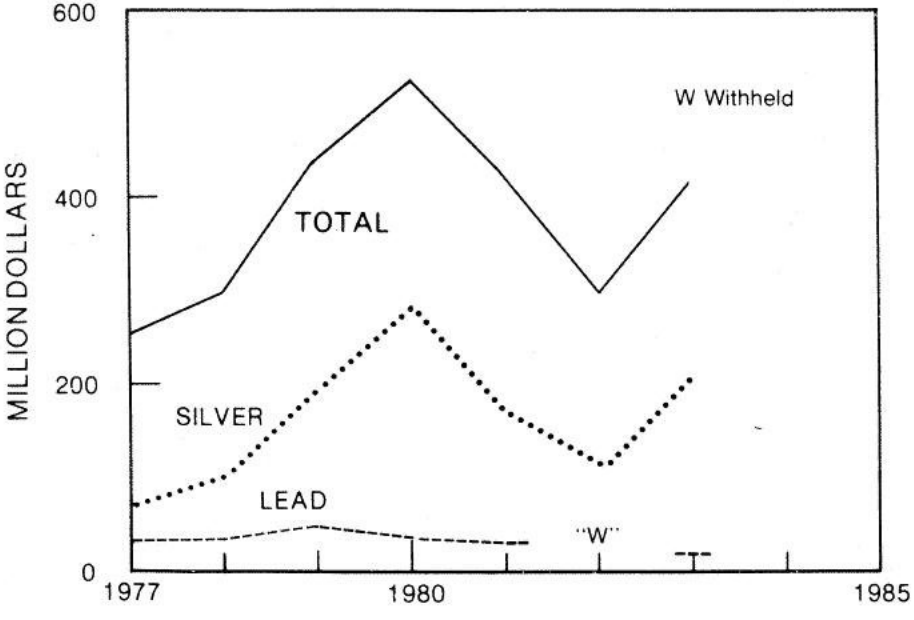

Figure 1.—Value of silver, lead, and total value of nonfuel mineral production in Idaho.

Bunker Ltd. Partnership, owner of the Bunker Hill lead-zinc-silver mining, smelting, and refining complex at Kellogg, maintained the mine and surface plants on standby, awaiting increased metal prices and an improved economy. Bunker stated that maintenance costs of about $450,000 per month could force a decision whether to reopen or dismantle the facilities in 1984.

Trends and Developments.—Improved silver prices were primarily responsible for the increase in value of nonfuel mineral production in the State. Several silver mining operations that had either cut back or temporarily closed resumed full-scale production during the year. In 1983, Idaho mines produced nearly 41% of domestic new silver, compared with 37% in 1982.

The Idaho phosphate industry made a limited recovery that enabled most plants to resume full production from cutbacks imposed in 1982. Exports, a major factor for the industry, were up in 1983, and the year began with slightly better domestic agricultural markets.

Blaming the depressed state of the mining industry, the Bucyrus-Erie Co. closed its mining machinery manufacturing plant in Pocatello. The plant, purchased by Bucyrus-Erie in 1974, employed about 1,200 people during its peak production period in the late 1970's. The plant closure cost 500 jobs and was a severe blow to the economy of the Pocatello area.

Exploration.—Anaconda Minerals Co. continued exploration of a 25,000-acre land package acquired in 1982 from Kennecott's Bear Creek Mining Co. subsidiary. The area is in the east end of the Coeur d'Alene District between the Placer Creek and Osburn Faults, and extends from south of the Caladay property eastward into Montana. Anaconda is required to spend at least $120,000 on the properties during the 1st year, with annual increases leading to $270,000 in the 5th year and $665,000 in the 10th year.

Encouraged by higher and generally more stable silver prices, exploration activity in the Coeur d'Alene area increased over that of 1982. Coeur Explorations Inc., the exploration subsidiary of Coeur d'Alene Mines Corp. (CAMP), continued work at the Royal Apex Silver, Capital Silver, and Highland Aurora projects at the west end of the district. At the CAMP project, geologic studies to explore the Polaris Fault between the Silver Summit and Coeur d'Alene Mines were continued.

ASARCO Incorporated continued exploration at the $3.5 million American Silver project that was placed on standby in June 1982. The project is exploring American Silver ground west from the 3400 level of the Coeur Mine. In 1983, 342 feet of new drift were completed for a total of 3,434 feet since the project started in mid-1980. Partners in the venture include Coeur d'Alene Mines, Callahan Mining Corp., and Hecla Mining Co.

Hecla continued work on the $11 million Consolidated Silver Corp. venture at the Silver Summit Mine. The shaft was completed to a depth of 5,524 feet, and a planned 10,000 feet of drifting and 20,000 feet of diamond drilling were started. Hecla is the operator and majority owner of the venture, along with Sunshine Mining Co. and Coeur d'Alene Mines.

Hecla completed over 1,200 feet of drifting at the Atlas Mine, south of the Lucky Friday Mine, preparatory to drilling the Boulder Creek vein system in 1984. The work is being done under a $1.3 million exploration agreement signed in 1982 with the Atlas Mining Co.

Sunshine Mining started a 2,000-foot drill hole to explore 400 acres in the city of Mullan held by Allied Silver-Lead Co. The company is looking for extensions of the Lucky Friday vein system beneath the town; two more holes are planned for 1984.

Rehabilitation of the Canyon Silver Mine on Canyon Creek, northeast of Wallace, was started in April. The crew of leasers intends to mine ore left on the 600 level and explore for higher grade ore on the 800 level.

The Evolution Tunnel was opened by the Evolution Mining Co., owner of 68 claims south of the Galena Mine. The company plans to explore the favorable Revett Formation about 1,000 feet below the tunnel level.

A 2-year exploration and drilling program was announced by Silverton Mines Inc. on the company's 15 claims in the Placer Center District.

Noranda Exploration Inc., a subsidiary of Noranda Mines Ltd., began exploration on a group of claims owned by Idaho-Montana Silver Inc. The claims are located northeast of Mullan on the Idaho-Montana border.

Cominco American Inc. continued its exploration program at the Hypotheek and Nabob Mines on Pine Creek. Cominco also entered into an exploration joint venture with Trans-Atlantic Pacific Co. on 33 patented claims at the Golden Chest Mine near Murray.

Teck Resources Inc., a subsidiary of Teck

Corp. of Vancouver, British Columbia, Canada, rehabilitated the 4,800-foot-long Rock Creek Tunnel on the Gem State and Rock Creek claims. Geological and geophysical studies were completed in preparation for diamond drilling in 1984.

Intermountain Minerals Engineers Inc. diamond drilled at the Golden Dream Mine northeast of Murray. Mining in conjunction with exploration yielded 674 tons of ore that was milled at the Nabob concentrator on Pine Creek.

Substantial exploration activity for base and precious metals occurred in the Elk City-Dixie area, Idaho County. Drilling programs were conducted at the War Eagle Mine by Award Resources USA Inc., and at the Robinson Dike Mine near Dixie. Centennial Minerals Ltd. drilled a large claim block centered on the Orogrande-Frisco pit near Orogrande. Agar, Baretta, and Ellis, an exploration group with Nugold Enterprises Corp., worked at the Erickson Reef gold property north of Elk City. Gray Eagle Resources evaluated the Alberta, Hercules, and Pasadena claims near Ditch Creek, and the Big Buffalo Mining Co. operated a pilot mill at the Big Buffalo Mine in the Buffalo Hump District.

In August, Gold Resources Inc. entered a joint venture with Gold Cache Inc. to evaluate the Kimberly and Golden Anchor Mines in the Marshall Lakes District southeast of Riggins.

Gold Fields Mining Corp. drilled 20 holes at the Consolidated Mine near Weiser, exploring for gold and mercury hot-springs-type deposits. Freeport Minerals Co. and Homestake Mining Co. drilled several holes at the Almaden Mine looking for similar targets.

Tenneco Minerals Corp. accomplished about 6,000 feet of exploration drilling at the Parker Mountain property in Lemhi County, searching for gold mineralization in silicified and brecciated rhyolite.

Anglo Bomarc Mines conducted a feasibility study for mining the Hercules property in Washington County. Open pit production may start in 1984.

The Yanke Machine Co. continued exploration at the Talache Mine in Atlanta. A newly discovered gold-silver vein is being developed in a new working near the old Talache Mine.

Democrat Resources drilled 20 holes as part of an exploration program at the Democrat Mine near Leadore. Further exploration is planned for 1984.

Employment.—A partial recovery in the State's mining industry because of higher silver prices, improved demand for phosphate fertilizers, and the start of production in late October at the Cyprus Thompson Creek molybdenum mine, led to a substantial increase in mineral sector employment by yearend. Metal mining employment advanced to 2,600, an increase of 4%, and overall mining employment was up to 4,100 workers for a 17.1% increase over that of 1982.

The late 1983 closure of the Bucyrus-Erie mining machinery plant in Pocatello caused a loss of 500 mining-related jobs. The effect of the closure was mitigated by the purchase of the Bucyrus property by Stearns-Rogers Corp., who plan to build modular units for use in oil and gas processing plants; the company announced that from 500 to 2,000 workers may eventually be employed.

Average weekly earnings, as of December, for mineral industry production workers remained the highest, at $605.87, of any production workers group in the State. This figure represented an increase of $80.18 per week over that of 1982.

Legislation and Government Programs.—The 47th Idaho Legislature, first regular session, did not enact any legislation in 1983 that would affect Idaho's mineral industry.

The Challis 2° Conterminous U.S. Map Program (CUSMAP) was completed in 1983 by the U.S. Geological Survey (USGS); the results were released in a symposium at the Northwest Mining Association's annual December convention in Spokane, WA. The Idaho Bureau of Mines and Geology (IBMG) participated in research for the CUSMAP and published an open-file geologic map. The IBMG (redesignated the Idaho Geological Survey in 1984) published a report detailing production statistics for all mines in the Coeur d'Alene mining district from 1884 to 1980; it also worked on a history of 100 years of mining in the Coeur d'Alene, to be released in time for the district's centennial in 1984.

The IBMG's 3-year phosphate program, done in cooperation with the U.S. Department of the Interior's Minerals Management Service, was completed at yearend, and five 7-1/2-minute quadrangle maps detailing phosphate reserves in southeastern Idaho were in preparation. A report describing epithermal gold deposits near Silver City, Owyhee County, was open filed in 1983 and will be published as a chapter in a forthcoming USGS professional paper. A

study of ground failure hazards in southeastern Idaho was begun during the year in cooperation with the USGS; the initial phase of this project is to compile data on conditions affecting ground failure hazards. A major program effort concentrated on the "Cenozoic Geology of Idaho" volume, which is the largest single publishing project undertaken by IBMG.

The Mining and Mineral Resources and Research Institute at the University of Idaho received an allotment of $150,000 in 1983. Idaho assisted the University of Nevada in work on a Mineral Industry Waste Treatment and Recovery Center that performed research in the treatment of mineral waste for the recovery of critical minerals and metals. The Idaho institute was also affiliated with the Virginia Polytechnic Institute in work on the Mine Systems Design and Ground Control generic area.

The Idaho National Engineering Laboratory was funded at $2.7 million by the U.S. Bureau of Mines to conduct a multiyear research program in strategic and critical materials. The 1983 effort addressed (1) biologically assisted minerals processing, (2) metal gas reactions and thermal plasmas, (3) joining silicon nitride-based ceramics, (4) joining rapidly solidified alloys, (5) nondestructive testing of ceramic and rapidly solidified alloy joints and materials, and (6) dehydration of aluminum chloride hexahydrate. The University of Idaho performed selected research tasks in support of this program with funding of $145,000.

Table 4.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1981, total	33	--	2,517,027	W	W	16,545,648	$174,033,250
1982, total	21	2	1,582,057	W	W	14,830,351	117,901,293
1983:							
Ada	1	--	W	W	W	W	W
Adams	1	--	6	--	--	368	4,210
Bear Lake	1	--	1	--	--	3	34
Blaine	3	--	W	W	W	W	W
Bonner	2	--	W	--	--	W	W
Camas	2	--	W	W	W	W	W
Custer	3	--	47,214	72	$30,528	179,893	2,057,976
Idaho	--	1	--	103	43,672	--	--
Lemhi	2	--	W	W	W	W	W
Owyhee	1	--	W	W	W	W	W
Shoshone	6	1	731,393	W	W	16,029,954	183,382,673
Valley	2	--	W	W	W	W	W
Total	24	2	[3]2,104,344	W	W	[3]17,684,278	[3]202,308,141

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1981, total	4,245	$7,966,106	38,397	$30,923,495	W	W	$258,468,805
1982, total	3,074	[r]4,932,940	W	W	W	W	[r]155,067,979
1983:							
Ada	--	--	W	W	--	--	W
Adams	[4]	420	--	--	--	--	4,630
Bear Lake	--	--	1	288	--	--	322
Blaine	1	876	W	W	--	--	W
Bonner	--	--	--	--	--	--	W
Camas	--	--	W	W	--	--	W
Custer	25	42,254	354	169,298	--	--	2,300,056
Idaho	--	--	--	--	--	--	43,672
Lemhi	--	--	W	W	--	--	W
Owyhee	--	--	--	--	--	--	W
Shoshone	3,530	5,956,330	25,363	12,122,654	W	W	W
Valley	--	--	--	--	--	--	W
Total	3,556	5,999,880	[3]25,726	[3]12,295,973	W	W	W

[r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Operations from which gold, silver, copper, lead, or zinc were recovered only from tailings or from cleanup are not counted as producing mines.
[2]Does not include gravel washed.
[3]Includes items indicated by symbol W; therefore, data do not add to total shown.
[4]Less than 1/2 unit.

Table 5.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by class of ore or other source material

Source	Number of mines	Material sold or treated[1] (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Dry gold	3	W	W	W	--	W	--
Gold-silver	3	W	W	W	1	W	--
Silver	16	785,201	W	16,221,322	3,556	25,722	W
Lead	1	1	--	3	--	1	--
Total	23	[2]2,104,344	W	[2]17,684,278	[3]3,556	[2]25,726	W
Placer	2	--	W	--	--	--	--
Grand total	25	[2]2,104,344	W	[2]17,684,278	3,556	[2]25,726	W

W Withheld to avoid disclosing company proprietary data.
[1]Does not include gravel washed.
[2]Includes items indicated by symbol W; therefore, data do not not add to total shown.
[3]Data do not add to total shown because of independent rounding.

Table 6.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:					
Cyanidation	W	W	--	--	--
Smelting of concentrates	W	W	3,556	25,711	W
Direct smelting of ore	W	5,041	([1])	15	--
Total lode material	W	[2]17,684,278	3,556	25,726	W
Placer	W	--	--	--	--
Grand total	W	[2]17,684,278	3,556	25,726	W

W Withheld to avoid disclosing company proprietary data.
[1]Less than 1/2 unit.
[2]Includes items indicated by symbol W; therefore, data do not add to total shown.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Antimony.—Antimony production in 1983 doubled that reported in 1982. Idaho's only antimony producer, Sunshine Mining in Shoshone County, returned to full production levels in 1983, following a temporary shutdown in the last half of 1982 owing to depressed silver prices. Antimony was recovered as a byproduct of the treatment of tetrahedrite, the principal silver-bearing ore mineral at the Sunshine Mine. Concentrates containing 585 short tons of antimony were produced in 1983, compared with 294 tons in 1982.

Exploration was conducted at the Antimony Rainbow Mine in Valley County; assessment work and development were carried out at the Scorpion Mine in Blaine County.

Copper.—Output and value increased slightly in 1983, with 10 mines reporting copper production. More than 3,500 metric tons were produced at a value of nearly $6 million, ranking Idaho eighth nationally in 1983 copper output. The largest producers, all from the Coeur d'Alene District, Shoshone County, were the Sunshine, Coeur, Lucky Friday, and Galena Mines. More than 99% of total State production came from six Coeur d'Alene District mines, where copper is a byproduct to silver recovery. An additional small production was reported from Adams, Blaine, and Custer Counties.

Gold.—Idaho gold production increased 78% over that of 1982 and the value doubled, reflecting increased 1983 gold prices. The State moved up to sixth in national ranking for the amount and value of gold produced in 1983. The West End Mine of Superior Mining Co. in Valley County became Idaho's largest producer, with MAPCO Minerals Corp.'s DeLamar Mine in Owyhee County ranking second.

Superior Mining's West End Mine com-

pleted its first year of full production in 1983; nearly 570,000 tons of ore were treated at the heap-leach facility near Stibnite.

The Golden Reef Joint Venture started operations in November at the Dewey Mine east of Yellow Pine in Valley County.

Placer gold operations, predominantly small, hobby-type suction dredges, were active throughout the State. The Idaho Department of Water Resources issued 606 stream alteration permits for placers during the year. Placer gold production was reported from Shoshone and Idaho Counties.

Lead.—Idaho retained its second ranking in 1983 lead production, although the amount produced was only slightly more than 6% of the total amount mined in Missouri, the major producing State. Although 14 mines reported lead production for 1983, over 98% came from the Lucky Friday Mine in the Coeur d'Alene mining region.

A 5% statewide production increase over that of 1982 was attributed to accelerated output at the Lucky Friday Mine following first-stage completion of the Silver Shaft.

Silver.—Idaho remained the top domestic silver producer, accounting for 41% of total 1983 production. Higher silver prices were the primary factor behind a 19% increase in production over the 1982 level. Four mines in the Coeur d'Alene District accounted for 91% of the total output reported from 21 mines in the State.

In April, Hecla Mining Co. completed the first stage of the $39 million Silver Shaft at the Lucky Friday Mine. The 6,205-foot shaft facilitated a 20% production increase over that of 1982. Mine output was increased from 725 to more than 1,000 tons per day, allowing 5 days of mining to feed a 7-day milling schedule.

Hecla continued work on the Consolidated Silver project at the Silver Summit Mine. The shaft was completed to a depth of 5,524 feet, and plans for 10,000 feet of drifting and 20,000 feet of diamond drilling were underway.

Sunshine Mining's Sunshine Mine was reopened and full production achieved by late February; by March 1, total employment had risen to 564. The Sunshine Mine ranked second in nationwide silver production in 1983, and the company finished the year with a net gain of almost $5.5 million compared with a $22.5 million loss in 1982. Development work at the Sunshine Mine included 5,972 feet of drifting, 878 feet of raises, and 16,614 feet of diamond drilling. A connection between the No. 10 and No. 12 shafts on the 4600 level was completed, and an operating station was cut on the 4400 level. The existing labor contract at the mine, scheduled to expire in April 1984, was extended for 3 years. Work commenced in December on phase 2 of Sunshine's $18 million hydrometallurgical silver refinery on Big Creek; startup of the refinery was expected in 1984.

Asarco's Galena Mine was the fourth ranked domestic silver producer, and Asarco's Coeur Mine ranked fifth. In the Galena Mine, the No. 3 shaft was sunk 132 feet to a depth of 5,301 feet, and a main shaft pocket was prepared at the 5200 level. Exploration was restarted by Asarco at the $3.5 million American Silver project that was placed on standby in June 1982. The project is exploring American Silver ground west from the 3400 level of the Coeur Mine. Partners in the venture include Coeur d'Alene Mines, Callahan Mining, and Hecla.

The shaft at Callahan Mining's Caladay project reached a depth of 4,578 feet, shaft stations were cut on the 4000 and 4300 levels, and work commenced on the 4600 level by yearend. Arrangements were made with Asarco to interconnect the Caladay and Galena properties and provide an escapeway on the 4900 level. Callahan spent $4.8 million on the Caladay in 1983; total expenditures on the project were $17.5 million through yearend 1983.

Operations at Clayton Silver Mines Inc.'s Clayton Mine in Custer County were suspended after an October 23, 1983, earthquake triggered a massive inflow of water that flooded the lower levels in the mine. Prior to the earthquake, Clayton Mine production had been at record-high levels. The mine remained closed for the remainder of the year while a new pumping system with increased capacity was installed.

MAPCO's DeLamar Mine in Owyhee County was the only significant producer outside the Coeur d'Alene District. The mine, which produced from two open pits, ranked fifth in silver production for the State in 1983.

Tungsten.—A small amount of scheelite production was reported from Valley County.

Vanadium.—Idaho ranked third in the Nation in vanadium production, and was the only State to recover vanadium from ferrophosphorus. Ferrophosphorus slag from Idaho phosphate was processed for vanadium pentoxide by Kerr-McGee Chemical Corp. at Soda Springs in Caribou County.

Zinc.—The loss of production from Ida-

ho's former principal zinc producers—the Bunker Hill Mine and Hecla's Star Unit Area—resulted in a zinc output of slightly less than 6% of the State's 1982 production. One mine reported zinc production in 1983, compared with output from seven mines in 1982.

NONMETALS

Cement.—Cement shipments in 1983 were principally portland cement, although a small amount of masonry cement was manufactured.

Clays.—Output was down 25% and value was down 10% from the 1982 production. Fire clay, kaolin, and bentonite were mined, in order of decreasing importance, by three companies from three pits in Latah and Clark Counties. The State's largest volume clay producer was A. P. Green Refractories Co. in Latah County.

Garnet.—The Emerald Creek Garnet Milling Co. at Fernwood, Benewah County, produced garnet sands from placer operations on Emerald and Carpenter Creeks. The company is the Nation's largest producer of garnet for abrasives and as a filtering medium.

Gem Stones.—Fire opals, jasper, and star garnets contributed to the estimated $100,000 in gem stones recovered and sold in the State in 1983.

Gypsum.—All gypsum production came from the Consumers Coop Association's Iron Mountain Mine in Washington County. Reported output was slightly less than that reported for 1982.

Lime.—Amalgamated Sugar Co.'s three quicklime operations in Canyon, Minidoka, and Twin Falls Counties accounted for all of the State's 1983 lime production. Total output was 16% less than that reported for 1982, although the value was nearly the same.

Perlite.—Oneida Perlite Corp. mined and processed perlite at its Malad City operation in Oneida County. The expanded perlite is used as a fireproofing material, in lightweight aggregate, and as a filtering medium.

Phosphate Rock.—Idaho ranked second in the Nation in production of marketable phosphate rock, accounting for 11% of the total domestic output. Production and value of Idaho phosphate rock were up slightly from 1982 levels owing to a partial economic recovery that enabled most operations to resume full production.

Six southeastern Idaho phosphate mines in Bingham and Caribou Counties accounted for all of the production. J. R. Simplot Co., the largest phosphate producer in the State, operated the Fort Hall (Gay) and Conda Mines. Simplot's new Smoky Valley Mine neared completion, and work was almost finished at yearend on a 27-mile-long slurry pipeline to transport ore from the mine to their Conda plant. Additional production was reported by Monsanto Co., Conda Partnership, and Alumet.

Pumice.—Pumice mined in Idaho in 1983 declined 14% in quantity and 21% in value from that of 1982.

Three operations in Bonneville and Oneida Counties accounted for the State's production. The largest pumice producer was Amcor Inc. from its Fan Claim near Idaho Falls; the product was used as lightweight concrete aggregate. Producers Pumice in Bonneville County and Hess Pumice Products in Oneida County mined pumice for building and decorative block.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Table 7.—Idaho: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	608	$1,774	r$2.92	NA	NA	NA
Gravel	1,313	3,873	2.95	NA	NA	NA
Sand and gravel (unprocessed)	418	642	1.54	NA	NA	NA
Total[1] or average	2,340	6,258	2.67	e3,000	e$9,800	e$3.27
Industrial sand	W	W	19.41	W	W	18.68
Grand total or average	W	W	3.28	W	W	e3.74

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Data may not add to totals shown because of independent rounding.

Table 8.—Idaho: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	34	75
Coarse aggregate, graded:		
Concrete aggregate, coarse	W	10
Bituminous surface treatment aggregate	18	104
Other graded coarse aggregate	22	26
Fine aggregate (-3/8 inch): Screening, undesignated	W	4
Coarse and fine aggregate:		
Graded road base or subbase	302	812
Unpaved road surfacing	491	1,444
Other coarse and fine aggregate	154	155
Agricultural:		
Poultry grit and mineral food	6	18
Other agricultural uses	33	99
Special: Other[2]	874	4,733
Total	[3]1,935	7,480

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes limestone, granite, sandstone, quartzite, and traprock.
[2]Includes bituminous aggregate (coarse), macadam, cement manufacture, flux stone, refractory stone, crusher run or fill or waste, uses not specified, and uses indicated by symbol W.
[3]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—The 1983 output of crushed stone increased in quantity and value from levels reported in 1981 and estimated for 1982. Increased activity in highway and secondary road construction and maintenance was largely responsible for the increased use of crushed stone. Five counties—Bannock, Idaho, Latah, Caribou, and Nez Perce—accounted for 79% of the State total. The U.S. Forest Service, Region 4, the DeAtley Co., and the Idaho Department of Transportation were the leading producers.

Dimension.—Quartzite and travertine were quarried for dimension stone in Cassia and Bonneville Counties, respectively. Marble Shop Inc., Idaho Falls, Bonneville County, completed an 18-month contract to supply travertine facing stone for Southwest Bell Co.'s new building complex in Dallas, TX.

---

[1]State Liaison Officer, Bureau of Mines, Spokane, WA.
[2]Associate director, Idaho Geological Survey, Moscow, ID.
[3]State geologist and director, Idaho Geological Survey, Moscow, ID.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Antimony:			
Sunshine Mining Co	Box 1080 Kellogg, ID 83837	Mine, mill, plant	Shoshone.
Cement:			
Idaho Portland Cement Co., a division of Oregon Portland Cement Co.	111 Southeast Madison St. Portland, OR 97214	Surface mine and plant.	Bannock.
Clays:			
A. P. Green Refractories, a subsidiary of United States Gypsum Co.	Box 158 Troy, ID 83871	do	Latah.
J. R. Simplot Co	Box 912 Pocatello, ID 83201	do	Do.
Copper:			
ASARCO Incorporated	Box 440 Wallace, ID 83873	Mine and mill	Shoshone.
Hecla Mining Co	Box 320 Wallace, ID 83873	do	Do.
Sunshine Mining Co	Box 1080 Kellogg, ID 83837	Mine, mill, plant	Do.
Gold:			
Hecla Mining Co	Box 320 Wallace, ID 83873	Mine and mill	Do.
MAPCO Minerals Corp	Box 52 Jordan Valley, OR 97910	Surface mine and mill.	Owyhee.
Superior Mining Co	7275 Franklin Rd. Boise, ID 83709	Surface mine and leach plant.	Valley.
Gypsum:			
Consumers Coop Association	265 East Commercial Weiser, ID 83672	Surface mine	Washington.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lead:			
Clayton Silver Mines	Box 890 Wallace, ID 83873	Mine and mill	Custer.
Hecla Mining Co	Box 320 Wallace, ID 83873	do	Shoshone.
Sunshine Mining Co	Box 1080 Kellogg, ID 83837	Mine, mill, plant	Do.
Lime:			
Amalgamated Sugar Co	First Security Bank Bldg. Ogden, UT 84402	Plant	Various.
Perlite:			
Oneida Perlite Corp	Box 162 Malad City, ID 83252	Surface mine and plant.	Oneida.
Phosphate rock:			
Conda Partnership	Box 37 Conda, ID 83230	do	Caribou.
Monsanto Co	Box 816 Soda Springs, ID 83276	Surface mine	Do.
J. R. Simplot Co	Box 912 Pocatello, ID 83201	Surface mine and plant.	Bingham and Caribou.
Pumice:			
Amcor Inc	Box 1141 Idaho Falls, ID 83401	Quarry and plant	Bonneville.
Hess Pumice Products	Box 209 Malad City, ID 83252	do	Oneida.
Producers Pumice	6001 Fairview Ave. Boise, ID 83704	Quarry	Bonneville.
Sand and gravel (industrial):			
Unimin Corp	Emmet, ID 83617	Pit	Gem.
Silver:			
ASARCO Incorporated	Box 440 Wallace, ID 83873	Mine and mill	Shoshone.
Clayton Silver Mines	Box 890 Wallace, ID 83873	do	Custer.
Hecla Mining Co	Box 320 Wallace, ID 83873	do	Shoshone.
MAPCO Minerals Corp	Box 52 Jordan Valley, OR 97910	Surface mine and mill.	Owyhee.
Sunshine Mining Co	Box 1080 Kellogg, ID 83837	Mine, mill, plant	Shoshone.
Stone:			
Crushed:			
DeAtley Co	Box 648 Lewiston, ID 83501	Quarries	Various.
Idaho Department of Transportation	Box 837 Lewiston, ID 83501	do	Do.
Idaho Portland Cement Co., a division of Oregon Portland Cement Co.	111 Southeast Madison St. Portland, OR 97214	Quarry and plant	Bannock.
Monsanto Co	Box 816 Soda Springs, ID 83276	Quarry	Caribou.
U.S. Forest Service, Region 4	324 25th St. Ogden, UT 84401	Quarries	Various.
Dimension:			
The Marble Shop Inc	3935 North Yellowstone Hwy. Idaho Falls, ID 83401	Quarry and plant	Bonneville.
Vanadium:			
Kerr-McGee Chemical Corp	Box 478 Soda Springs, ID 83276	Plant	Caribou.
Zinc:			
Hecla Mining Co	Box 320 Wallace, ID 83873	Mine and mill	Shoshone.

The Mineral Industry of Illinois

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey Division, Illinois Department of Energy and Natural Resources, for collecting information on all nonfuel minerals.

By James J. Hill[1] and Wanda J. West[2]

The value of nonfuel mineral production in Illinois was $406.9 million in 1983. For the first time in 4 years, mineral production value increased, rising more than 4% over the 1982 figure. Illinois led the Nation in output of fluorspar, industrial sand, and tripoli and ranked 19th in value of nonfuel mineral production. Barite, lead, silver, and zinc were extracted as byproducts at fluorspar operations. Slag from steelmaking was processed in the State, and sulfur was recovered at petroleum refineries. Several commodities, including gypsum, iron oxide pigments, perlite, and vermiculite, were shipped into the State for processing.

Trends and Developments.—Several sectors of the Illinois mineral industry began to recover in 1983. The U.S. Department of Labor, Bureau of Labor Statistics, reported average monthly employment in mining and quarrying, excluding coal extraction, was 4,500 workers in 1983, down from 4,700 reported in 1982. Average weekly earnings and hours worked increased 20.6% and 12.3%, respectively. The State's steel industry improved somewhat during the year. Although steel shipments increased in 1983, most mills were operated well below capacity. Average monthly employment in the basic steel industry dropped from 31,300

Table 1.—Nonfuel mineral production in Illinois[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement (portland)	thousand short tons	1,757	$78,444	1,857	$74,975
Clays[2]	do.	455	2,305	717	3,360
Gem stones		NA	15	NA	15
Sand and gravel:					
Construction	thousand short tons	21,557	59,149	e21,100	e58,400
Industrial	do.	3,989	45,665	4,060	42,871
Stone:					
Crushed	do.	e42,900	e148,300	42,761	166,860
Dimension	do.	e2	e98	2	71
Combined value of barite, cement (masonry), clays (fuller's earth), fluorspar, lead, lime, peat, silver, tripoli, and zinc		XX	55,618	XX	60,355
Total		XX	389,594	XX	406,907

eEstimated. NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes fuller's earth; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Illinois, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Adams	$12,410	W	Sand and gravel (construction).
Alexander	W	W	Tripoli.
Bond	142	W	Sand and gravel (construction), clays.
Boone	W	$267	Sand and gravel (construction).
Brown	441	(2)	
Bureau	93	475	Sand and gravel (construction).
Calhoun	86	(2)	
Carroll	748	(2)	
Cass	228	(3)	Sand and gravel (construction).
Champaign	(4)	1,422	Do.
Christian	W	(2)	
Clark	W	W	Sand and gravel (construction).
Clay	W	(2)	
Clinton	17	W	Sand and gravel (construction).
Coles	W	W	Do.
Cook	94,857	32,571	Lime, sand and gravel (construction), clays, peat.
Crawford	(4)	--	
Cumberland	(4)	248	Sand and gravel (construction).
De Kalb	W	293	Do.
De Witt	(4)	139	Do.
Douglas	W	(2)	
Du Page	W	W	Sand and gravel (construction).
Effingham	(4)	W	Do.
Fayette	W	W	Do.
Ford	(4)	W	Do.
Fulton	(4)	W	Do.
Gallatin	(4)	W	Do.
Greene	W	(2)	
Grundy	W	W	Sand and gravel (construction), clays.
Hancock	1,417	W	Sand and gravel (construction).
Hardin	28,174	W	Fluorspar, zinc, barite, lead, silver.
Henderson	W	(2)	
Henry	1,818	W	Sand and gravel (construction).
Jackson	W	(2)	
Jersey	W	(2)	
Jo Daviess	784	373	Sand and gravel (construction).
Johnson	W	(2)	
Kane	3,121	13,551	Sand and gravel (construction).
Kankakee	4,958	W	Clays, sand and gravel (construction).
Kendall	W	W	Sand and gravel (construction).
Lake	W	W	Sand and gravel (construction), peat.
La Salle	78,080	W	Sand (industrial), cement, sand and gravel (construction), clays.
Lawrence	(4)	W	Sand and gravel (construction).
Lee	W	W	Cement.
Livingston	W	1,476	Clays.
Logan	W	833	Sand and gravel (construction).
McDonough	W	W	Clays.
McHenry	(4)	9,663	Sand and gravel (construction).
McLean	(4)	2,441	Do.
Macon	(4)	W	Do.
Madison	2,819	W	Do.
Marshall	(4)	W	Do.
Mason	(4)	W	Do.
Massac	W	W	Cement, sand and gravel (construction).
Menard	W	(2)	
Mercer	109	(2)	
Monroe	W	(2)	
Montgomery	2,250	(2)	
Moultrie	(4)	W	Sand and gravel (construction).
Ogle	W	W	Sand (industrial).
Peoria	657	1,030	Sand and gravel (construction).
Piatt	(4)	377	Do.
Pike	1,962	W	Do.
Pulaski	W	W	Clays, sand and gravel (construction).
Putnam	(4)	41	Sand and gravel (construction).
Randolph	W	W	Do.
Rock Island	4,296	W	Do.
St. Clair	5,363	W	Do.
Sangamon	(4)	2,418	Do.
Schuyler	W	245	Do.
Scott	W	(2)	
Shelby	128	(2)	
Stephenson	751	W	Sand and gravel (construction).
Tazewell	W	W	Sand and gravel (construction), clays.
Union	W	(2)	

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Illinois, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Vermilion	W	$238	Sand and gravel (construction).
Wabash	(4)	W	Do.
Warren	W	(2)	
Washington	W	(2)	
White	(4)	W	Sand and gravel (construction).
Whiteside	W	W	Peat, sand and gravel (construction).
Will	$14,337	2,708	Sand and gravel (construction).
Winnebago	1,620	345	Do.
Woodford	(4)	2,239	Do.
Undistributed[5]	96,853	167,796	
Sand and gravel (construction)	e68,970	XX	
Stone:			
Crushed	XX	e148,300	
Dimension	XX	e98	
Total[6]	427,486	389,594	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Edgar, Edwards, Franklin, Hamilton, Iroquois, Jasper, Jefferson, Knox, Macoupin, Marion, Morgan, Perry, Pope, Richland, Saline, Stark, Wayne, and Williamson. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Stone, either crushed or dimension, was produced; data not available by county.

[3]Less than 1/2 unit.

[4]Construction sand and gravel was produced; data not available by county.

[5]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[6]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Illinois business activity

	1982	1983p	Change, percent
Employment and labor force, annual average:			
Total civilian labor force thousands	5,586.6	5,504.3	-1.5
Unemployment do	771.6	589.4	-23.6
Employment (nonagricultural):			
Mining[1] do	23.3	23.3	--
Manufacturing do	927.2	969.7	+4.6
Contract construction do	124.1	121.5	-2.1
Transportation and public utilities do	260.9	263.1	+.8
Wholesale and retail trade do	1,060.8	1,090.8	+2.8
Finance, insurance, real estate do	318.2	317.5	-.2
Services do	1,001.5	998.4	-.3
Government do	716.8	683.7	-4.6
Total nonagricultural employment[1] do	4,432.8	4,468.0	+.8
Personal income:			
Total millions	$138,460	$145,021	+4.7
Per capita	$12,091	$12,626	+4.4
Construction activity:			
Number of private and public residential units authorized	18,980	29,907	+57.6
Value of nonresidential construction millions	$1,872.9	$1,879.4	+.4
Value of State road contract awards do	$510.0	$782.0	+53.3
Shipments of portland and masonry cement to and within the State thousand short tons	2,363	2,305	-2.4
Nonfuel mineral production value:			
Total crude mineral value millions	$389.6	$406.9	+4.4
Value per capita, resident population	$34	$35	+2.9
Value per square mile	$6,908	$7,222	+4.6

pPreliminary.

[1]Includes bituminous coal and oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

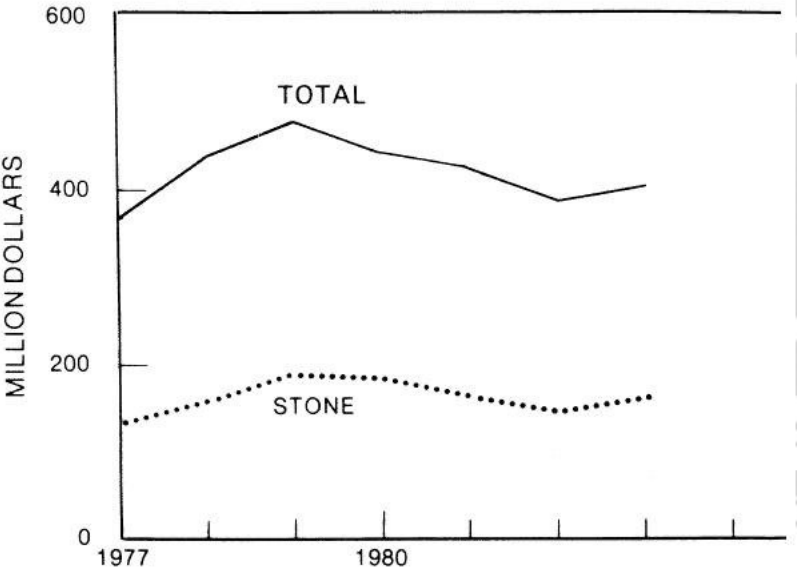

Figure 1.—Value of stone and total value of nonfuel mineral production in Illinois.

persons in 1982 to 25,300 in 1983. Average weekly earnings also dropped because of contract concessions negotiated during the year.

Increased residential building in 1983 stimulated a demand for some construction mineral commodities. The U.S. Department of Commerce reported a 57.6% increase in construction permits issued for residential units (public and private) in the State. Also, the value of private nonresidential construction increased slightly during the year. The value of State road contract awards jumped 53.3% in 1983, from $510 million in 1982 to $782 million in 1983.

Several developments occurred in the State's mineral industry. In the nonmetallic sector, several operations changed hands. Martin Marietta Corp. sold its industrial sand operations near Oregon in Ogle County and Troy Grove in La Salle County to Unimin Corp. of Connecticut in keeping with plans to divest itself of industrial sand operations in several States. The firm retained its operation near Wedron in La Salle County, which accounted for a large share of its industrial sand production.

Illinois Minerals Co., one of two companies producing amorphous silica (tripoli) in Illinois, was sold to Georgia Kaolin Co. of New Jersey. The firm also opened a surface mine in Alexander County during the year.

Lone Star Industries Inc. sold its cemen plant in Dixon to Dixon-Marquette Cement Inc., a new company owned by Prairie Materials Sales Inc. of Bridgeview.

In the State's metallic sector, Gould Inc. of Rolling Meadows signed a definitive agreement for selling its lead-acid battery operations, GNB Batteries Inc., to a group of private investors, including Allen & Co. Inc., a New York investment firm. Among the company's United States and Canadian battery operations is the firm's secondary lead smelter in Savanna, IL.

Thomas Steel Corp. of Chicago acquired the Ceco Corp. steel mill in Lemont, previously known as Lemont Manufacturing Co. Ceco shut down the mill in December 1982. The new owner began production in February. Plans were underway to increase annual capacity at the mill from 240,000 short tons to approximately 300,000 tons with installation of a continuous caster and other improvements.

Inland Steel Co. agreed to sell its Container Co. division to Royal Packaging Industries Van Leer BV of the Netherlands. The division has about 925 employees at plants in Alsip, IL; Jersey City, NJ; Cleveland and

Greenville, OH; and Canton, MS, that produce stainless steel shipping containers for the chemical, food products, paint, and petroleum industries.

Ivaco Inc. of Montreal, Canada, purchased newly issued shares of Laclede Steel Co. of St. Louis, MO, for $10.1 million, which increased its investment in Laclede to 51% from 40%. Laclede, a carbon steel and alloy steel manufacturer with a plant in Alton, IL, was expected to use the funds to boost its continuous-casting capabilities. Ivaco controls 36 steel-related firms in the United States and Canada.

Reynolds Metals Co. completed a $125 million modernization program at its McCook aluminum sheet and plate mill to increase its market share for can materials and the automotive industry. The mill features state-of-the-art equipment and quality control.

R. Lavin & Sons Inc., Chicago, opened a precious metals division at its North Chicago plant that was to specialize in custom refining and production of gold, palladium, platinum, and silver. The metals will be recovered from a variety of industrial scrap including dental gold, floor sweepings, printed circuit boards, and telephone jacks.

In a nationwide move to reduce costs and remain competitive, United States Steel Corp. announced plans in late December to cut its annual steel production 16%, to 26 million short tons, eliminating 15,400 jobs in 13 States by April 1984. At U.S. Steel's South Works in Chicago, electric-furnace steelmaking and one structural mill would be kept open. Closing the other plant units reduced active employment there to 800 persons from 1,100, and permanently laid off another 2,800 persons on furlough. In addition, the company scrapped plans to build a new rail mill at its South Works.

Exploration Activities.—Most of the State's exploration was centered around the coal industry with 22 companies filing plugging reports on about 3,000 holes drilled in 30 counties.

Ozark-Mahoning Co. continued exploring for fluorspar deposits in Hardin and Pope Counties in the Illinois portion of the Illinois-Kentucky fluorspar district. The firm filed an exploration plan with the U.S. Forest Service for properties in the Shawnee National Forest after an environmental assessment found there would be "no significant impact." The company planned exploration drilling along faults of the Lusk Creek Fault Zone in central Pope County. At yearend, the plan was still under review.

Exploration drilling also continued for tripoli deposits in Alexander and Union Counties in the southern part of the State. Interest developed over the possible use of the microcrystalline silica, including the iron-stained deposits previously rejected for conventional uses, as a source of silica and minor amounts of iron needed in cement manufacture.[3]

As part of its stratigraphic assessment of base-metal potential in southeastern Wisconsin, Mobil Oil Corp. was reported to have drilled holes across the border in northern Illinois counties.

Legislation and Government Programs.—During the year, the Governor signed Public Act 83-0012, which amended the Motor Fuel Tax Law, Illinois Vehicle Code, and the State Finance Act. Major provisions of the act are increased motor fuel taxes with yearly indexed adjustments; increased diesel fuel taxes; and increased vehicle registration fees and taxes. The act created a State Construction Account Fund in the State Treasury for constructing, maintaining, and reconstructing the State-maintained highway system. The act was expected to add an average of $393 million per year through fiscal year 1987 for State highway projects and to allow the State to match Federal funds created under the Surface Transportation Assistance Act of 1983.

The State Geological Survey Division continued research in environmental geology, geochemistry, geology, hydrology, mineral economics, and mineral resources. Among the several publications released during the year were guides to the geology of carbonate and sand and gravel aggregate resources in Illinois. Work continued on an Illinois directory of sand and gravel and stone producers. The Survey compiled laboratory studies of the geologic characteristics of Illinois gravel deposits and freeze-thaw tests for the State Department of Transportation. The study results were expected to assist State aggregate producers in meeting department specifications for highway materials.

Southern Illinois University—Carbondale, the State's Mining and Mineral Resources and Research Institute created under title III of Public Law 95-87, received $150,000 from the U.S. Bureau of Mines in fiscal year 1983 for operations and research.

Also in 1983, the U.S. Bureau of Mines had several active contracts and grants with Illinois consulting firms, educational institutions, and industrial firms for equipment, research, and services. Funding for these items was approximately $479,000.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives (Manufactured).—ESK Corp., a subsidiary of Wacker Chemical Co., manufactured silicon carbide at its plant near Hennepin, Putnam County. Metallurgical and crystalline grades of material were produced from a mixture of petroleum coke and silica sand in a series of on-site furnaces. Metallurgical silicon carbide was used in manufacturing steel and cast iron. Crystalline silicon carbide was used in grinding wheels and polishing stones, as a refractory lining for blast furnaces, and as a cutting agent for wire sawing granite. Production and value of silicon carbide increased 21% and 24%, respectively, compared with 1982 figures.

During the year, Superior Graphite Co. filed for a U.S. patent on a new proprietary silicon-carbide continuous furnace, following a successful commercial-scale trial production run. Designated "HSC silicon carbide," the new product is made by forming silicon carbide on the external and internal surfaces of relatively porous carbon particles; HSC can be made with up to 95% silicon carbide. The material was developed for a range of uses including fine abrasive grit, high-performance ceramics, metallurgical additions, and refractories.[4]

Barite.—Ozark-Mahoning recovered barite as a byproduct at its fluorspar operations in Hardin County in southern Illinois. Production and value increased about 3% and 2%, respectively, compared with 1982 figures.

Cement.—Illinois ranked 10th in portland cement shipments in 1983. Four companies operated plants in the State. In La Salle County, Dixon-Marquette operated a plant near Dixon, and Illinois Cement Co., a plant near La Salle. Lone Star operated a plant near Oglesby, Lee County; and Missouri Portland Cement Co., a plant near Joppa, Massac County. All companies produced gray portland cement. Two companies, Dixon-Marquette and Lone Star, also produced masonry cement. Portland cement sales increased about 6% compared with 1982 figures; however, the value per short ton averaged about 10% below that of 1982, reflecting increased sales competition. Most portland cement sold in the State consisted of Types I and II, general use and moderate heat. About 78% of the sales was to ready-mixed concrete companies. Most of the cement was shipped to consumers by truck in bulk form.

During the year, Lone Star sold its cement plant in Dixon to Dixon-Marquette.

Table 4.—Illinois: Portland cement salient statistics

(Short tons unless otherwise specified)

	1982	1983
Number of active plants	4	4
Production	1,544,154	1,888,713
Shipments from mills:		
Quantity	1,757,270	1,857,430
Value	$78,444,165	$74,975,215
Stocks at mills, Dec. 31	198,208	229,491

Clays.—Illinois ranked 14th of 44 States in total clay production in 1983. Output and value increased 47% and 24%, respectively, compared with 1982 figures. Eight companies produced common clay from eight pits in Bond, Kankakee, La Salle, Livingston, and McDonough Counties. Livingston County led in production, supplying more than three-fourths of the State's output. Most of the State's common clay production was used in face brick manufacture; the second greatest quantity was used in portland cement manufacture. Other uses included manufacturing crockery and earthenware, drain tile, and sewer pipe.

Fuller's earth was produced by Absorbent Clay Products Co. and Lowe's Inc. in Pulaski County. Production and value increased 13% and 16%, respectively, compared with 1982 figures. The clay was used as animal litter and as an oil and grease absorbent.

No fire clay production was reported during 1983. A. P. Green Refractories Co., a subsidiary of United States Gypsum Co., began importing fire clay from an out-of-State source for its plant near Morris, Grundy County.

Fluorspar.—Illinois continued to lead the Nation in fluorspar production. Shipments declined for the second consecutive year, dropping more than 19% below 1982 figures. Two companies produced fluorspar during the year in Hardin and Pope Counties in southeastern Illinois. Ozark-Mahoning operated its Denton and Henson Mines and processed acid-grade material at its central flotation mill in Rosiclare; Hastie Mining Co. produced metallurgical-grade fluorspar (metspar) from an open pit mine on the Defender tract on Spar Mountain near Cave In Rock.

Inverness Mining Co.'s mining operation north of Cave In Rock was idle in 1983. The company operated its drying plant to proc-

ess foreign acid-grade filter cake to serve its customers.

Ozark-Mahoning continued shaft sinking operations at its new minesite, the Annabel Lee. By yearend, work on the shaft was approximately two-thirds complete, and development work started on the upper level of the mine.

During the year, the Illinois Central Gulf Railroad abandoned its 26.3-mile spur line from Reevesville to Rosiclare, leaving the State's fluorspar industry to find alternate transportation.

Gem Stones.—The value of mineral specimens collected by dealers and hobbyists was estimated at $15,000 in 1983.

Gypsum (Calcined).—Shut down for most of 1982 because of economics, National Gypsum Co. resumed producing calcined gypsum at its Waukegan plant in 1983. Production for the year did not attain 1981 levels.

Lime.—Illinois ranked seventh of 39 States in lime output; both production and value increased 18% compared with 1982 figures. All production was from three plants in the Chicago area of Cook County. Marblehead Lime Co., a subsidiary of General Dynamics Corp., produced both quicklime and hydrated lime at its South Chicago and Thornton plants, and Vulcan Materials Co. produced only quicklime at its McCook plant. Marblehead's South Chicago plant ranked eighth nationally in total lime output.

Lime was used principally for steelmaking, water purification, sewage and industrial waste treatment, and sulfur removal from stack gases.

Lime consumed in the State during 1983, from all domestic sources, totaled 560,000 short tons of quicklime and 103,000 tons of hydrated lime.

Peat.—Illinois continued to rank fourth nationally in peat sales. Production was by five companies in Cook, Lake, and Whiteside Counties. Reed-sedge was the predominant type of peat mined, followed by hypnum and humus. Most of the State's peat production was sold in packaged form. Major peat uses were for general soil improvement and as an ingredient for potting soil. Peat was also used for earthworm culture, golf courses, mushroom beds, nurseries, and vegetable growing.

Perlite (Expanded).—Illinois ranked second in sales of expanded perlite, following California. Quantity and value of sales increased 16% and 27%, respectively, compared with 1982 figures. Three companies operated plants in the northeastern part of the State: Silbrico Corp. in Cook County, Strong-Lite Products Corp. of Illinois in De Kalb County, and Manville Products Corp. in Will County. In descending order of use, sales were for roof insulation board, agricultural purposes, low-temperature insulation, concrete and plaster aggregate, cavity-fill insulation, and fillers.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Illinois ranked first in industrial sand production. Five companies produced from eight pits in La Salle and Ogle Counties; La Salle County had the greater output. Major sales were for glass manufacture and foundry applications. Most industrial sand was shipped by truck, with lesser amounts shipped by rail and waterway.

Table 5.—Illinois: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	9,386	$23,423	$2.50	NA	NA	NA
Gravel	10,229	31,810	3.11	NA	NA	NA
Sand and gravel (unprocessed)	1,943	3,916	2.02	NA	NA	NA
Total[1] or average	21,557	59,149	2.74	e21,100	e$58,400	e$2.77
Industrial sand	3,989	45,665	11.45	4,060	42,871	10.56
Grand total[1] or average	25,547	104,813	4.10	e25,160	e101,271	e4.03

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Slag, Iron and Steel.—Illinois ranked fifth of 22 States in sales of processed iron and steel slag. Four companies processed slag from the State's iron and steel furnaces with this product being used in the construction industry. Sales increased approximately 13% in 1983 because of renewed construction activity.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Illinois ranked fourth in the Nation in crushed stone output in 1983. Ninety-three companies or government agencies reported production from 169 quarries in 54 of the State's 102 counties. Counties producing in excess of 1 million short tons were Cook, Hardin, Johnson, Kankakee, La Salle, Livingston, Rock Island, St. Clair, Union, and Will. Output from these counties totaled 26.8 million tons, nearly two-thirds of the State total. Six companies, producing more than 1 million tons each, collectively accounted for more than one-half of the State total. All crushed stone mined in the State was limestone. About 88% of the State's output was shipped to consumers by truck.

Table 6.—Illinois: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	3,286	11,428
Riprap and jetty stone	1,852	6,981
Filter stone	14	60
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,715	13,433
Bituminous aggregate, coarse	3,926	15,470
Bituminous surface treatment aggregate	1,375	4,929
Railroad ballast	584	2,040
Fine aggregate (-3/8 inch):		
Stone sand, bituminous mix or seal	156	673
Screening, undesignated	24	70
Coarse and fine aggregate:		
Graded road base or subbase	8,608	28,876
Unpaved road surfacing	3,315	10,250
Crusher run or fill or waste	32	102
Other coarse and fine aggregate	421	1,408
Agricultural:		
Agricultural limestone	2,832	10,928
Poultry grit and mineral food	139	1,985
Cement manufacture	2,829	7,780
Miscellaneous fillers or extenders	381	11,885
Other[2]	9,273	38,563
Total[3]	42,761	166,860

[1]Includes limestone and dolomite.
[2]Includes stone sand (concrete), flux stone, mine dusting or acid water treatment, asphalt fillers or extenders, glass manufacture, roofing granules, waste materials, sulfur oxide removal, coarse aggregate (large), fine aggregate, and uses not specified.
[3]Data do not add to totals shown because of independent rounding.

Table 7.—Illinois: Crushed limestone and dolomite sold or used by producers, by county

County	1981			1983		
	Number of quarries	Quantity (thousand short tons)	Value (thousands)	Number of quarries	Quantity (thousand short tons)	Value (thousands)
Adams	9	1,040	$12,410	6	880	$14,503
Boone	2	W	W	3	103	385
Brown	1	100	441	--	--	--
Bureau	1	32	93	--	--	--
Calhoun	2	30	86	1	53	218
Carroll	8	241	748	6	205	688
Cass	1	78	228	1	W	W
Clay	1	W	W	1	249	1,033
Clinton	1	7	17	--	--	--
Douglas	1	W	1,321	1	W	W

See footnotes at end of table.

Table 7.—Illinois: Crushed limestone and dolomite sold or used by producers, by county —Continued

County	1981			1983		
	Number of quarries	Quantity (thousand short tons)	Value (thousands)	Number of quarries	Quantity (thousand short tons)	Value (thousands)
Du Page	1	W	W	1	795	$3,267
Greene	3	W	W	3	W	697
Hancock	4	454	$1,417	4	400	1,624
Hardin	5	2,205	5,746	4	2,429	7,129
Henry	1	412	1,818	1	375	1,542
Jersey	2	W	W	1	32	120
Jo Daviess	17	304	784	9	284	895
Kane	3	743	3,036	3	725	2,837
Kankakee	3	W	W	3	1,200	4,789
La Salle	5	2,152	6,450	4	2,130	7,305
Lee	9	1,076	2,962	8	776	2,464
Madison	3	770	2,819	3	780	3,131
Mercer	1	62	109	1	87	358
Montgomery	4	663	2,250	4	631	2,604
Ogle	12	627	1,862	10	772	2,509
Peoria	1	173	657	1	77	331
Pike	5	518	1,962	5	737	2,509
Rock Island	4	1,030	4,296	3	W	4,053
St. Clair	4	1,722	5,363	4	1,746	5,717
Schuyler	1	W	W	1	34	140
Shelby	1	35	128	1	27	112
Stephenson	11	252	751	12	395	956
Washington	1	W	W	1	71	450
Whiteside	5	120	370	2	W	W
Will	8	3,917	14,337	7	3,669	13,025
Winnebago	18	429	1,620	16	315	971
Undistributed[1]	37	24,964	91,138	38	22,783	80,496
Total[2]	196	44,159	165,218	169	42,761	166,860

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes Christian, Clark, Coles, Cook, De Kalb, Fayette, Henderson, Jackson, Johnson, Kendall, Livingston, Logan, McDonough, Menard, Monroe, Pulaski, Randolph, Scott, Union, Vermilion, and Warren Counties and data indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

Dimension.—All dimension stone—cut stone, flagging, and irregular-shaped stone—was from a limestone quarry in the northeastern part of the State.

Sulfur (Recovered).—Sulfur was recovered in conjunction with refinery operations by Marathon Oil Co. in Crawford County, Texaco Inc. in Lawrence County, Shell Oil Co. in Madison County, and Mobil and Union Oil Co. of California in Will County. Production during 1983 totaled 225,000 metric tons, a slight increase over the 214,000 tons reported in 1982.

Tripoli.—Illinois ranked first of three States in tripoli production. Two companies, Illinois Minerals at Elco and Tammsco Inc. at Tamms, operated surface and underground mines in Alexander County in the extreme southern part of the State.

Prepared tripoli sales increased 26% over those reported in 1982; value increased 56%. Approximately three-fourths of the processed material was sold as a filler and extender in paint, plastic, and rubber. The rest was sold as an abrasive for buffing and polishing compounds, soap, and toothpaste.

Vermiculite (Exfoliated).—Three companies exfoliated crude vermiculite shipped into the State. Producers were Strong-Lite Products at De Kalb in De Kalb County, W. R. Grace & Co. at its West Chicago plant in Du Page County, and International Vermiculite Co. at its Girard plant in Macoupin County.

Vermiculite sales decreased about 18% compared with 1982 figures. About 40% of the sales was for loose-fill insulation, 15% for concrete aggregate, and 13% for block insulation. Other sales were for agricultural purposes, fireproofing, high-temperature insulation, industrial purposes, and plaster aggregate.

A $327,500 Community Development Assistance Program block grant was awarded to the city of Girard to help fund a production expansion at International Vermiculite's plant during the year. The grant was to be used in conjunction with $853,000 worth of industrial revenue bonds issued to help finance the project.

METALS

Iron Oxide Pigments (Finished).—Pfizer Inc., Minerals, Pigments & Metals Div. at East St. Louis; Prince Manufacturing Co. Inc. at Quincy; George B. Smith Color Co. at Maple Park; and Solomon Grind-Chem Service Inc. at Springfield manufactured finished iron oxide pigments for use in paint and coatings. Shipments were about 33,000 short tons valued at $33.3 million.

Iron and Steel.—Illinois ranked fifth of 13 States in pig iron shipments. In 1983, shipments increased to 2.8 million short tons, compared with 2.3 million tons shipped in 1982, but were well below the record high 7.9 million tons shipped in 1973. The steel industry continued to restructure in 1983 to reduce costs and to meet foreign competition. Bethlehem Steel Corp. cut salaries of more than 14,000 nonunion workers because of severe economic and competitive pressures. U.S. Steel slashed its management work force by 40% at its South Works in Chicago as part of a nationwide reduction in its steel operations. The firm also announced that it would not construct a rail mill there as previously planned. Continental Steel Corp. of Joliet and Northwestern Steel & Wire Co. of Sterling received contract concessions from workers after suffering through strikes. Workers at Laclede's Alton plant also made concessions during the year.

Lead, Silver, and Zinc.—Ozark-Mahoning continued to recover byproduct lead, silver, and zinc from its fluorspar operations in Hardin and Pope Counties. With the decline in fluorspar production, recovery of silver and zinc fell during the year. Lead recovery reportedly increased slightly.

[1]State Liaison Officer, Bureau of Mines, Minneapolis, MN.
[2]Program assistant, Bureau of Mines, Minneapolis, MN.
[3]Mining Engineering. Precious Metals Continue To Dominate 1983 Exploration. V. 36, No. 5, May 1984, pp. 437-460.
[4]Chemical Engineering. New Technology for Silicon Carbide. V. 90, No. 20, Oct. 3, 1983, p. 40.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives (manufactured):			
ESK Corp., a subsidiary of Wacker Chemical Co.	Box 412 Hennepin, IL 61327	Plant	Putnam.
Barite:			
Ozark-Mahoning Co	Box 57 Rosiclare, IL 62982	Byproduct of fluorspar operations.	Hardin.
Cement:			
Dixon-Marquette Cement Inc., a subsidiary of Prairie Materials Sales Inc.	6406 Joliet Rd. Countryside, IL 60525	Plant	La Salle.
Illinois Cement Co., a subsidiary of Centex Corp.	Box 442 La Salle, IL 61301	do	Do.
Lone Star Industries Inc., Cement and Construction Materials Group.	1 Greenwich Plaza Box 5050 Greenwich, CT 06836	do	Lee.
Missouri Portland Cement Co., a division of H. K. Porter Co. Inc.	Box 147 Joppa, IL 62953	do	Massac.
Clays:			
Absorbent Clay Products Co	Box 120 Anna, IL 62906	Pit and plant	Pulaski.
Lowe's Inc	348 South Columbia South Bend, IN 46624	do	Do.
Streator Brick Systems Inc	West 9th St. Streator, IL 61364	do	Livingston.
Fluorspar:			
Hastie Mining Co	Cave In Rock, IL 62919	Open pit	Hardin.
Ozark-Mahoning Co.[1]	Box 57 Rosiclare, IL 62982	Underground mines and plant.	Hardin and Pope.
Gypsum (calcined):			
National Gypsum Co	515 Sea Horse Dr. Box 139 Waukegan, IL 60085	Plant	Lake.
Iron oxide pigments (finished):			
Pfizer Inc., Minerals, Pigments & Metals Div.	2001 Lynch Ave. East St. Louis, IL 62201	do	St. Clair.
Prince Manufacturing Co. Inc	700 Lehigh St. Bowmanstown, PA 18030	do	Adams.
Iron and steel:			
Granite City Steel Div. of National Steel Corp.	Box 365 Granite City, IL 62040	Iron and steel furnaces.	Madison.
Interlake Inc	13500 South Perry Ave. Riverdale, IL 60627	do	Cook.
Republic Steel Corp	1629 Republic Bldg. Cleveland, OH 44101	do	Do.
United States Steel Corp	3426 East 89th St. Chicago, IL 60617	do	Do.
Lime:			
Marblehead Lime Co., a subsidiary of General Dynamics Corp.	300 West Washington St. Chicago, IL 60606	Plants	Do.
Vulcan Materials Co	Joliet Rd. and 53d St. McCook, IL 60525	Plant	Do.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Peat:			
Hyponex Corp	2013 South Anthony Blvd. Fort Wayne, IN 46803	Bog and processing plant.	Whiteside.
Markman Peat Co	Route 3 Morrison, IL 61270	do	Do.
Perlite (expanded):			
Manville Products Corp	Box 864 Joliet, IL 60434	Plant	Will.
Silbrico Corp	6300 South River Rd. Hodgkins, IL 60525	do	Cook.
Sand and gravel:			
Construction (1982):			
Elmhurst-Chicago Stone Co	400 West 1st St. Elmhurst, IL 60126	Pits and plants	Du Page and Will.
General Dynamics Corp.:			
Material Service Corp	300 West Washington St. Chicago, IL 60606	do	Grundy, Kane, McHenry.
Yackley Materials Corp	1504 Ogden Ave. Lisle, IL 60532	Pit and plant	Will.
McHenry Sand & Gravel Co. Inc	1819 Dot St. McHenry, IL 60050	Pits and plants	McHenry.
Meyer Material Co	Route 2, Box 56 Algonquin, IL 60102	do	Kane and McHenry.
Road Materials Corp	Box 209 Algonquin, IL 60102	do	Do.
Thelen Sand & Gravel	28955 West Route 173 Antioch, IL 60002	Pit and plant	Lake.
Vulcan Materials Co	Box 6 Countryside, IL 60525	Pits and plants	Champaign and McHenry.
Industrial:			
Consolidated Zemi Corp	Box 136 Serena, IL 60549	Pit and plant	La Salle.
Manley Bros. of Indiana Inc	Box 538 Chesterton, IN 46304	do	Do.
Martin Marietta Corp., Industrial Sand Div.	2 Crossroads of Commerce Rolling Meadows, IL 60008	do	Do.
Ottawa Silica Co	Box 577 Ottawa, IL 61350	do	Do.
Unimin Corp	50 Locust Ave. New Canaan, CT 06840	Pits and plants	La Salle and Ogle.
Stone (limestone):			
Crushed:			
Anna Quarries Inc	Box 180 Anna, IL 62906	Quarry and plant	Union.
Columbia Quarry Co	Box 128 Columbia, IL 62236	Underground mine, quarries, plants.	Johnson, Monroe, Pulaski, St. Clair, Union.
Material Service Corp., a subsidiary of General Dynamics Corp.	300 West Washington St. Chicago, IL 60606	do	Cook, Henderson, Logan, Menard, Montgomery, St. Clair, Vermilion, Will.
Moline Consumers Co	313 16th St. Moline, IL 61265	Quarries and plants.	Adams, Hancock, Henry, La Salle, McDonough, Pike, Rock Island, Warren.
Vulcan Materials Co	Box 6 Countryside, IL 60525	do	Cook, Kankakee, Livingston, Will.
Dimension:			
Fox River Stone Co	670 South McLean Blvd. South Elgin, IL 60177	Quarry and plant	Kane.
Sulfur (recovered):			
Mobil Oil Corp	Box 874 Joliet, IL 60434	Plant	Will.
Shell Oil Co	Box 262 Wood River, IL 62095	do	Madison.
Union Oil Co. of California	1650 East Golf Rd. Schaumburg, IL 60196	do	Will.
Tripoli:			
Illinois Minerals Co., a subsidiary of Georgia Kaolin Co.	2035 Washington Ave. Cairo, IL 62914	Underground and open pit mines and plant.	Alexander.
Tammsco Inc	Box J Tamms, IL 62988	Underground mine and plant.	Do.
Vermiculite (exfoliated):			
W. R. Grace & Co	6051 West 65th St. Bedford Park, IL 60638	Plant	Du Page.
International Vermiculite Co	1st and Mound Sts. Girard, IL 62640	do	Macoupin.
Strong-Lite Products Corp. of Illinois	1120 Oak St. De Kalb, IL 60115	do	De Kalb.

[1]Also lead, silver, and zinc.

The Mineral Industry of Indiana

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey, Indiana Department of Natural Resources, for collecting information on all nonfuel minerals.

By William A. Bonin[1]

Indiana's nonfuel mineral production was valued at $250.5 million in 1983. Although this figure was 16.5% over the $215.1 million reported in 1982, it was 21% below the record high $317 million set in 1979. This $35.4 million gain in value increased the State's national ranking to 26th from 29th place. Indiana was second in production of dimension stone, shipments of masonry cement, and sales of iron slag. The State also ranked third in sales of peat, sixth in production of gypsum, and eighth among 39 lime producing States. Other commodities produced were crushed stone, construction sand and gravel, portland cement, common clay, industrial sand, steel slag, natural abrasives, and fire clay. The State also increased its lead in pig iron and raw steel production and continued to rank fifth among the 16 States that produced primary aluminum. Elemental sulfur was recovered as a nondiscretionary byproduct of oil refining, and perlite was shipped into the State for processing. Indiana ranked fourth nationally in the value of expanded perlite sales.

Table 1.—Nonfuel mineral production in Indiana[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement (portland)	thousand short tons	1,523	$58,055	W	W
Clays	do.	501	1,221	[2]558	[2]$1,421
Gem stones		NA	1	NA	1
Peat	thousand short tons	89	[r]2,243	81	1,973
Sand and gravel (construction)	do.	13,097	34,579	[e]14,400	[e]37,900
Stone:					
Crushed	do.	[e]20,300	[e]65,500	24,051	82,782
Dimension	do.	[e]135	[e]13,337	144	11,015
Combined value of abrasives (natural), cement (masonry), clays (fire clay, 1983), gypsum, lime, sand and gravel (industrial), and value indicated by symbol W		XX	40,199	XX	115,450
Total		XX	[r]215,135	XX	250,542

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing proprietary data; included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes fire clay; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Indiana, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Adams	W	$232	Sand and gravel (construction).
Allen	W	W	Sand and gravel (construction), peat.
Bartholomew	W	362	Sand and gravel (construction).
Boone	(2)	W	Do.
Carroll	W	122	Do.
Cass	W	W	Cement, sand and gravel (construction), clays.
Clark	W	W	Do.
Clay	$462	W	Clays.
Clinton	(2)	W	Sand and gravel (construction).
Crawford	9,224	(3)	
Daviess	(2)	W	Sand and gravel (construction).
Dearborn	(2)	W	Do.
Decatur	W	(3)	
De Kalb	(2)	642	Sand and gravel (construction).
Delaware	693	232	Do.
Dubois	46	1	Clays.
Elkhart	W	814	Sand and gravel (construction).
Fayette	(2)	W	Do.
Floyd	(2)	--	
Fountain	W	W	Sand and gravel (construction).
Franklin	W	W	Do.
Fulton	1	W	Sand and gravel (construction), peat.
Gibson	(2)	W	Sand and gravel (construction).
Grant	W	W	Do.
Greene	(2)	W	Do.
Hamilton	6,273	W	Sand and gravel (construction), peat.
Hancock	(2)	W	Sand and gravel (construction).
Harrison	941	221	Do.
Henry	(2)	W	Do.
Howard	W	W	Do.
Huntington	W	444	Do.
Jackson	W	W	Sand and gravel (construction), clays.
Jasper	W	W	Sand and gravel (construction), peat.
Jay	W	W	Sand and gravel (construction).
Jennings	W	(3)	
Johnson	(2)	--	
Knox	(2)	776	Sand and gravel (construction).
Kosciusko	W	W	Sand and gravel (construction), peat.
Lagrange	(2)	W	Sand and gravel (construction).
Lake	W	W	Lime.
La Porte	W	W	Peat, sand and gravel (construction), sand (industrial).
Lawrence	W	W	Cement.
Madison	1,231	W	Sand and gravel (construction).
Marion	3,996	3,916	Do.
Marshall	(2)	W	Do.
Martin	W	W	Gypsum.
Miami	1,331	139	Sand and gravel (construction).
Monroe	9,103	(3)	
Montgomery	(2)	6	Sand and gravel (construction).
Morgan	W	W	Sand and gravel (construction), clays.
Newton	W	(3)	
Noble	(2)	W	Sand and gravel (construction).
Ohio	(2)	58	Do.
Orange	W	W	Abrasives.
Owen	W	W	Sand and gravel (construction).
Parke	W	329	Do.
Perry	W	(3)	
Porter	W	W	Sand (industrial), clays.
Pulaski	W	(3)	
Putnam	W	W	Cement, clays.
Randolph	W	W	Sand and gravel (construction).
Ripley	W	(3)	
Rush	W	4	Sand and gravel (construction).
St. Joseph	W	1,759	Do.
Scott	W	(3)	
Shelby	W	507	Sand and gravel (construction).
Starke	--	125	Do.
Steuben	(4)	261	Do.
Sullivan	66	W	Do.
Switzerland	159	W	Do.
Tippecanoe	(2)	W	Do.
Union	(2)	--	
Vanderburgh	(2)	241	Sand and gravel (construction).
Vermillion	W	717	Do.
Vigo	(2)	662	Do.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Indiana, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Wabash	[2]	$34	Sand and gravel (construction).
Warren	$135	1,183	Do.
Washington	809	[3]	
Wayne	W	1,234	Sand and gravel (construction).
Wells	W	W	Peat.
White	W	[3]	
Whitley	[2]	W	Sand and gravel (construction).
Undistributed[5]	175,563	121,278	
Sand and gravel (construction)	[e]41,330	XX	
Stone:			
Crushed	XX	[e]65,500	
Dimension	XX	[e]13,337	
Total[6]	251,362	215,135	

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Benton, Blackford, Brown, Hendricks, Jefferson, Pike, Posey, Spencer, Tipton, and Warrick. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Less than 1/2 unit.

[5]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[6]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Indiana business activity

	1982	1983[p]	Change, percent
Employment and labor force, annual average:			
Total civilian labor force, thousands	2,586.5	2,578.9	-0.3
Unemployment, do.	370.5	310.0	-16.3
Employment (nonagricultural):			
Mining[1], do.	9.2	8.7	-5.4
Manufacturing, do.	557.2	595.3	+6.8
Contract construction, do.	61.3	60.4	-1.5
Transportation and public utilities, do.	99.5	99.9	+.4
Wholesale and retail trade, do.	441.6	452.1	+2.4
Finance, insurance, real estate, do.	98.8	99.9	+1.1
Services, do.	351.7	354.6	+.8
Government, do.	336.2	329.5	-2.0
Total nonagricultural employment[1 2], do.	1,955.4	2,000.5	+2.3
Personal income:			
Total, millions	$54,840	$57,902	+5.6
Per capita	$9,994	$10,567	+5.7
Construction activity:			
Number of private and public residential units authorized	12,783	17,284	+35.2
Value of nonresidential construction, millions	$713.4	$920.4	+29.0
Value of State road contract awards, do.	$139.2	$165.3	+18.8
Shipments of portland and masonry cement to and within the State, thousand short tons	1,076	1,216	+13.0
Nonfuel mineral production value:			
Total crude mineral value, millions	$215.1	$250.5	+16.5
Value per capita, resident population	$39	$46	+18.0
Value per square mile	$5,924	$6,924	+16.9

[p]Preliminary.

[1]Includes bituminous coal and oil and gas extraction.

[2]Data do not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

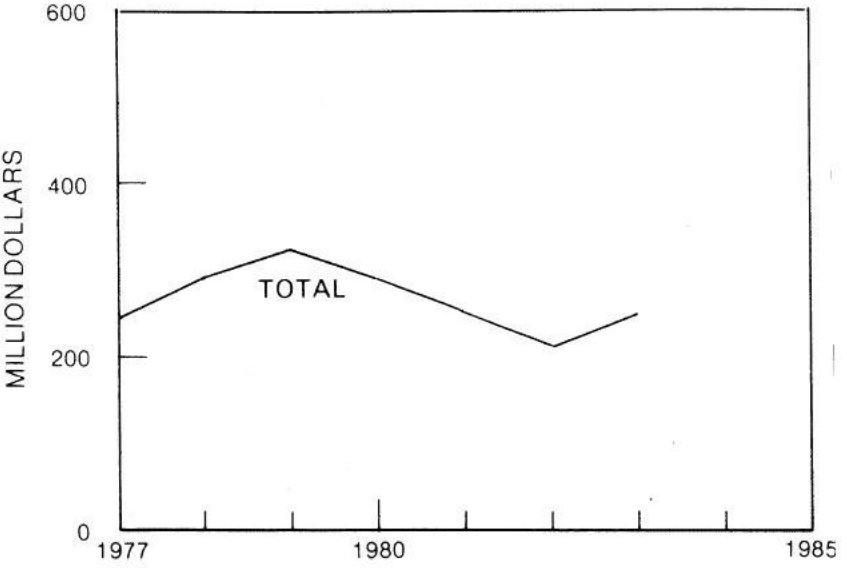

Figure 1.—Total value of nonfuel mineral production in Indiana.

Trends and Developments.—In 1983, the Indiana mineral industry for the most part, participated in the recovery from the recent recession. Compared with 1982 levels, the value of the State's nonfuel mineral production rose by 16.5%. This compares favorably with the value of total U.S. industrial mineral production, which was up an estimated 10% over that of 1982. In real terms, these figures reflect a modest economic growth. Of particular importance to the State's mineral industry were surges in key mineral-consuming sectors such as construction and automobile and appliance manufacturing.

It is significant that shipments of cement to and within Indiana increased over those of 1982 by 13%, and production of common clay, 11%; construction sand and gravel, 10%; gypsum, 20%; and crushed stone, 18% was up over 1982 levels, as these commodities are largely used in the housing and construction industry. The State's lime production and the value of that production increased 15% and 22%, respectively, over 1982 levels, as demand for fluxing lime by steelmakers and building lime for construction markets increased significantly.

Raw steel production, a major indicator of material use and mineral production, rose 22% over that of 1982 in Indiana—the Nation's leading steelmaker. Though this gain remained 11% below the recent high production level of 1981, it did reflect that U.S. automakers turned out 35% more cars and 25% more trucks than in 1982.

Raw steel and steel mill products, iron and steel castings, and purchased scrap, showed improvement and increased in value during 1983, yet output remained far below levels of just a few years ago. Total U.S. steel production was still 30% less than in 1981. Raw steelmaking capacity operated at less than 60% during 1983.

One of the more positive responses to the general economic recovery in Indiana came from Warrick County, where the State's only primary aluminum smelter was up to 100% of operating capacity by yearend; nationally, the operating rate of primary smelters was at 78%.

The Indiana Department of Commerce announced in March that both coal and limestone from Indiana would be tested in a pressurized fluidized-bed system at Malmo, Sweden, under the sponsorship of the State of Indiana and Michigan Electric Co. About 1,200 tons of coal from the Chinook Mine of

Amax Coal Co. and 600 tons of dolomite from the Huntington Quarry of Erie Stone Inc. were tested. In October, American Electric Power of Columbus, OH, reported that the dolomite had given exceptionally good results, which was probably related to the rock's good porosity. American Electric had provided 200 hours of testing and planned to complete 300 more. The Indiana Geological Survey (IGS) collected samples from flank beds of the Silurian Reef, which are exposed in the Huntington Quarry, for detailed description and chemical analysis.

Great Lakes Metals Co. of Bethesda, MD, applied for a special zoning exception to start a commercial mining operation for gold on part of 220 acres in northeastern Brown County. The Salt Creek streambed would be mined, washed, and sifted for gold-bearing heavy minerals in the proposed 2-year project. The Indiana Department of Natural Resources approved the company's mining plan.

The Southern Indiana Shale Oil Co. (SISO) produced the first oil from its pilot plant near Marysville in Clark County. In November, Midwest Energy Resources, a development firm formed by SISO, announced plans to build a $15 to $18 million plant for shale oil the next spring. The plant, designed to produce up to 500 barrels of oil per day, would be near Marysville. The process is being developed by Allis-Chalmers Corp. Midwest Energy Resources has shale oil leases in Clark, Scott, Jennings, and Jackson Counties.

In June, it was reported that Phillips Petroleum Co. planned to drop all its oil shale leases in Ohio and sell its Kentucky leases, but that it would hold about 77,000 acres in southern Indiana.

Legislation and Government Programs.—In August, the Indiana Coal Council reported that the Division of Reclamation of the State's Department of Natural Resources (DNR) had processed only 23 out of 147 applications for surface mining permits. At the time that Indiana was granted primacy for the program, July 29, 1982, coal operators had 60 days within which to apply for a permit, and DNR had 8 months after the submission to grant or deny the permit.

The IGS hosted the 1983 Annual Meeting of the Geological Society of America (GSA) in Indianapolis. As cosponsor for this event, IGS gathered and edited material for 16 field trips and produced two guidebook volumes. Other IGS involvements with GSA for the year included preparation of 13 articles for the Indiana section of the "Decade of North Amercia Geology Centennial Field Guide" and a field trip for the combined north-central and southeastern sections meeting in Lexington in April 1984. IGS published, in early 1983, "The Proceedings of the 18th Forum on Geology of Industrial Minerals" as IGS Occasional Paper 37. The 1982 forum had been cosponsored by the IGS and the Department of Geology at Indiana University. Other 1983 publications of the IGS were "Directory of Crushed Stone, Ground Limestone, Cement, and Lime Producers in Indiana"; "Geologic Sources of Construction Materials in Indiana"; and "Sand and Gravel Resources of the Wabash Valley: Causes of Variability."

Considerable progress was made by the Petroleum Section of the IGS on an atlas showing structure and thickness of major stratigraphic units. The section also published a paper on analysis of oilfield brines and compiled a computerized data base for 758 wells that penetrate the Black River unit or deeper units. The data base will be updated annually. The Geophysics Section, using a newly completed network of gravity base stations, began an extensive new gravity survey of the State. Also, research in techniques of measuring thermal characteristics of building stone was continued. Work on the "Annotated Bibliography of Indiana Geology—1956-75" was resumed, and publication is expected in 1984. Annotating and indexing of post-1975 reports and maps for a later volume were proceeding concurrently.

Drilling capabilities of the IGS were enhanced in 1984 by acquisition of a new mobile drilling rig with 2,000-foot capabilities and by full renovation of its older Failing-1500 rig. One of its two truck-mounted augers was also entirely rehabilitated.

The Mining and Mineral Resources and Research Institute at Purdue University at West Lafayette, which was authorized by the Surface Mining Control and Reclamation Act of 1977, received $150,000 in fiscal year 1983 from the U.S. Bureau of Mines. The funds are designed to encourage the training of mining engineers and other scientists involved in mineral-related studies. These funds must be matched with non-Federal funds and can be used for research projects, demonstrations, fellowships, or other programs.

In April 1983, the U.S. Bureau of Land Management decided not to issue leases to explore and drill for oil and gas in

the Hoosier National Forest until the forest management plan was completed. The plan and Environmental Impact Study was ready for public distribution at yearend. In August 1982, the U.S. Forest Service had begun processing 139 of the applications on 150,000 acres of Federal mineral lands beneath the 187,300-acre forest, excluding the recently created Charles C. Deam Wilderness Area.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives. — *Manufactured.* — Annealed and chilled iron shot and grit were produced and sold by Jumbo Manufacturing Inc. in Tippecanoe, Marshall County. The company also produces gray iron castings. The plant of Wheelabrator-Frye Inc. at Mishawaka in St. Joseph County remained idle throughout the year.

Manufactured abrasives operations continued to be depressed and reflected continuing reduced economic activity in heavy industries such as steel, foundry, and automotive. Production of metallic abrasives was approximately the same as that of 1982 and was again reported at its lowest level since 1964.

Natural.—Hindostan Whetstone Co. remained the State's sole producer of natural abrasives. The company quarried the siltstone 9 miles northwest of Orleans, Orange County, for shaping into sharpening stones and cuticle removers. These special silica stone products were manufactured at its plant in Bedford, Lawrence County. In the United States, only Arkansas and Indiana produced oilstones and whetstones.

Cement.—Three companies manufactured cement in the State—Lehigh Portland Cement Co., Lone Star Industries Inc., and Louisville Cement Co.

Lehigh, a subsidiary of Heidelberger Zement AG of the Federal Republic of Germany, produced calcium aluminate cement at its Buffington Station plant at Gary in Lake County and portland cement at its Mitchell plant in Lawrence County. Lehigh also operated a distribution terminal at Anderson in Madison County. Lone Star, by far the largest cement-producing company in the Nation, produced both portland and masonry cement at its Greencastle plant in Putnam County. Louisville Cement produced both portland and masonry cement at Logansport in Cass County and at Speed in Clark County.

Cement production and consumption increased in 1983, reflecting greater activity by the construction industry and improvement of the U.S. economy. Portland cement shipments increased after 3 years of steady decline in which a 20-year low had been recorded.

Clays.—Common clay and shale was produced by 10 companies at 14 operations in 9 of Indiana's 92 counties in 1983. Production, exclusive of fire clay, at 558,000 tons was valued at $1.4 million. Over 1982 levels, quantity and value increased 11.4% and 16.4%, respectively. Morgan County, with one-third of Indiana's production, led the State in the production of common clay and shale for the manufacture of face brick and lightweight aggregate. A small amount was mined for pottery in Dubois County and for electrical porcelain in Fountain County, while most was used in the manufacture of portland cement, lightweight aggregate, and bricks. Other uses included sewer pipe, drain tile, and flue linings. Production of common clay and shale increased because of the upturn in construction that produced a greater demand for structural clay products such as brick, pipe, and tile; portland cement clinker; and bloated lightweight aggregate.

In addition to mining common clay for pottery and other uses, Yellow Banks Clay Products Inc., Huntingburg, obtained underclays from coal strip mines in Dubois County. The company is grinding both clay and limestone for use as fillers in the manufacture of rubber, paint, caulking, ceramics, and polishing compounds. The limestone is obtained from the Hy-Rock Products Co. quarry at Marengo.

Table 4.—Indiana: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Fire clay		Common clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1979	1	15	1,184	2,325	1,185	[1]2,341
1980	([2])	3	932	1,927	932	1,930
1981	--	--	691	1,602	691	1,602
1982	--	--	501	1,221	501	1,221
1983	W	W	558	1,421	558	1,421

W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.
[2]Less than 1/2 unit.

Gypsum.—National Gypsum Co. and United States Gypsum Co. produced crude gypsum from underground mines at Shoals in Martin County. Production and value increased 20% and 14.6%, respectively, from 1982 levels. In order of total output, U.S. Gypsum's mine ranked third in the Nation and National Gypsum's mine ranked eighth. Both companies calcined gypsum at minesite plants. U.S. Gypsum also operated a calcining plant at East Chicago in Lake County. The quantity and value of production increased 27.4% and 46.4%, respectively, from 1982 levels. In order of total output, U.S. Gypsum's and National Gypsum's Shoals plants ranked sixth and ninth, respectively, in total U.S. calcined production.

The U.S. gypsum industry, spurred by lower interest rates and released pent-up demand for housing, ended the year with record-high shipments of wallboard, an increase of 28% over that of 1982 for a total of 16.8 billion square feet. Of the total gypsum products sold or used, 5.5 million short tons (25%) was uncalcined. Of this, 72% was used for portland cement and 24% was used in agriculture. A total of 96% of calcined gypsum was used for wallboard and 4% for industrial and building plasters.

U.S. Gypsum received approval to rezone 120 acres in Springfield and Center Townships from residential to industrial. The company proposes to develop an underground gypsum mine and construct a wallboard manufacturing plant at the La Porte County site. The mine will operate 24 hours per day, 5 to 7 days per week. At full production, reserves are estimated for 50 years. Mining and manufacturing will employ between 150 and 200 people with an annual payroll of $4.5 million. Construction will require nearly 2 years and involve more than 100 workers.

In late 1983, U.S. Gypsum's Shoals Mine was recognized by the Mine Safety and Health Administration and the American Mining Congress for being the Nation's safest underground nonmetal mine in 1982.

Lime.—Two companies, both in Lake County, produced quicklime during the year for steelmaking. Marblehead Lime Co. operated a plant at Buffington Station in Gary, and Inland Steel Co. operated a plant near its Indiana Harbor Works in East Chicago. In order of total output, these plants are among the 10 leading in the Nation which accounted for 38% of national production. The quantity and value of the State's quicklime production in 1983 increased 15.5% and 22.2%, respectively, over 1982 levels. Both had decreased 31% from that of 1981. Indiana ranked third behind Ohio and Pennsylvania in consumption of quicklime. These three States, each of which consumed over 1 million short tons, accounted for 35% of total quicklime consumed.

Peat.—In 1983, eight active peat mining operations produced 65,000 tons of peat in Indiana. Sales of 81,000 tons, valued at almost $2 million, represented 11% of total U.S. sales. From 1982 levels, sales decreased 9% while value fell by 12%. Sales and value in 1982 had fallen 15% and 33%, respectively, from 1981 levels. Of total sales, the percent packaged has increased from 79 in 1981, to 82 in 1982, to 85 in 1983.

La Porte County led in sales and, along with Hamilton and Jasper Counties, accounted for about 90% of sales. Packaged peat sales were used primarily for soil improvement and potting soil. Bulk sales were used primarily for nurseries and golf courses.

Perlite (Expanded).—Indiana was 1 of 33 States that expanded processed perlite ore in 1983. The State ranked seventh in production and sales, and fourth in value. Sales of 24,300 short tons of expanded perlite were valued at $5.3 million in 1983, an increase of 28% in quantity and 37% in value over 1982 levels.

Four companies expanded perlite at five plants. Grefco Inc. at its Crawfordsville plant in Montgomery County expanded per-

lite for use as a filter aid. The Chemrock Corp. plant at Lafayette in Tippecanoe County produced primarily filter aid from its expanded perlite. Chemrock also produced aggregates for concrete, plaster, and formed products; cavity fill insulation; fillers; and horticultural aggregate. U.S. Gypsum at its Shoals and East Chicago plants, and National Gypsum at Shoals produced plaster aggregate from its expanded perlite.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Based on these estimates, Indiana's production in 1983 of 14.4 million tons was valued at $37.9 million—about 10% over 1982 levels. The State's percentage increase in production compared favorably with total U.S. production, but the State's value of production lagged by about 6 percentage points. Nationwide, 1983 had the second lowest production level for construction sand and gravel since 1958—32% below the record high set in 1978 and only 10% higher than that of 1982.

Industrial.—In 1983, two companies continued to produce industrial sand in Indiana. The Crisman Sand Co. Inc. at its Portage operations in Porter County produced refractory sand, and the Unimin Corp. at its Michigan City operations in La Porte County, formerly owned by Martin Marietta Corp., produced primarily mold and core sand, and also blasting and engine sand. Most of their products were shipped to market by truck and some was transported by rail.

Table 5.—Indiana: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	5,982	$15,048	$2.52	NA	NA	NA
Gravel	5,413	16,276	3.01	NA	NA	NA
Sand and gravel (unprocessed)	1,703	3,255	1.91	NA	NA	NA
Total or average	[1]13,097	34,579	2.64	[e]14,400	[e]$37,900	[e]$2.63
Industrial sand	W	W	9.38	W	W	8.95
Grand total or average	W	W	2.71	W	W	[e]2.70

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

In the second half of 1983, Unimin Corp. completed the purchase of the Industrial Sand Div. of Martin Marietta for $27 million. The Michigan City plant was 1 of 10 plants involved in the transaction.

The Corning Glass Works at Bluffton in Wells County shut down on June 19, ending 18-1/2 years of output from which millions of color television picture tubes and glass components had been produced. As recently as 1980, employment at the Bluffton plant had soared to over 850.

Slag, Iron and Steel.—Three companies processed iron and steel slag for use by the construction industry. Levy Co. Inc. at Burns Harbor and Vulcan Materials Co. at Indiana Harbor in East Chicago processed air-cooled iron slag. Levy also produced expanded iron slag and processed steel slag. Heckett Co., also at Indiana Harbor, processed steel slag. The construction material was used for road base, fill, asphaltic concrete, and concrete aggregate.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—In 1983, production and value of crushed stone increased 18.5% and 26.5%, respectively, over 1982 levels. This output was 29.5% below the recent high production of 1979.

Crushed stone was produced by 52 companies at 191 quarries in 45 of the State's 92 counties. About 97% of all production was limestone, 3% was dolomite, and a minor amount was marl for agricultural use.

The primary uses of crushed stone were

for construction aggregate (45%); agricultural limestone (8%); cement, lime, and glass manufacture; flux stone; and other special uses such as sulfur oxide removal.

The average unit values per ton of crushed stone for various uses were $3.01 for cement manufacture, $3.83 for agricultural limestone, $4.34 for agricultural dolomite, $3.88 for flux stone, $6.50 for glass manufacture, and $2.80 for sulfur oxide removal. Marl for agricultural uses had the lowest unit value—$1.11 per ton. About 83% of shipments were by truck, and twice as much material was moved by waterway as by rail.

The IGS reported continued interest in high-calcium limestone in northern Indiana, especially the reef limestone in Grant and Cass Counties. Marblehead Lime, Gary, was planning to develop part of the Camden Reef limestone for whiting. Some properties on the high-calcium limestone reef became available for leasing, and attorneys for the landowners sent out notices to people who might be interested in developing the properties.

Hy-Rock Products at Marengo in Crawford County, which had filed for bankruptcy under chapter 11 of the Federal Bankruptcy Act in October 1981, continued to operate under court protection from its creditors throughout 1983.

Mitchell Crushed Stone Co. at Mitchell in Lawrence County began supplying scrubber stone to the Petersburg Station of the Indiana Power & Light Co. and the Gibson Station of Public Service Indiana (PSI). Bloomington Crushed Stone Co. supplied scrubber stone to the Merom Station of Hoosier Energy. In addition, in 1983, Robertson Crushed Stone Co. at Milltown in Harrison County also began selling stone to PSI's Gibson Station.

On July 1, Mulzer Crushed Stone Co., Tell City, purchased the Crawford County Stone Co., Rogers Group Inc., quarry near Leavenworth. Vulcan, Countryside, IL, purchased the Western Material Div. quarry of Medusa Aggregates Co. near Francesville in Pulaski County. Vulcan also operates a second quarry near Monon in White County.

Stockpiles of stone at the former Medusa plant at Orleans were being sold by Orleans Crushed Stone Co. No quarrying or crushing was being done on-site.

McCorkle Stone Co. was sold to Rush County Stone Co. Inc. The two companies, both of which produced construction aggregate, flagstone, and rubble, operated within a mile of each other at Milbury in Rush County for over 15 years.

Dimension.—In 1983, a total 1,866,000 cubic feet of dimension stone valued at $11 million was produced in Indiana. The industry consisted of 13 companies operating 19 quarries in 5 counties. Over 90% of production was from Lawrence and Monroe Counties. More than 98% consisted of limestone, the remainder was sandstone. Indiana continued to be the leading State in the production of dimension limestone. In total production of dimension stone, Indiana ranked second behind Georgia, the leading producer of granite and ahead of Vermont, a leading producer of granite, marble, and slate. Georgia, Indiana, and Vermont together produced 39% of the Nation's total.

The quantity of Indiana's production increased 6.7% over that of 1982, while the value of production decreased 17.4%. Of the $11 million of production, 17% by value was ashlars and partially squared pieces, 36% was rough blocks for building and construction, and 47% was dressed slabs and blocks for building and construction. The average unit value of veneer and cut stone was $8.34 and $8.86, respectively. Irregular-shaped stone, rough blocks, and flagging were sold for $42 to $45 per ton.

Some of the largest limestone panels ever made were ordered from the Indiana Limestone Co. Inc. for a 40-story office building in Denver, CO. A production technique known as post-tensioning will be used extensively for construction of the large panels.

B. G. Hoadley Co. Inc., Bloomington, began quarrying at the Maple Hill Quarry of the former Bloomington Limestone Company. B. G. Hoadley also operates a quarry in Guthrie.

Table 6.—Indiana: Stone sold or used by producers

Year	Crushed		Dimension		
	Quantity (million short tons)	Value (millions)	Quantity: Thousand short tons	Quantity: Thousand cubic feet	Value (millions)
1976	28.2	$59.4	263	3,570	$12.8
1977	26.7	61.4	244	3,317	11.8
1978	33.4	80.5	234	3,177	13.0
1979	34.1	92.6	181	2,301	10.5
1980	30.9	92.1	161	2,173	14.0
1981	25.3	79.9	145	1,965	13.7
1982[e]	20.3	65.5	135	1,790	13.3
1983	24.1	82.8	144	1,866	11.0

[e]Estimated.

Table 7.—Indiana: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	726	2,698
Riprap and jetty stone	431	1,561
Filter stone	85	314
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,616	5,718
Bituminous aggregate, coarse	4,418	14,679
Bituminous surface-treatment aggregate	811	3,011
Railroad ballast	745	2,364
Fine aggregate (-3/8 inch):		
Stone sand, concrete	24	147
Stone sand, bituminous mix or seal	42	189
Screening, undesignated	142	531
Coarse and fine aggregate:		
Graded road base or subbase	2,323	7,734
Unpaved road surfacing	1,206	4,027
Crusher run or fill or waste	440	1,468
Other coarse and fine aggregate	1	5
Agricultural:		
Agricultural limestone	1,900	7,276
Other agricultural	11	12
Chemical and metallurgical: Cement manufacture	2,770	8,352
Special: Other[2]	6,360	22,696
Total	24,051	82,782

[1]Includes limestone, dolomite, and marl.
[2]Includes poultry grit and mineral food, flux stone, glass manufacture, sulfur oxide removal, coarse aggregate (graded), fine aggregate, and uses not specified.

Table 8.—Indiana: Dimension stone[1] sold or used by producers in 1983, by use

Use	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Rough blocks for building and construction	88,735	1,143	$3,972
Irregular-shaped stone	1,735	25	W
Dressed stone:			
Ashlars, partially squared pieces[2]	19,453	221	1,880
Flagging	281	4	12
Other[3]	34,274	473	5,150
Total	144,478	1,866	[4]11,015

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone and sandstone.
[2]Includes veneer.
[3]Includes rough flagging, dressed slabs and blocks for building and construction, and value indicated by symbol W.
[4]Data do not add to total shown because of independent rounding.

Sulfur (Recovered).—Amoco Oil Co. recovered elemental sulfur from refinery gases at its East Chigaco facility. Its parent company, Standard Oil Co. (Indiana), is the fifth largest producer of recovered sulfur in the Nation.

Although production of recovered sulfur was at an alltime high in 1983, sulfur demand continued to exceed domestic production. Yet prices for all elemental sulfur decreased significantly. The largest sulfur end use was for production of sulfuric acid, and the largest end use for sulfuric acid was for phosphatic fertilizer production. Its use for copper ore leaching decreased by almost one-third. Other end uses for sulfuric acid are for petroleum refining and other petroleum and coal products.

Stauffer Chemical Co. Inc., at its Hammond plant in Lake County, produced liquid sulfur dioxide. The company also made sulfuric acid and liquid sulfur trioxide.

METALS

Aluminum.—Indiana ranked fifth among the 16 States in which primary aluminum was produced in 1983. Aluminum Co. of America (Alcoa), the State's sole producer of this primary metal, operated a smelter and fabrication plant in Newburgh near Evansville in southwestern Indiana. Value of production increased 7.1% over that of 1982 compared with a 5% increase in the value of total domestic production, which was responding to an increased demand for aluminum by the building and transportation industries. Alcoa is Warrick County's largest employer with about 3,500 workers. The Warrick operations consisted of smelting, recycling, ingot-casting, and fabricating facilities. The fully integrated facility produces light-gauge aluminum sheet for beverage cans, which is Alcoa's largest single product. In 1983, packaging accounted for an estimated 30% of domestic consumption; transportation, 18%; building, 22%; electrical, 10%; consumer durables, 8%; and other uses, 12%. Alcoa also operates finishing mills at Fort Wayne, Lafayette, and Richmond, and has research facilities at Fort Wayne and Richmond.

Near yearend, Alcoa announced that it would invest $120 million over the next 2 years to upgrade and modernize its sheet-rolling mill in Warrick and that it was evaluating a $150 million investment in upgrading the smelter. The 298,000-short-ton-per-year smelter was operating at full capacity at yearend, and the plant was producing over 1 billion pounds of can stock per year. In response to the continuing improvement in aluminum demand and to replace depleted inventories of the primary metal, the six-potline Warrick smelter was brought up to full capacity in October with the restart of the idled 44,000-ton-per-year potline.

Also, near yearend, Alcan Aluminum Ltd. of Montreal, Canada, agreed in principal to purchase most of the aluminum operations of Atlantic Richfield Co. (ARCO). Included in the purchase would be ARCO's rolling mills at Terre Haute. The final transaction is subject to approval under U.S. antitrust laws and the boards and stockholders of both organizations.

In October, Alumax Inc. formed the Alumax Group, which will operate the secondary aluminum smelters of its subsidiary, Apex International Alloys Inc. The smelters are located in Bicknell, IN, and Cleveland, OH.

CMI International Inc. (formerly Cast Metal Industries Inc.) announced in May that it would construct a low-pressure casting plant in northern Indiana for producing aluminum wheels for passenger cars. The company reported that the facility would cost $6 million, employ 200 workers, and be ready for production in about 1 year.

During the year, Kaiser Aluminum & Chemical Corp. sold its lidmaking plant in Wanatah to the National Can Corp. of Chicago, IL, along with can body plants in Texas and Florida.

Iron and Steel.—In 1983, there was increased demand for steel from consumer-related markets, but capital goods and industrial construction markets remained depressed. Overall, steel industry shipments showed only a modest 10% improvement over the 33-year low of 1982, and the prices that steelmakers got for their products were still depressed. In 1983, despite huge losses, U.S. steelmakers continued to modernize their plants in support of strategies to improve quality and reduce costs. They also continued to restructure and to adjust their capacity to expected demand. Significantly, progress was made in reducing noncompetitive employment costs when the Nation's seven largest steelmakers and the United Steelworkers of America concluded a new 41-month contract that provided for lower hourly employment costs during the period from March 1, 1983, to July 1, 1986. Most other steel companies received concessions from their unions in 1982 or 1983. Addition-

ally, the U.S. specialty steel industry was granted import protection by extra tariffs and quotas and the steel industry sought trade law protection against alleged unfair trade imports.

The Indiana steel industry continued to lead the domestic industry in its slow recovery.

Table 9.—Indiana: Pig iron shipments and raw steel production

Year	Pig iron shipments (million short tons)		Indiana		Raw steel production (million short tons)		Indiana	
	Indiana	United States	Percent of U.S. shipments	Rank	Indiana	United States	Percent of U.S. production	Rank
1977	16.5	81.5	20.2	2	21.5	125.3	17.2	3
1978	18.8	87.7	21.4	2	24.4	137.0	17.8	2
1979	18.0	87.0	20.7	2	22.9	136.3	16.8	2
1980	15.8	68.7	23.0	1	19.8	111.8	17.7	2
1981	18.3	73.8	24.8	1	22.7	120.8	18.8	2
1982	13.5	43.5	31.0	1	16.5	74.6	22.1	1
1983	16.4	49.1	33.4	1	20.2	84.6	23.9	1

In 1983, Indiana increased its lead over both Ohio and Pennsylvania as the largest domestic producer of pig iron. Indiana's shipments at 16.4 million short tons in 1983 represented 33.4% of total U.S. shipments. Indiana also led the Nation in consumption of pig iron, at 16.5 million tons in 1983, 21.4% more than in 1982. During the year, 11 of 18 operating blast furnaces were "in blast" for more than 179 days. Indiana also increased its share of the modest 13.5% increase in U.S. raw steel production, and further secured its recently acquired position as the Nation's No. 1 steel producer.

Indiana, Ohio, and Pennsylvania, the Nation's leading steelmakers, shipped 67% of U.S. pig iron production in 1983. The three States also accounted for 56% of the Nation's raw steel production.

Significant developments during the year in the State's steel industry included the following.

Bethlehem Steel Corp. began production at its new $60 million continuous sheet steel heat-treating line at Burns Harbor. A similar facility, costing $100 million, went into production at the Indiana Harbor Works of Inland Steel in East Chicago. Bethlehem Steel also signed financial agreements and began site preparation for the construction of a 2.2-million-short-ton-per-year continuous caster at Burns Harbor. Startup is scheduled for April 1986. Bethlehem Steel has been operating one continuous slab caster at Burns Harbor since 1975. Construction also began on a continuous caster operating at Inland Steel's No. 2 basic oxygen furnace shop at the Indiana Harbor Works. The facility, costing over $200 million, is scheduled for completion in 1986, and a second one is planned. In December, United States Steel Corp. approved a continuous slab caster for its Gary Works. Two parallel continuous slab casters came onstream at the Indiana Harbor Works of Jones & Laughlin Steel Corp. (J&L). J&L's $165 million installation is slated for full capacity production in late 1984. At its Midwest Steel Div. in Portage, National Steel Corp. planned to modify its 48-inch, hot-dip galvanizing line in order to increase capacity by 75,000 tons per year.

In September, the J&L subsidiary of LTV Corp. and Republic Steel Corp., the Nation's third and fourth largest steelmakers, respectively, announced plans to merge. At yearend, the agreement remained subject to shareholder and U.S. Department of Justice approval. The two companies have a combined raw steel capacity of over 24 million short tons per year, about one-sixth of the U.S. total. Republic has six steelworks located in Ohio, Alabama, and Illinois. J&L has five steelworks—three in Pennsylvania, one in Ohio, and the Indiana Harbor Works in East Chicago. The new company, to be called LTV Steel Co., is expected to be the Nation's No. 2 steelmaker, after U.S. Steel.

Late in the year, U.S. Steel announced that it would permanently close about 20% of its raw steel capacity and 23 finishing and fabricating mills by April 1984, cutting full employment capacity by about 15,000. The closures were to include the No. 10 blast furnace, one of the six at the Gary Works. Also to be closed at Gary would be the rail mill, which would take U.S. Steel out of the rail business.

Other Metals.—*Beryllium-Copper.*—The Cabot Berylco Div. of Cabot Corp. at Reading, PA, embarked on a $16 million capital expansion program that will move all of its beryllium-copper rolling activities out of Reading into two Indiana plants. A wide-strip (50-inch) rolling mill will be installed at the company's existing service center in Elkhart. When the modernization program is completed, cast slabs produced in Reading, PA, will be shipped to Kokomo and rolled on its new four-strand mill. The new $58 million mill in Kokomo delivers hot bands in widths from 36 to 50 inches, which are conditioned and rolled to 0.150- by 36-inch hot band coils. A second part of the expansion program will be the installation of a traverse winding line at both Elkhart and the company's service center in Elmsford, NJ.

Coils produced at Kokomo will be shipped to Elkhart for rolling into gauges and widths required by beryllium-copper consumers, which are mainly stamping houses that produce components for the electronics industry. Currently, all melting and rolling (in strips up to 12 inches), casting, and extrusion will continue in Reading, PA.

Nickel and/or Cobalt-Based Alloys and Titanium.—The Wrought Products Div. of Cabot Corp., Boston, MA, planned to install accumulator towers to the annealing line at Kokomo by March 1984. The $1 million towers will facilitate the passage of metal through the new annealing line.

Steel and Aluminum Scrap.—M&K Corp., Atwood, signed a contract with U.S. Steel to provide 25 million pounds of steel pellets. M&K uses a proprietary process to separate the aluminum in can lids from the steel body. The high-density steel pellets are used for detinning or used directly in steelmaking. The company had been providing steel pellets to the steelmaker for 4 consecutive years. M&K processes the aluminum lids and the all-aluminum containers into pellets, granules, and shot.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Manufactured:			
Jumbo Manufacturing Inc	Box 155, 2900 Center St. Tippecanoe, IN 46570	Plant	Marshall.
Wheelabrator-Frye Inc., Materials Cleaning Systems Div.[1]	400 South Byrkit St. Mishawaka, IN 46544	do	St. Joseph.
Natural:			
Hindostan Whetstone Co	Box 862 2922 South Mitchell Rd. Bedford, IN 47421	Quarry and plant	Orange (quarry) and Lawrence (plant).
Aluminum:			
Aluminum Co. of America	Warrick Operations Box 10 Newburgh, IN 47630	Smelter and fabricating plant.	Warrick.
Cement:			
Lehigh Portland Cement Co.[2]	Box 97 Mitchell, IN 47446	Plant (portland) and quarry.	Lawrence.
Do	Buffington Station Gary, IN 46401	Plant (calcium aluminate).	Lake.
Do	6300 Columbus Ave. Anderson, IN 46013	Terminal (distribution).	Madison.
Lone Star Industries Inc.[2 3]	Box 482 Greencastle, IN 46135	Plant (portland-masonry) and quarry.	Putnam.
Louisville Cement Co.[2 3]	Box 659, Highway 25 West Logansport, IN 46947	Plant (portland) and quarry.	Cass.
Do	Speed, IN 47172	Plant (portland-masonry) and quarry.	Clark.
Clays:			
General Shale Products Corp	Box 96 Mooresville, IN 46158	Pits and plant	Morgan.
Hydraulic-Press Brick Co	Brooklyn, IN 46111	Pit and plant (lightweight aggregate).	Do.
Gypsum:			
National Gypsum Co.[4]	Box 250 Shoals, IN 47581	Underground mine and plant.	Martin.
United States Gypsum Co.[4]	Box M Shoals, IN 47581	do	Do.
Do	3501 Canal St. East Chicago, IN 46312	Plant	Lake.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Iron and steel:			
Bethlehem Steel Corp	Box 248, U.S. 12 Chesterton, IN 46304	Mill (basic steel)	Porter.
Inland Steel Co	3210 Watling St. East Chicago, IN 46312	do	Lake.
Jones & Laughlin Steel Corp	3001 Dickey Rd. East Chicago, IN 46312	Mills (basic steel)	Lake and Marion.
United States Steel Corp., Gary Works Div.	1 North Broadway Gary, IN 46402	do	Lake.
Lime:			
Inland Steel Co., Indiana Harbor Works (Limekiln).	3210 Watling St. East Chicago, IN 46312	Plant	Do.
Marblehead Lime Co	Box 689 Gary, IN 46402	do	Do.
Peat:			
Hyponex Corp., Noblesville plant.	2013 South Anthony Blvd. Fort Wayne, IN 46803	Bog and plant	Hamilton.
Michigan Peat Co	Box 234, Rural Route 6 Rensselaer, IN 47978	do	Jasper.
Milburn Peat Co. Inc	Box 236 La Porte, IN 46350	do	La Porte.
Perlite (expanded):			
Chemrock Corp	Box 5465, Highway 25 at Monon RR Crossing Lafayette, IN 47903	Plant	Tippecanoe.
Grefco Inc	Box 48, 100 East Country Rd. Crawfordsville, IN 47933	do	Montgomery.
Sand and gravel:			
Construction:			
American Aggregates Corp	District Office Box 40228 4700 East 96th St. and Gray Rd. Indianapolis, IN 46240 Corporate Headquarters Drawer 160 Garst Ave. at Ave. B Greenville, OH 45331	Pits and plants	Hamilton, Marion, Wayne.
Hilltop Basic Resources Inc	630 Vine St. Cincinnati, OH 45202	Pit and plant	Switzerland.
Irving Materials Inc	Box 369, Rural Route 5 Greenfield, IN 46140	Pits and plants	Fayette, Hamilton, Henry, Madison, Wayne.
Martin Marietta Aggregates	Box 30013, 2170 Wycliff Rd. Raleigh, NC 27622	do	Clark, Hamilton, Howard, Marion, Vermillion, Vigo.
Rogers Group Inc	Box 849, 350 South Adams St. Bloomington, IN 47402	do	Fountain, Gibson, Greene, Knox, Morgan, Owen, Warren.
Vulcan Materials Co.[2 5]	Box 5229 Lafayette, IN 47903	do	La Porte, Parke, St. Joseph, Tippecanoe.
Industrial:			
Crisman Sand Co. Inc	6480 Melton Rd. Portage, IN 46368	Pit and plant	Porter.
Unimin Corp.[6]	East Dunes Highway (U.S. 12) Michigan City, IN 46360	do	La Porte.
Slag:			
Iron:			
Vulcan Materials Co.[2 7]	Box 6, 500 West Plainfield Rd. Countryside, IL 60525	Plant	Lake.
Iron and steel:			
The Levy Co. Inc.[2 7]	Box 540 Portage, IN 46368	Plants	Lake, Porter, St. Joseph.
Steel:			
Heckett Co	Box 1071, North Main St. Butler, PA 46368	Plant	Lake.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Crushed:			
American Aggregates Corp	District Office Box 40228 4700 East 96th St. and Gray Rd. Indianapolis, IN 46240 Corporate Headquarters Drawer 160 Garst Ave. at Ave. B Greenville, OH 45331	Quarries and plants	Hamilton, Marion, Owen.
The France Stone Co	Box 1298 Toledo, OH 43603	do	Allen and Putnam.
Irving Bros. Gravel Inc.[7]	Rural Route 13 Munice, IN 47302	do	Blackford, Delaware, Grant, Hunting-ton, Wells.
Martin Marietta Aggregates, Central Div.	Box 30013, 2170 Wycliff Rd. Raleigh, NC 27622	do	Clark, Hamilton, Howard, Madison, Marion, Crawford.
Mulzer Crushed Stone Co	Box 248, 603 6th St. Tell City, IN 47586	Quarries, mine, plants.	Crawford.
Rogers Group Inc.[3]	Box 849, 350 South Adams St. Bloomington, IN 47402	Quarry and plants	Lawrence, Monroe, Newton, Putnam.
Dimension:			
Bybee Stone Co	Box 968 Bloomington, IN 47402	Quarry and plant	Monroe.
Elliot Stone Co. Inc	Box 743 Bedford, IN 47421	Quarries and plant	Lawrence.
Evans Quarries Inc	Box 711 Bedford, IN 47421	Quarry and plant	Do.
B. G. Hoadley Co. Inc	Box 1224 Bloomington, IN 47402	Quarry and plants	Lawrence and Monroe.
Independent Limestone Co	6001 South Rockport Rd. Bloomington, IN 47401	Quarry and plant	Monroe.
Indiana Limestone Co. Inc	Box 72, 405 First St. Bedford, IN 47421	Quarries and plants	Lawrence and Monroe.
Indiana Sandstone Co. Inc	Box 501 Bedford, IN 47421	Quarry and plant	Lawrence.
Reed Quarries Inc	Box 64 Bloomington, IN 47402	do	Monroe.
Rush County Stone Co. Inc.[2]	Rural Route 1 Milroy, IN 46156	do	Rush.
Victor Oolitic Stone Co	Box 668 Bloomington, IN 47402	do	Monroe.
Sulfur (recovered):			
Amoco Oil Co	Box 710 2815 Indianapolis Blvd. Whiting, IN 46394	Refinery	Lake.

[1]Idle throughout 1983.
[2]Also crushed stone.
[3]Also clays.
[4]Also expanded perlite.
[5]Also iron slag.
[6]Formerly the Industrial Sand Div. of Martin Marietta Corp.
[7]Also construction sand and gravel.

The Mineral Industry of Iowa

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Iowa Geological Survey for collecting information on all nonfuel minerals.

By James H. Aase[1]

Nonfuel mineral production value in Iowa during 1983 was $247.4 million, a 13% increase over that of 1982 but 11% below the record high set 4 years earlier.

Of the mineral commodities produced during the year, only dimension stone dropped in value and production from that of 1982. Crushed stone, leading all other commodities produced in terms of value, accounted for 41 cents of every dollar of the State's total mineral worth.

Nationally, the State was ranked 27th in value of nonfuel mineral output, accounting for 1% of the U.S. total. In 1983, the quantity of gypsum produced in Iowa was 2d among 22 producing States; peat, 11th of 22; portland cement, 12th of 40; crushed stone, 14th of 48; clay, 21st of 44; construction sand and gravel, estimated 17th of 50; dimension stone, 23d of 39; and lime, 27th of 39.

Table 1.—Nonfuel mineral production in Iowa[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	W	W	37	$3,425
Portland do.	1,622	$82,225	1,644	87,836
Clays do.	437	2,392	576	3,258
Gem stones	NA	1	NA	1
Gypsum thousand short tons	1,177	11,345	1,612	13,518
Sand and gravel (construction) do.	10,064	25,618	e11,800	e32,800
Stone (crushed) do.	e22,600	e88,800	24,844	101,097
Combined value of lime, peat, sand (industrial, 1982), stone (dimension), and value indicated by symbol W	XX	8,256	XX	5,425
Total	XX	218,637	XX	247,360

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Iowa, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Adair	W	(2)	
Adams	W	(2)	
Allamakee	$311	$76	Sand and gravel (construction).
Appanoose	W	W	Clays, sand and gravel (construction).
Audubon	(3)	W	Sand and gravel (construction).
Benton	W	W	Do.
Black Hawk	W	964	Do.
Boone	(3)	1,644	Do.
Bremer	W	(2)	
Buchanan	1,247	W	Sand and gravel (construction).
Buena Vista	(3)	W	Do.
Butler	520	W	Do.
Calhoun	(3)	70	Do.
Carroll	(3)	397	Do.
Cass	W	W	Do.
Cedar	W	W	Do.
Cerro Gordo	W	W	Cement, clays, sand and gravel (construction).
Cherokee	(3)	398	Sand and gravel (construction).
Chickasaw	377	(2)	
Clarke	466	(2)	
Clay	(3)	342	Sand and gravel (construction).
Clayton	W	W	Sand (industrial), sand and gravel (construction).
Clinton	1,752	W	Sand and gravel (construction).
Crawford	(3)	--	
Dallas	W	W	Sand and gravel (construction), clays.
Davis	W	(2)	
Decatur	610	(2)	
Delaware	1,048	W	Sand and gravel (construction).
Des Moines	W	W	Gypsum, sand and gravel (construction).
Dickinson	(3)	382	Sand and gravel (construction).
Dubuque	W	(2)	
Emmet	(3)	W	Sand and gravel (construction).
Fayette	1,223	W	Do.
Floyd	W	81	Do.
Franklin	W	172	Do.
Fremont	284	(2)	
Greene	(3)	524	Sand and gravel (construction).
Grundy	(3)	--	
Guthrie	(3)	210	Sand and gravel (construction).
Hamilton	518	W	Do.
Hancock	W	W	Sand and gravel (construction), peat.
Hardin	6,527	W	Sand and gravel (construction).
Harrison	1,085	(2)	
Henry	W	(2)	
Howard	392	45	Sand and gravel (construction).
Humboldt	952	W	Do.
Ida	(3)	W	Do.
Iowa	--	W	Do.
Jackson	1,016	W	Do.
Jasper	322	W	Do.
Jefferson	W	(2)	
Johnson	W	W	Sand and gravel (construction).
Jones	2,171	465	Do.
Keokuk	W	W	Do.
Kossuth	(3)	97	Do.
Lee	W	175	Do.
Linn	W	958	Sand and gravel (construction), peat.
Louisa	W	W	Sand and gravel (construction).
Lyon	(3)	290	Do.
Madison	W	W	Clays.
Mahaska	151	(2)	
Marion	W	W	Sand and gravel (construction), gypsum.
Marshall	W	557	Sand and gravel (construction).
Mills	240	(2)	
Mitchell	W	W	Sand and gravel (construction).
Monona	(3)	W	Do.
Monroe	863	(2)	
Montgomery	1,404	(2)	
Muscatine	W	479	Sand and gravel (construction).
O'Brien	(3)	W	Do.
Osceola	(3)	304	Do.
Page	420	W	Do.
Palo Alto	(3)	W	Do.
Plymouth	(3)	1,350	Do.
Pocahontas	W	(2)	
Polk	13,889	W	Cement, sand and gravel (construction).
Pottawattamie	W	W	Sand and gravel (construction).
Poweshiek	W	(2)	

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Iowa, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Sac	(3)	$1,196	Sand and gravel (construction).
Scott	$34,715	W	Cement, lime, clays.
Shelby	(3)	W	Sand and gravel (construction).
Sioux	(3)	667	Do.
Story	W	W	Do.
Tama	W	W	Do.
Taylor	216	(2)	
Union	W	(2)	
Van Buren	1,465	W	Sand and gravel (construction).
Wapello	W	W	Sand and gravel (construction), clays.
Washington	W	W	Sand and gravel (construction).
Webster	W	8,810	Gypsum, sand and gravel (construction).
Winnebago	W	W	Peat.
Winneshiek	2,150	174	Sand and gravel (construction).
Woodbury	W	W	Sand and gravel (construction), clays.
Worth	1,037	W	Sand and gravel (construction), peat.
Wright	(3)	W	Sand and gravel (construction).
Undistributed[4]	122,939	109,009	
Sand and gravel (construction)	e29,080	XX	
Stone (crushed)	XX	e88,800	
Total[5]	229,391	218,637	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Lucas, Ringgold, Warren, and Wayne Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2]Crushed stone was produced; data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes gem stones and stone (dimension, 1982) that cannot be assigned to specific counties, and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Iowa business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,387.1	1,391.6	+0.3
Unemployment	do.	150.4	114.9	-23.6
Employment (nonagricultural):				
Mining[1]	do.	1.3	1.5	+15.4
Manufacturing	do.	193.7	206.5	+6.6
Contract construction	do.	26.2	26.0	-.8
Transportation and public utilities	do.	50.0	49.4	-1.2
Wholesale and retail trade	do.	254.7	258.2	+1.4
Finance, insurance, real estate	do.	58.4	59.9	+2.6
Services	do.	209.6	208.7	-.4
Government	do.	207.3	203.3	-1.9
Total nonagricultural employment[1]	do.	1,001.2	1,013.5	+1.2
Personal income:				
Total	millions	$31,330	$32,089	+2.4
Per capita		$10,754	$11,048	+2.7
Construction activity:				
Number of private and public residential units authorized		5,416	6,923	+27.8
Value of nonresidential construction	millions	$322.8	$339.9	+5.3
Value of State road contract awards	do.	$190.0	$264.6	+39.3
Shipments of portland and masonry cement to and within the State	thousand short tons	1,170	1,159	-.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$218.6	$247.4	+13.2
Value per capita, resident population		$75	$85	+13.3
Value per square mile		$3,884	$4,396	+13.2

pPreliminary.

[1]Includes bituminous coal.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

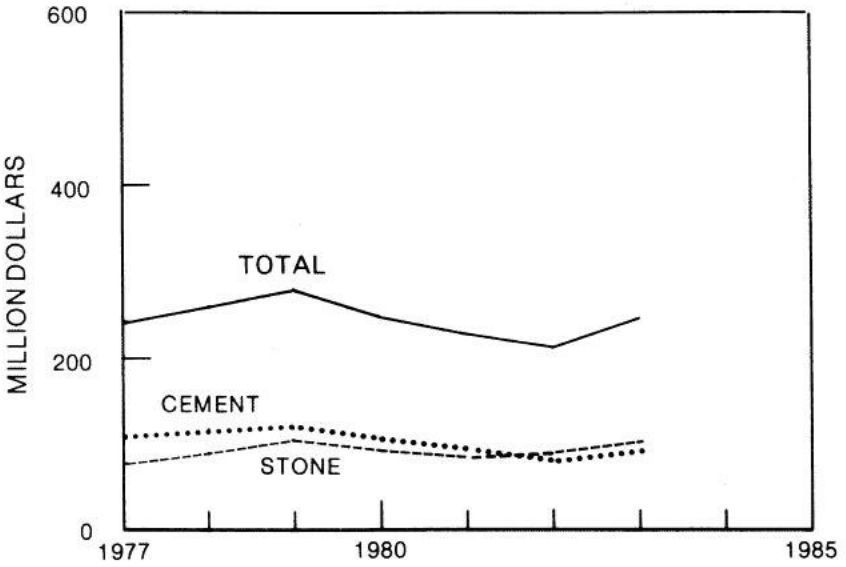

Figure 1.—Value of cement, stone, and total value of nonfuel mineral production in Iowa.

Under title III of Public Law 95-87, The Mining and Mineral Resources and Research Institute at Iowa State University in Ames was awarded $150,000 by the U.S. Bureau of Mines in 1983 for operations and research designed to encourage the training of engineers and scientists in mineral-related studies.

Various organizations honored a host of Iowa mineral producers for their safety accomplishments during 1983. The Gypsum Association recognized 4 gypsum plants in Iowa among the 55 gypsum plants nationwide for their outstanding safety records in 1983. Those cited were the Celotex Corp., a subsidiary of Jim Walter Corp., Fort Dodge; Georgia-Pacific Corp., Fort Dodge; and United States Gypsum Co., Sperry and Fort Dodge. The National Crushed Stone Association honored 362 member plants nationwide for significant safety achievements in 1983. Award winners in Iowa included B. L. Anderson Inc., 7 units; Kaser Corp., 10 units; and Martin Marietta Aggregates, 4 units.

Trends and Developments.—The industrial development data the Iowa Development Commission (IDC) collected for the manufacturing sector of the State's economy indicated that the State was in a recession during 1983. Announcements of new industries and expansions to existing facilities were down 10% from those of 1982 and 36% from the 10-year average. Employment created by new development and expansions decreased 35% from the 1982 level and 53% from the 10-year average. Although capital investment was down 42% from the 10-year average, 1983 capital investment figures were 18% greater than in 1982. IDC indicated that in 1983 56 new industries located in the State and 84 existing industries expanded. Resulting in a capital investment of $242.9 million in Iowa, these enhancements created 3,862 new manufacturing jobs. Mineral-related processing and manufacturing industries among the 140 new and expanded facilities reported for 1983 included 4 within the Standard Industrial Classification (SIC) 32, Stone, Clay, Glass, and Concrete Products, and 2 within SIC 33, Primary Metal Industries.

Martin Marietta Corp. of Bethesda, MD, sold its Davenport cement manufacturing plant, together with other out-of-State plants, to a subsidiary of Blue Circle Industries PLC of the United Kingdom and a partnership controlled by a subsidiary of Cementia Holdings AG of Zurich, Switzerland.

Citing a continuing depressed demand for cement, Northwestern States Portland Ce-

ment Co. of Mason City had two temporary shutdowns totaling 2-1/2 months at its manufacturing plant during the year.

The State issued no permits for metallic mineral exploration during 1983.

Employment.—According to the Iowa Employment Security Commission's research and statistical data, at midyear, employment in the State's mining industry was 2,000, compared with 1,800 for the same period in 1982. The average hourly earnings of mining production and related nonsupervisory workers was $7.50 in July 1983, a decrease of approximately 7% compared with the same month of 1982.

Legislation and Government Programs.—The Iowa Geological Survey (IGS), an independent State agency reporting directly to the Governor, actively pursued its ongoing role of conducting research and providing data on the State's geology and water and mineral resources. Among the activities within the various divisions of IGS during the year were the following:

1. Water Resources Division continued evaluating the alluvial aquifer systems on the interior streams of the State to expand knowledge of the quantity and quality of the water and to check for nitrate and agricultural pesticide concentrations.

2. Geologic Studies Division completed a study on the Big Springs drainage basin in Clayton County to quantify the amounts of nitrates and agricultural pesticides entering the ground water system, and to correlate these amounts with changes in cropping practices and rates of fertilizer and pesticide application. Work on the Quaternary statigraphy and the engineering properties of glacial materials continued.

3. Stratigraphy and Economic Geology Division conducted a major restudy of the State's entire stratigraphic column.

4. Technical Services designed and developed a comprehensive water information system to monitor water-resource conditions and to serve the data needs of the State's regulatory agencies.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—The quantity and value of Iowa's cement shipments in 1983 increased slightly over those recorded in 1982. However, the quantity of cement marketed during the year remained at a reduced level, falling about 25% below the 10-year average. The State's cement production in 1983 was from four companies that collectively operated eight kilns at one wet-process and three dry-process plants at Davenport, Des Moines, and Mason City.

Portland cement sold by Iowa producers in 1983 averaged $53.44 per ton, the highest price on record. The largest users of the State's portland cement production were ready-mix companies, consuming about 64% of the output, followed, in descending order, by concrete product manufacturers, highway and other contractors, building material dealers, and a minor amount to government agencies and other customers. Approximately 96% of the portland cement shipments were in bulk form with trucks handling approximately 90% of the movements.

Approximately 2.9 million tons of nonfuel minerals and related raw materials was consumed in producing the 1.7 million tons of finished cement manufactured in the State during 1983.

Clays.—Clay production during 1983 was from nine mines operated by seven companies in seven counties. The tonnage mined during the year increased 32% over the deeply depressed level of 1982 but remained 26% below the 10-year average. The average unit price for the total 1983 output reached a record high of $5.65 per ton, a 17-cent-per-ton increase over that of 1982. Scott County led the State in clay production, followed by Cerro Gordo and Dallas Counties, which collectively produced slightly more than three-quarters of the State's output in 1983.

Cement manufacturing was the largest consumer of the clay produced, followed by face-brick manufacturing, together using approximately three-quarters of the output.

Gypsum.—The 1983 production of crude gypsum was from six mines operated by five companies at sites in Des Moines, Marion, and Webster Counties. Gypsum mined increased 37% over the depressed production level recorded in 1982 and exceeded the 10-year average by 10%. The average unit price of crude gypsum was $8.39 per ton, a drop of $1.25 per ton from that of 1982.

Nationally, Iowa ranked second among the States in value of crude gypsum produced during 1983, surpassed only by Texas. Webster County, with four producing mines, accounted for nearly three-quarters of the output for the year. United States

Gypsum's Fort Dodge Mine was ranked 10th among the 69 mines reporting production in the United States during 1983.

Active operations during the year included surface mines operated by United States Gypsum; National Gypsum Co.; Georgia-Pacific; and Celotex near Fort Dodge. Underground mines were operated by United States Gypsum near Sperry and by Kaser near Harvey. Except for Kaser, all companies calcined part of their crude production at plants near their minesites.

Lime.—The quantity and value of lime produced in the State during 1983 rose slightly over that of 1982. Linwood Stone Products Co. Inc. produced all the State's output during the year. Quicklime and hydrated lime produced were used principally for road stabilization, sewage treatment, steel furnace operations, and water purification and softening.

Consumption of lime in Iowa, obtained from all domestic sources, totaled 79,000 tons in 1983.

Peat.—Three companies produced either hypnum or reed-sedge peat from bogs in Linn, Winnebago, and Worth Counties. Most of the production was reed-sedge, marketed principally in bulk form for use on golf courses. Other uses of the production included use as an ingredient for potting soil, vegetable and nursery stock growing, general soil improvement, and as an earthworm culture medium. Total output rose slightly in 1983 over the 1982 level.

Perlite (Expanded).—Perlite from other States was expanded by National Gypsum and United States Gypsum at their Fort Dodge gypsum-calcining plants. The expanded material was used for plaster aggregate.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Table 4.—Iowa: Sand and gravel sold or used by producers

	1982			1983[e]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	5,237	$14,579	$2.78	NA	NA	NA
Gravel	3,909	9,556	2.44	NA	NA	NA
Sand and gravel (unprocessed)	917	1,483	1.62	NA	NA	NA
Total or average	[1]10,064	25,618	2.55	11,800	$32,800	$2.78
Industrial sand	W	W	11.86	--	--	--
Grand total or average	W	W	2.59	11,800	32,800	2.78

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Limestone, the only type of crushed stone produced in Iowa during 1983, was from 291 quarries 63 firms operated in 66 counties. Production increased about 10% over that of 1982 but remained approximately 12% below the 10-year average level. The average unit price for material produced during the year was a record high of $4.07 per ton. Scott County led in crushed stone output, followed by Black Hawk, Cerro Gordo, Linn, and Johnson Counties, which together accounted for one-fourth of the total State output.

Nearly 40% of the State's crushed stone output came from the operations of seven firms, each producing in excess of 1 million tons in 1983. Quantities from individual quarry operations ranged widely. In 1983, 42% of the quarries produced less than 25,000 tons each; 31%, between 25,000 and 100,000 tons; 25%, between 100,000 and 500,000 tons; and the remainder between 500,000 and 1,000,000 tons.

Among the 26 separate uses for the crushed stone produced, the largest specified use was bituminous surface treatment aggre-

gate, followed by use as unpaved road surfacing, graded road base or subbase, and cement manufacture—cumulatively accounting for 41% of the total output. Approximately 94% of all crushed stone shipments were by truck, 4% by railroad, and the remainder by waterway or other means.

Table 5.—Iowa: Crushed limestone sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	27	86
Riprap and jetty stone	157	586
Filter stone	252	1,089
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,382	7,015
Bituminous aggregate, coarse	1,078	5,150
Bituminous surface treatment aggregate	2,980	11,945
Railroad ballast	30	136
Other graded coarse aggregate	956	4,364
Fine aggregate (-3/8 inch):		
Screening, undesignated	100	232
Other fine aggregate	146	345
Coarse and fine aggregate:		
Graded road base or subbase	2,445	8,539
Unpaved road surfacing	2,551	9,580
Crusher run or fill or waste	183	674
Agricultural: Agricultural limestone	1,691	6,443
Chemical and metallurgical: Cement manufacture	2,245	5,991
Special: Other[1]	8,622	38,924
Total[2]	24,844	101,097

[1]Includes poultry grit and mineral food, other agricultural uses, stone sand (concrete), lime manufacture, flux stone, asphalt filler, stone sand (bituminous mix or seal), coarse aggregate (large), combined coarse and fine aggregate, and uses not specified.

[2]Data do not add to totals shown because of independent rounding.

Table 6.—Iowa: Crushed limestone sold or used by producers, by county

County	1981			1983		
	Number of quarries	Quantity (thousand short tons)	Value (thousands)	Number of quarries	Quantity (thousand short tons)	Value (thousands)
Allamakee	15	87	$311	11	W	W
Appanoose	2	W	W	6	466	$1,898
Buchanan	14	359	1,247	11	334	1,303
Butler	5	173	520	4	W	W
Cedar	4	W	W	6	239	766
Cerro Gordo	4	1,671	3,428	5	1,276	4,747
Chickasaw	5	125	377	4	131	519
Clarke	1	140	466	1	W	W
Clayton	17	320	1,021	21	389	967
Clinton	9	512	1,752	11	536	959
Decatur	3	183	610	3	W	W
Delaware	12	328	1,048	12	372	688
Des Moines	4	380	1,604	4	331	1,453
Dubuque	14	524	1,595	12	738	2,398
Fayette	14	431	1,223	15	W	W
Franklin	4	67	220	3	W	W
Fremont	2	69	284	2	155	632
Hamilton	1	122	518	1	90	388
Hardin	4	978	6,527	5	909	7,888
Harrison	2	335	r1,085	2	394	1,604
Howard	6	108	392	6	202	801
Humboldt	4	302	952	1	291	1,186
Jackson	9	272	1,016	12	401	1,111
Jasper	1	73	322	1	83	337
Jefferson	1	W	W	1	16	82
Jones	8	511	1,868	9	353	946
Keokuk	4	W	W	3	341	1,389
Lee	3	W	W	4	247	951
Linn	8	940	3,392	11	1,018	3,951
Madison	10	975	3,203	9	968	3,786

See footnotes at end of table.

Table 6.—Iowa: Crushed limestone sold or used by producers, by county —Continued

County	1981			1983		
	Number of quarries	Quantity (thousand short tons)	Value (thousands)	Number of quarries	Quantity (thousand short tons)	Value (thousands)
Mahaska	1	37	$151	2	W	W
Marion	3	276	1,199	3	228	$947
Mills	2	53	240	1	11	46
Monroe	1	191	863	1	231	940
Montgomery	1	264	1,404	1	215	874
Muscatine	1	W	W	1	439	1,767
Page	1	114	420	1	125	508
Scott	2	W	W	4	1,630	5,066
Story	1	276	1,058	1	W	W
Taylor	1	60	216	1	58	238
Van Buren	4	356	1,465	4	359	1,620
Webster	2	W	1,953	2	400	1,673
Winneshiek	16	644	2,150	13	299	1,045
Worth	5	176	629	4	239	759
Undistributed[1]	r59	9,990	36,160	56	10,328	44,861
Total[2]	290	22,424	82,891	291	24,844	101,097

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes Adair, Adams, Benton, Black Hawk, Bremer, Cass, Davis, Floyd, Hancock, Henry, Johnson, Louisa, Marshall, Mitchell, Pocahontas, Polk, Pottawattamie, Poweshiek, Tama, Union, Wapello (1983), and Washington Counties, and data indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

Dimension.—Wm. Becker & Sons Stone Co. in Dubuque County and W. C. Weber Stone Co. in Jones County produced dimension limestone in 1983. Total output for the year was down slightly from that estimated for 1982. The material mined was marketed as rough blocks, irregular-shaped rough stone, rubble, cut stone, house stone veneer, and sawed stone.

[1]State Liaison Officer, Bureau of Mines, Minneapolis, MN.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Davenport Cement Co., a subsidiary of Cementia Holdings AG.	Box 4288 Davenport, IA 52808	Plant	Scott.
Lehigh Portland Cement Co., a subsidiary of Heidelberger Zement AG.	Box 1882 Allentown, PA 18105	do	Cerro Gordo.
The Monarch Cement Co	Humboldt, KS 66748	do	Polk.
Northwestern States Portland Cement Co.	Box 1008 Mason City, IA 50401	do	Cerro Gordo.
Clays and shale:			
Carter Waters Corp	Box 19676 Kansas City, MO 64141	Pit and plant	Appanoose.
Davenport Cement Co., a subsidiary of Cementia Holdings AG.	Box 4288 Davenport, IA 52808	do	Scott.
Lehigh Portland Cement Co., a subsidiary of Heidelberger Zement AG.	Box 1882 Allentown, PA 18105	do	Cerro Gordo.
Midland Brick Co	Box A Redfield, IA 50233	Pits and plants	Dallas and Wapello.
Northwestern States Portland Cement Co.	Box 1008 Mason City, IA 50401	Pit and plant	Cerro Gordo.
Sioux City Brick & Tile Co	Box 56 Sergeant Bluff, IA 51054	Pits and plants	Dallas and Woodbury.
Gypsum:			
Celotex Corp., a subsidiary of Jim Walter Corp.	Box 22601 Tampa, FL 33622	Mine and plant	Webster.
Georgia-Pacific Corp	133 Peachtree St. NE. Atlanta, GA 30303	do	Do.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	do	Do.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	Mines and plant	Des Moines and Webster.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lime:			
Linwood Stone Products Co. Inc.	Route 2 Davenport, IA 52804	Plant	Scott.
Peat:			
Eli Colby Co	Box 248 Lake Mills, IA 50450	Bog and plant	Winnebago.
Colby Pioneer Peat Co	Box 8 Hanlontown, IA 50444	do	Worth.
Hughes Peat Co	Route 2 Marion, IA 52302	do	Linn.
Perlite (expanded):			
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	Plant	Webster.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Do.
Sand and gravel (construction, 1982):			
G. A. Finley Inc	Box 465 Harlan, IA 51537	Pits and plants	Audubon, Cass, Dallas, Page, Pottawattamie, Shelby.
Hallett Construction Co	Box 13 Boone, IA 50036	do	Boone, Cherokee, Clay, Franklin, Marshall, Polk, Sac, Story.
Higman Sand & Gravel Co	Box 106 Akron, IA 51001	Pit and plant	Plymouth.
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 27622	Pits and plants	Appanoose, Linn, Marshall, Polk, Wapello.
Maudlin Construction Co	Box 634 Webster City, IA 50595	do	Boone, Buena Vista, Cerro Gordo, Cherokee, Clay, Dallas, Franklin, Hamilton, Kossuth, Marshall, Osceola, Sac, Story, Webster, Woodbury, Worth, Wright.
Stevens Sand & Gravel Co. Inc	2525 Highway 218 South Iowa City, IA 52240	Pit and plant	Johnson and Washington.
Stone:			
Crushed (limestone):			
B. L. Anderson Inc	327 Guaranty Bldg. Cedar Rapids, IA 52401	Quarries and plants	Benton, Cedar, Clinton, Jackson, Johnson, Jones, Linn, Tama.
Kaser Corp	7200 Hickman Rd. Des Moines, IA 50322	Underground mine, quarries, plants.	Des Moines, Fremont, Jasper, Keokuk, Marion, Monroe, Poweshiek, Washington.
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 27622	do	Clarke, Decatur, Linn, Madison, Marshall, Polk, Story.
P. Niemann Construction Co.	106 North Maple St. Sumner, IA 50674	Quarries and plants	Bremer, Buchanan, Butler, Chichasaw, Fayette, Winneshiek.
River Products Co	220 Savings & Loan Bldg. Iowa City, IA 52240	Underground mine, quarries, plants.	Johnson, Louisa, Washington.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Crushed (limestone)—Continued			
Schildberg Construction Co. Inc.	Box 358 Greenfield, IA 50849	Quarries and plants	Adair, Adams, Cass, Madison, Pottawattamie, Union.
Welp & McCarten Inc	Box W Fort Dodge, IA 50501	Underground mines, quarries, plants.	Black Hawk, Hancock, Webster, Worth.
Dimension (limestone):			
Wm. Becker & Sons Stone Co.	Kaufman Ave. Dubuque, IA 52001	Quarry and plant	Dubuque.
W. C. Weber Stone Co	Route 1 Anamosa, IA 52205	----do	Jones.

The Mineral Industry of Kansas

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Kansas Geological Survey for collecting information on all nonfuel minerals.

By James J. Hill,[1] David A. Grisafe,[2] and Wanda J. West[3]

Nonfuel mineral production in Kansas was valued at $267 million in 1983, a 4% increase compared with that of 1982 and the highest reported value in 5 years. Value of sales increased for all minerals produced in the State except lime, salt, and industrial sand.

Kansas was ranked 25th in value of nonfuel mineral production and led the Nation in helium output. Cement sales comprised the greatest portion of the State's mineral commodity value, followed by, in order of importance, sales of salt, crushed stone, Grade-A helium, and construction sand and gravel.

Table 1.—Nonfuel mineral production in Kansas[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	46	$2,628	W	W
Portland	do.	1,549	79,558	W	W
Clays	do.	664	3,656	718	$3,921
Gem stones		NA	1	NA	1
Helium:					
Crude	million cubic feet	---	---	188	3,572
Grade-A	do.	790	26,860	775	27,125
Salt[2]	thousand short tons	r1,601	r72,146	1,719	67,195
Sand and gravel:					
Construction	do.	9,720	20,612	e12,400	e26,600
Industrial	do.	331	3,635	199	2,184
Stone:					
Crushed	do.	e14,400	e41,100	12,192	44,540
Dimension	do.	e11	e395	W	W
Combined value of gypsum, lime, pumice, salt (brine), and values indicated by symbol W		XX	5,745	XX	91,866
Total		XX	r256,336	XX	267,004

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes salt in brines; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Kansas, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Allen	W	W	Cement, clays.
Anderson	$374	(2)	
Atchison	974	(2)	
Barber	W	W	Gypsum, sand and gravel (construction).
Barton	87	W	Sand and gravel (construction), clays.
Bourbon	725	(2)	
Brown	(3)	--	
Butler	1,537	(2)	
Chase	W	(2)	
Chautauqua	190	(2)	
Cherokee	W	W	Sand and gravel (construction), clays.
Cheyenne	(3)	$25	Sand and gravel (construction).
Clark	(3)	22	Do.
Clay	W	W	Do.
Cloud	136	W	Sand and gravel (construction), clays.
Coffey	225	(2)	
Comanche	(3)	--	
Cowley	1,550	329	Sand and gravel (construction).
Crawford	W	W	Clays.
Decatur	(3)	83	Sand and gravel (construction).
Dickinson	1,738	W	Sand and gravel (construction), sand (industrial).
Doniphan	W	(2)	
Douglas	645	W	Sand and gravel (construction), sand (industrial).
Edwards	(3)	87	Sand and gravel (construction).
Elk	W	(2)	
Ellis	9	216	Sand and gravel (construction).
Ellsworth	W	8,997	Helium, salt, clays, sand and gravel (construction).
Finney	195	W	Sand and gravel (construction).
Ford	(3)	W	Do.
Franklin	W	W	Clays.
Geary	W	W	Sand and gravel (construction).
Gove	--	50	Do.
Graham	130	35	Do.
Grant	W	W	Helium, sand and gravel (construction).
Gray	(3)	33	Sand and gravel (construction).
Greeley	(3)	14	Do.
Greenwood	230	153	Do.
Hamilton	(3)	165	Do.
Harper	(3)	W	Do.
Harvey	(3)	W	Do.
Haskell	(3)	W	Do.
Hodgeman	(3)	28	Do.
Jackson	--	21	Do.
Jefferson	1,609	(2)	
Jewell	W	W	Clays.
Johnson	W	W	Sand and gravel (construction), sand (industrial).
Kearny	(3)	346	Sand and gravel (construction).
Kingman	--	36	Do.
Kiowa	(3)	274	Do.
Labette	1,138	(2)	
Leavenworth	1,231	(2)	
Lincoln	W	73	Sand and gravel (construction).
Linn	710	(2)	
Logan	--	13	Sand and gravel (construction).
Lyon	281	49	Do.
McPherson	W	W	Clays, sand and gravel (construction).
Marion	W	(2)	
Marshall	W	W	Gypsum, sand and gravel (construction).
Meade	(3)	40	Sand and gravel (construction).
Miami	895	(2)	
Montgomery	W	W	Cement, clays.
Morris	128	(2)	
Morton	W	W	Helium, sand and gravel (construction).
Nemaha	164	(2)	
Neosho	W	W	Cement, clays, sand and gravel (construction).
Ness	(3)	94	Sand and gravel (construction).
Norton	W	W	Pumice, sand and gravel (construction).
Osage	347	(2)	
Ottawa	(3)	112	Sand and gravel (construction).
Pawnee	(3)	142	Do.
Phillips	(3)	35	Do.
Pottawatomie	411	104	Do.
Pratt	(3)	W	Do.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Kansas, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Rawlins	[3]	$20	Sand and gravel (construction).
Reno	$43,086	52,788	Salt, sand and gravel (construction).
Republic	W	W	Sand and gravel (construction), sand (industrial).
Rice	W	W	Salt, sand and gravel (construction).
Riley	970	W	Sand and gravel (construction).
Rooks	[3]	19	Do.
Rush	W	W	Helium.
Russell	[3]	47	Sand and gravel (construction).
Saline	[3]	W	Do.
Sedgwick	W	W	Sand and gravel (construction), salt.
Seward	[3]	314	Sand and gravel (construction).
Shawnee	W	798	Do.
Sheridan	[3]	51	Do.
Sherman	W	W	Lime, sand and gravel (construction).
Smith	W	[2]	
Stafford	[3]	W	Sand and gravel (construction).
Stevens	[3]	46	Do.
Sumner	[3]	W	Do.
Thomas	[3]	144	Do.
Trego	23	105	Do.
Wabaunsee	135	[2]	
Wallace	[3]	4	Sand and gravel (construction).
Washington	W	W	Do.
Wichita	--	20	Do.
Wilson	W	W	Cement, clays, sand and gravel (construction).
Woodson	102	W	Clays.
Wyandotte	W	W	Cement, sand (industrial), sand and gravel (construction).
Undistributed[4]	168,088	148,909	
Sand and gravel (construction)	e21,000	XX	
Stone:			
Crushed	XX	e41,100	
Dimension	XX	e395	
Total	[5]249,060	256,336	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Lane, Mitchell, Osborne, Scott, and Stanton Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Stone, either crushed or dimension, was produced; data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Kansas business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,162.1	1,147.5	-1.3
Unemployment	do	90.9	66.9	-26.4
Employment (nonagricultural):				
Mining[1]	do	16.7	17.2	+3.0
Manufacturing	do	155.9	170.1	+9.1
Contract construction	do	33.4	35.0	+4.8
Transportation and public utilities	do	60.7	62.4	+2.8
Wholesale and retail trade	do	219.2	222.6	+1.6
Finance, insurance, real estate	do	48.9	49.0	+.2
Services	do	170.5	171.5	+.6
Government	do	188.3	186.1	-1.2
Total nonagricultural employment[1]	do	893.6	913.9	+2.3
Personal income:				
Total	millions	$28,289	$29,796	+5.3
Per capita		$11,717	$12,285	+4.8
Construction activity:				
Number of private and public residential units authorized		8,628	13,570	+57.3
Value of nonresidential construction	millions	$392.1	$664.4	+69.5
Value of State road contract awards	do	$73.7	$238.3	+223.3
Shipments of portland and masonry cement to and within the State	thousand short tons	974	1,004	+3.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$256.3	$267.0	+4.2
Value per capita, resident population		$106	$110	+3.8
Value per square mile		$3,112	$3,245	+4.3

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

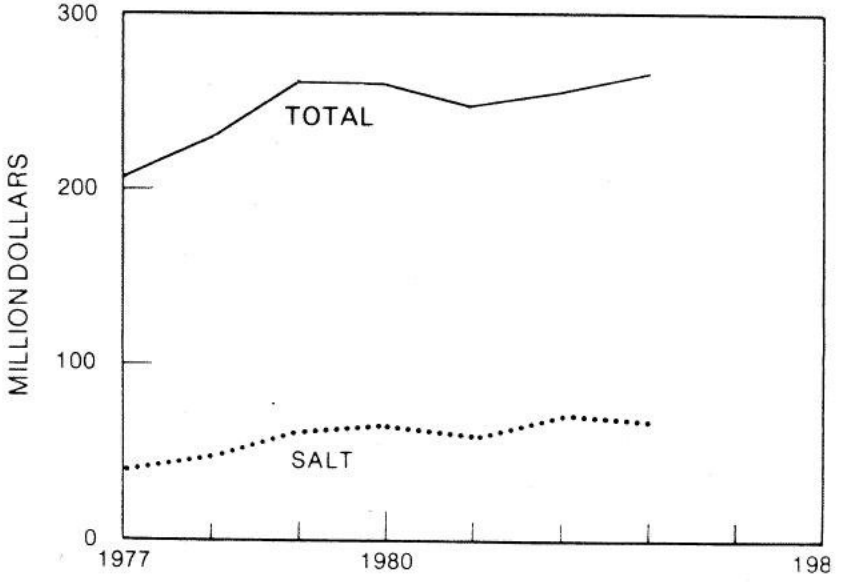

Figure 1.—Value of salt and total value of nonfuel mineral production in Kansas.

Trends and Developments.—Kansas' economic recovery from the 1981-82 recession extended to most sectors of the State's mining industry. Employment in the State's nonfuel mineral industry improved during the year. According to the Kansas Department of Human Resources, employment rose from a low of 993 in February to a high of 1,370 in July, reflecting the seasonal nature of the State's mining industry. Average monthly employment increased 6.5% during the year.

Increased residential building stimulated demand for mineral commodities used in construction. The U.S. Department of Commerce reported a 57% increase in construction permits for residential units (public and private) in the State. Also, the value of private nonresidential construction increased 69% during the year.

The Kansas Department of Transportation awarded contracts valued at $238.3 million in 1983. Many of the projects involved upgrading the State's bridge system by replacement or renovation; other projects included highway widening and pavement reconstruction. This higher level of construction activity increased sales of cement, clays, gypsum, sand and gravel, and stone.

Legislation and Government Programs.—Several mineral-related bills were enacted into law during the 1983 legislative session.

Senate Bill 20 requires each State agency leasing State real property for producing oil, gas, sand, gravel, or any other mineral to give the following information to the Kansas Geological Survey: the terms and conditions of the lease, rates and amounts of royalty and other revenues received under each lease, mineral production data, and any other information the State geologist might require relating to leasing agency land and production from that land.

Senate Bill 143 provides that an interest in coal, oil, gas, or other minerals will lapse and revert to the current surface owner if the mineral interest is unused for 20 years. Six conditions are to be considered in determining whether a mineral interest is being used: (1) minerals are produced under the interests, (2) operations are conducted on the interest for injection, withdrawal, storage, or disposal of water, gas, or other fluid substances, (3) rentals or royalties are paid by the owner of the interest for the purpose of delaying or enjoying the use or exercise of the mineral rights, (4) the use of the mineral right is carried out on a tract where the mineral interest is unitized or pooled for production, (5) in the case of coal or other solid minerals, production is from a common vein or seam by the owners of the mineral interest, and (6) taxes are paid on the mineral interest by its owner.

Effective May 1, 1983, Senate Bill 452 imposed an excise tax on the severance and production of oil, gas, coal, and salt in Kansas. The net tax rate after credits are allowed was 4.33% on oil, 7% on gas, $1 per ton on coal, and $0.04 per ton on salt. Coal from a mine with less than 350,000 tons annual production was exempt. Certain stripper wells were also exempt.

House Bill 2418 required forced pooling mineral interests into a drilling unit in any city in Kansas if the governing body of the city authorizes developing such minerals within its corporate limits.

House Bill 2516 authorized the Mined-Land Conservation and Reclamation Board of the State Corporation Commission to acquire abandoned mined land for reclamation by purchase, donation, or eminent domain. Funds for acquisition were to come from the abandoned Mined-Land Fund, and title to the properties was to be vested in the State and administered by the Mined-Land Reclamation Board. After such land is reclaimed, the board was authorized to sell or lease these properties and deposit the proceeds in the Abandoned Mined-Land Reclamation Fund for future projects.

House Bill 2566 increased motor fuels taxes to provide revenue for State highways, county roads, and city streets.

During the year, the Kansas Geological Survey expanded into a new 15,000-square-foot addition to Moore Hall, the Survey's headquarters on the west campus of the University of Kansas. The addition houses much of the Survey's mineral information program, including oil and gas records, computer services, advanced projects, publication sales, library and archives, and an auditorium. Along with this expansion, the Survey reorganized into research and service components and created a minerals information section.

Several projects were completed during the year. In cooperation with the geological surveys of Iowa, Missouri, and Nebraska, seven maps were issued on the Forest City basin that outline the geologic and geophysical features and mineral resources of the region.

The Survey also published an atlas entitled "Kansas GeoMaps" that contains page-

size maps of the State's rivers and reservoirs, ground water, oil and gasfields, coal, and other mineral products.

In 1983, the Survey completed a report[4] on subsidence and cave-ins in the inactive Tri-State lead-zinc mining district, which extends into southeastern Kansas. Similar studies were conducted in Missouri and Oklahoma. Funded by the U.S. Bureau of Mines Rolla Research Center in Rolla, MO, the report outlined the potentially hazardous situations associated with past lead-zinc mining in the Kansas portion of the Tri-State mining district. Included in the report were tabulations and map displays of the surface effects of underground and open pit mine workings; the lateral extent of underground mining; accumulations of mining wastes, tailings ponds, and open pit water; and the locations of mine shafts.

The U.S. Bureau of Mines Rolla Research Center undertook a project to demonstrate techniques for closing and stabilizing abandoned mine shafts in the Galena area where approximately 350 open mine shafts were reported in a study the Kansas Geological Survey conducted. Of the 13 shafts selected for closure, 2 were closed by backfilling and covering with reinforced concrete caps, and 11 were closed by lowering inverted pyramid-shaped reinforced concrete plugs that were then backfilled.

In December, the Office of Surface Mining, U.S. Department of the Interior, awarded Kansas $350,000 in grants to help operate the State's coal regulatory and abandoned-mine reclamation program. Awarded for the 1984 calendar year, the grants were to be administered by the Mined-Land Conservation and Reclamation Board of the Kansas Corporation Commission.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Kansas was ranked 13th in portland cement sales of the 40 producing States and 16th in masonry cement sales of 38 producing States. Production and value for both types of cement increased during the year. Average unit value decreased for both portland and masonry cement, reflecting soft markets and competition for sales. At the beginning of the year, the U.S. Bureau of Mines initiated new procedures of aggregating cement statistics by districts. Because of this change in reporting methods, cement statistics for Kansas cannot be revealed for 1983.

The State's five producers manufactured both portland and masonry cements. Four plants were in southeastern Kansas in Allen, Montgomery, Neosho, and Wilson Counties; one plant was on the western edge of Kansas City in Wyandotte County. Most cement was shipped to consumers by truck in bulk form. Ready-mixed concrete companies were the State's largest cement consumers.

The Monarch Cement Co. installed a two-speed roller mill at its Humboldt plant during the year.[5]

Clays.—Kansas was ranked 19th of 44 States in clay and shale output. Production and value increased 8% and 7%, respectively, compared with 1982 figures. Common clay was produced in 12 counties: Barton, Cloud, Ellsworth, and McPherson in central Kansas; Allen, Cherokee, Crawford, Franklin, Montgomery, Neosho, and Wilson in eastern Kansas; and Jewell in north-central Kansas.

Almost 41% of the common clay was used in portland cement manufacture; the next major use was as lightweight aggregate in concrete blocks and other concrete products. Clay was also used to manufacture ceramic floor and wall tile, common and face brick, drain tile, roof tile, and sewer tile.

Micro-Lite Inc. mined micaceous bentonitic clay in Woodson County for use in manufacturing feed and fertilizer supplements.

The combination of increasing production costs, competition, and a poor economic climate took its toll on the brick industry in Kansas. Both Excelsior Brick Manufacturing Co. Inc. at Fredonia and Humboldt Brick & Tile Co. at Humboldt ceased producing in 1983. Equipment at the former facility was auctioned. Bishop Brick began using the Humboldt property as a distribution center.

Rapidly escalating gas rates prompted Buildex Inc., a division of Clemens Coal Co., to switch to coal-fired rotary kilns at its plant in Ottawa, Franklin County. Plant conversion costs were considerably lessened by management's foresight to install a scrubber system several years ago. Buildex manufactures lightweight aggregate from expanded shale for use in lightweight concrete and landscaping.

During 1983, Seville Industries acquired

Pittsburg Pottery, its second entry in the pottery field in Kansas. The company began operating Chimes Inc. at Oswego in 1981. Seville planned to upgrade the facilities at Pittsburg after the purchase. Clay for the pottery and windchime operations was purchased from producers in Kansas and several other States.

Gypsum.—Of 22 States, Kansas was ranked eighth in producing crude gypsum. With the acceleration in construction, output reached a record high in 1983, exceeding by 18% the previous high set in 1979. Value was 29% greater than the record-high value established in 1981. Two companies produced gypsum during the year—National Gypsum Co. at its Sun City Mine, Barber County, in south-central Kansas; and Georgia-Pacific Corp. at its Blue Rapids Mine, Marshall County, in northeastern Kansas. National Gypsum's mine, operated by both surface and underground methods, was ranked seventh nationally in output. Georgia-Pacific's underground mine was a runner-up for the Sentinels-of-Safety Award in 1983.

Both companies operated calcining plants. National Gypsum's plant at Medicine Lodge, Barber County, was ranked 10th nationally in output. Georgia-Pacific's plant was at Blue Rapids. Calcined gypsum output increased 76% compared with that of 1982; value increased 83%.

Helium.—Kansas was ranked first among the three States producing Grade-A helium. Although production dropped about 2% during 1983, value increased about 1%. Grade-A helium plants were operated by Cities Service Cryogenics Inc. near Ulysses, Grant County; Kansas Refined Helium Co. near Otis, Rush County; and Union Carbide Corp., Linde Div., near Bushton, Ellsworth County, and Elkhart, Morton County. The Elkhart plant, owned by Union Carbide, is operated by Helium Sales Inc.

Crude helium plants were operated by Cities Service Cryogenics near Scott City, Scott County; Cities Service Helex Co. at Ulysses; and Northern Helex Co. at Bushton, Ellsworth County.

Major end uses of helium were cryogenics, pressurizing and purging, and welding.

Lime.—The Great Western Sugar Co. produced quicklime for use in refining sugar at its sugar beet plant near Goodland, Sherman County. Production and value fell 75% and 79%, respectively. During 1983, 64,000 tons of quicklime and 15,000 tons of hydrated lime, from all domestic sources, were consumed in Kansas.

Perlite (Expanded).—Lite-Weight Products Inc. expanded perlite from out-of-State at a plant in Kansas City, Wyandotte County. Sales were for use as a filter and other miscellaneous uses. Production was about the same as during 1982.

Pumice and Pumicite.—Kansas was one of four States producing volcanic ash. Calvert Mines Inc., the State's only producer, mined and processed volcanic ash near Norton, Norton County, for use as abrasives and absorbents. Production declined about 15% during the year, although value increased about 22%.

Salt.—Kansas was ranked fifth of 15 States producing salt. Production increased about 7% during the year; however, average value per ton dropped 13%, indicating a soft market and competition for sales. All production occurred in the central part of the State from the Hutchinson Salt Member of the Wellington Formation. During 1983, five companies produced either evaporated salt (E), rock salt (R), or both (ER). Producers were American Salt Co. (ER) near Lyons in Rice County; Carey Salt Co., a division of Processed Minerals Inc. (ER), Cargill Inc. (E), and Morton Thiokol Inc. (E) all near Hutchinson in Reno County; and Independent Salt Co. (R) near Kanopolis in Ellsworth County.

The Salt Institute surveyed the salt used by State departments of transportation for the winters of 1981-82 and 1982-83. Kansas reportedly used 35,490 tons of salt in the winter of 1981-82 for deicing and 31,630 tons in the winter of 1982-83. Salt was also sold to the agricultural and meatpacking industries and for use as a hard water conditioner.

Vulcan Materials Co., Chemical Div., extracted sodium chloride brines at its operation at Wichita, Sedgwick County, and electrolytically separated chlorine, hydrogen, and sodium hydroxide.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Three companies produced industrial sand in the Kansas City area, Wyandotte County; one company produced sand in Republic County in north-central Kansas. Production and value decreased about 40% during the year. Most of the State output was used for fiberglass manu-

facture. Other sales were for filtration, foundry applications, sandblasting, and traction. Virtually all the industrial sand produced in the State was shipped by truck.

Table 4.—Kansas: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	5,330	$11,772	$2.21	NA	NA	NA
Gravel	2,790	6,446	2.31	NA	NA	NA
Sand and gravel (unprocessed)	1,600	2,393	1.50	NA	NA	NA
Total or average	9,720	[1]20,612	2.12	[e]12,400	[e]$26,600	[e]$2.15
Industrial sand	331	3,635	10.99	199	2,184	10.99
Grand total or average	10,051	24,247	2.41	[e]12,599	[e]28,784	[e]2.28

[e]Estimated. NA Not available.
[1]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Kansas was ranked 25th of 48 States in crushed stone production, the third most valuable nonfuel mineral produced in the State, following portland cement and salt. Output declined about 15% during the year, but average value per ton increased 28%.

Stone was produced at 156 quarries in 44 counties. Limestone was the major rock type mined, accounting for about 97% of the State's production. Sandstone and quartzite were mined in lesser quantities.

About 94% of the State's output was shipped by truck, lesser quantities by rail and waterway. Some stone, used at plant-sites for cement manufacture, was captive production.

Table 5.—Kansas: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	176	199
Riprap and jetty stone	187	754
Filter stone	92	454
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,402	5,915
Bituminous aggregate, coarse	967	4,352
Bituminous surface treatment aggregate	374	1,426
Railroad ballast	121	621
Fine aggregate (-3/8 inch):		
Stone sand, bituminous mix or seal	34	177
Screening, undesignated	207	647
Other fine aggregate	730	2,781
Coarse and fine aggregate:		
Graded road base or subbase	1,656	5,416
Unpaved road surfacing	660	2,310
Crusher run or fill or waste	493	2,150
Other coarse and fine aggregate	590	2,564
Agricultural:		
Agricultural limestone	450	1,738
Other agricultural uses	6	23
Chemical and metallurgical: Cement manufacture	2,089	5,348
Special: Other[2]	1,957	7,666
Total[3]	12,192	44,540

[1]Includes limestone, quartzite, sandstone, and miscellaneous stone.
[2]Includes stone sand (concrete), lime manufacture, mine dusting or acid water treatment, coarse aggregate (large), coarse aggregate (graded), and uses not specified.
[3]Data do not add to totals shown because of independent rounding.

Table 6.—Kansas: Crushed stone[1] sold or used by producers, by county

County	1981			1983		
	Number of quarries	Quantity (thousand short tons)	Value (thousands)	Number of quarries	Quantity (thousand short tons)	Value (thousands)
Allen	4	953	$1,844	3	705	$1,515
Anderson	7	W	W	7	92	188
Atchison	1	209	974	1	W	W
Bourbon	6	218	725	10	W	W
Butler	5	349	1,537	4	383	1,214
Chautauqua	1	63	190	2	73	250
Coffey	4	91	225	3	128	381
Cowley	2	W	W	3	337	643
Dickinson	5	434	1,738	4	257	1,041
Douglas	5	157	645	4	W	W
Ellis	1	3	9	1	W	W
Finney	1	25	195	--	--	--
Franklin	3	404	1,184	3	394	1,303
Graham	2	14	130	2	7	59
Greenwood	2	110	230	1	W	W
Jefferson	6	471	1,609	6	537	2,525
Johnson	9	1,543	5,953	14	1,717	6,719
Labette	6	377	1,138	6	306	944
Leavenworth	3	423	1,231	3	W	W
Lincoln	2	290	W	2	W	W
Linn	8	291	710	6	W	W
Lyon	2	131	281	1	W	W
Marshall	4	109	332	5	85	276
Miami	10	312	895	3	W	W
Montgomery	6	668	1,733	6	468	1,742
Morris	1	41	128	1	W	W
Nemaha	2	53	164	1	27	252
Neosho	7	1,047	2,541	12	920	2,698
Norton	1	4	4	1	13	26
Osage	4	113	347	3	W	W
Pottawatomie	5	110	383	6	247	1,125
Riley	7	221	891	4	W	W
Trego	1	5	22	1	2	12
Wabaunsee	1	43	135	--	--	--
Wilson	6	746	1,612	7	731	1,846
Woodson	2	W	102	--	--	--
Wyandotte	3	1,143	3,241	2	W	W
Undistributed[2]	25	2,970	12,659	18	4,762	19,783
Total[3]	170	14,143	45,738	156	12,192	44,540

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes limestone, quartzite, sandstone, and miscellaneous stone.
[2]Includes Chase (1981), Cherokee, Clay, Crawford, Doniphan, Elk, Geary (1981), Jewell, Marion, Republic (1981), Rice, Shawnee, Smith, and Washington (1981) Counties, and data indicated by symbol W.
[3]Data may not add to totals shown because of independent rounding.

Dimension.—Production and value of the State's dimension stone increased considerably in 1983. Two companies reported production during the year. Bayer Stone Inc. operated quarries in Pottawatomie and Riley Counties, and H. J. Born Stone Inc. operated quarries in Chase and Cowley Counties. Output consisted primarily of cut limestone, with lesser amounts sold as rough blocks and irregular-shaped stone.

Sulfur (Recovered).—Sulfur was recovered as a byproduct of the petroleum refining operations of Getty Refining & Marketing Co. at El Dorado in Butler County, and Farmland Industries Inc. at Coffeyville in Montgomery County. Sales increased 22% during the year, but the average value per ton decreased about 11%.

---

[1]State Liaison Officer, Bureau of Mines, Minneapolis, MN.
[2]Associate scientist, Mineral Information, Kansas Geological Survey, Lawrence, KS.
[3]Program assistant, Bureau of Mines, Minneapolis, MN.
[4]McCauley, J. R., L. L. Brady, and F. W. Wilson. A Study of Stability Problems and Hazard Evaluation of the Kansas Portion of the Tri-State Mining Area. BuMines OFR 75-83. Jan. 1983, 193 pp.
[5]Rock Products. V. 86, No. 12, Dec. 1983, p. 40.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co.[1 2]	Box 25900 Overland Park, KS 66225	Plant and quarry	Neosho.
General Portland Inc., Victor Div., LaFarge Corp.[1 2]	7701 East Kellogg St. Suite 240 Wichita, KS 67207	do	Wilson.
Lehigh Portland Cement Co., Heidelberger Zement AG[1 2]	718 Hamilton Mall Allentown, PA 18105	do	Montgomery.
Lone Star Industries Inc.[2]	Box 12449 Dallas, TX 75225	do	Wyandotte.
The Monarch Cement Co.[1 2]	Box 187 Humboldt, KS 66748	do	Allen.
Clays:			
Buildex Inc., a division of Clemens Coal Co.	Box 62299 Pittsburg, KS 66762	Pit and plants	Franklin and McPherson.
Cloud Ceramics, a division of General Finance Inc.	Box 369 Concordia, KS 66901	Pits and plant	Cloud.
Justin Industries Inc., Acme Brick Co	Box 425 Fort Worth, TX 76101	do	Cherokee and Ellsworth.
Kansas Brick & Tile Co. Inc	Box 540 Hoisington, KS 67544	Pit and plant	Barton.
Micro-Lite Inc	1100 South Katy St. Chanute, KS 66720	do	Woodson.
Gypsum:			
Georgia-Pacific Corp	133 Peachtree St., NE. Atlanta, GA 30303	Underground mine and plant.	Marshall.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	Open pit, underground mine, plant.	Barber.
Helium:			
Cities Service Helex Co	Route 1, Box 14D Satanta, KS 67870	Plants	Grant and Scott.
Kansas Refined Helium Co	Otis, KS 67565	Plant	Rush.
Northern Helex Co	Bushton, KS 67427	do	Ellsworth.
Union Carbide Corp., Linde Div	do	Plants	Ellsworth and Morton.
Lime:			
The Great Western Sugar Co	Box 5308 Denver, CO 80217	do	Sherman.
Perlite (expanded):			
Lite-Weight Products Inc	1706 Kansas Ave. Kansas City, KS 66105	do	Wyandotte.
Pumice and pumicite:			
Calvert Mines Inc	Box 97 Norton, KS 67654	Pit and plant	Norton.
Salt:			
American Salt Co	3142 Broadway Kansas City, MO 64111	Wells and underground mine.	Rice.
Carey Salt Co., a division of Processed Minerals Inc.	1800 Carey Blvd. Hutchinson, KS 67501	Underground mine	Reno.
Cargill Inc., Salt Div	Box 1403 Hutchinson, KS 67501	Wells	Do.
Independent Salt Co	Box 36 Kanopolis, KS 67454	Underground mine	Ellsworth.
Morton Salt Co., a division of Morton Thiokol Inc.	110 North Wacker Dr. Chicago, IL 60606	Wells	Reno.
Vulcan Materials Co., Chemical Div	Box 7689 Birmingham, AL 35223	do	Sedgwick.
Sand and gravel:			
Construction (1982):			
Bingham Sand & Gravel Co	Box 728 Baxter Springs, KS 66713	Pits and plants	Cherokee.
Builders Sand Co	4150 Kansas Ave. Kansas City, KS 66106	Dredge and plant	Johnson and Wyandotte.
Holliday Sand & Gravel Co., a division of List & Clark Construction Co.	6811 West 63d St. Overland Park, KS 66202	Pits and plants	Do.
Ritchie Paving Inc	6500 West 21st St. Wichita, KS 67204	Dredge	Sedgwick.
Industrial:			
Holliday Sand & Gravel Co, a division of List & Clark Construction Co.	6811 West 63d St. Overland Park, KS 66202	Pit and plant	Wyandotte.
HUB Materials Inc	Box 11126 Kansas City, KS 66111	do	Do.
Stone:			
Crushed:			
Limestone:			
Ash Grove Cement Co	Box 25900 Overland Park, KS 66225	Quarries, underground mine, plants.	Johnson and Neosho.
N. R. Hamm Quarry Inc	Box 17 Perry, KS 66073	Quarries and plants	Various (8 counties).

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Crushed —Continued			
Limestone —Continued			
McAdam Limestone Products Inc.	Moran, KS 66755	Quarries and plants	Anderson, Bourbon, Cowley, Linn.
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 27622	do	Various (8 counties).
Midwest Minerals Inc	Box 412 Pittsburg, KS 66762	do	Cherokee, Crawford, Labette, Montgomery, Neosho, Wilson.
Thompson-Strauss Quarries Inc., a division of Beatrice Foods Co.	7000 Holliday Dr. Kansas City, KS 66106	Underground mine and plant.	Wyandotte.
Sandstone:			
Quartzite Stone Co. Inc	Box 97 Lincoln, KS 67455	Quarries and plant	Lincoln.
Dimension:			
Limestone:			
Bayer Stone Inc	6th and Mission St. Marys, KS 66536	Quarries	Pottawatomie and Riley.
H. J. Born Stone Inc	Box 45 Silverdale, KS 67005	do	Chase and Cowley.
Sulfur (recovered):			
Farmland Industries Inc	North Linden St. Coffeyville, KS 67337	Secondary recovery plant.	Montgomery.
Getty Refining & Marketing Co	Box 1121 El Dorado, KS 67042	do	Butler.

[1]Also clays.
[2]Also crushed stone.

The Mineral Industry of Kentucky

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Kentucky Geological Survey for collecting information on all nonfuel minerals.

By Donald K. Harrison[1]

The value of Kentucky's nonfuel mineral production in 1983 was $224.5 million, $17.6 million more than that of 1982. Crushed stone was the leading nonfuel mineral produced and accounted for more than 52% of the total value; it has accounted for more than one-half of the total value of minerals produced in the last 10 years. The State ranked second in ball clay production, after Tennessee; third in primary aluminum output; and fourth in synthetic graphite production and lime output. Leading commodities in terms of value were crushed stone, lime, and portland cement. Other nonfuel minerals produced included construction sand and gravel, industrial sand, common and fire clay, masonry cement, and zinc.

Other commodities processed or manufactured included ferroalloys, perlite, vermiculite, pig iron, regenerator iron oxides, and synthetic mullite. In 1983, about 2,000 people were employed in Kentucky in the extraction and processing of nonfuel minerals.

Table 1.—Nonfuel mineral production in Kentucky[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2]	thousand short tons	579	$2,039	669	$2,142
Gem stones		NA	1	NA	1
Sand and gravel:					
Construction	thousand short tons	6,499	15,936	e5,500	e13,000
Industrial	do.	7	116	10	124
Stone (crushed)	do.	e29,500	e104,300	33,399	117,842
Combined value of cement, clays (ball clay, fire clay, 1983), lime, and zinc		XX	84,555	XX	91,408
Total		XX	206,947	XX	224,517

eEstimated. NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes certain clays; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Kentucky, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Adair	$493	(2)	
Allen	W	(2)	
Anderson	W	(2)	
Barren	W	(2)	
Bell	(3)	(2)	
Boone	(3)	$1,627	Sand and gravel (construction).
Bourbon	W	(2)	
Boyd	--	W	Clays.
Boyle	W	(2)	
Breckinridge	W	65	Sand and gravel (construction).
Bullitt	W	W	Clays.
Caldwell	W	(2)	
Calloway	242	159	Sand (industrial), sand and gravel (construction).
Carlisle	W	W	Clays, sand and gravel (construction).
Carroll	(3)	W	Sand and gravel (construction).
Carter	W	W	Clays.
Casey	360	(2)	
Christian	3,177	(2)	
Clark	W	(2)	
Clinton	749	W	Sand and gravel (construction).
Crittenden	W	(2)	
Cumberland	150	(2)	
Daviess	(3)	1,102	Sand and gravel (construction).
Edmonson	W	(2)	
Estill	407	(2)	
Fayette	W	(2)	
Fleming	W	(2)	
Floyd	1,400	(2)	
Franklin	1,677	(2)	
Gallatin	(3)	--	
Garrard	682	(2)	
Graves	2,795	W	Clays, sand and gravel (construction).
Grayson	W	(2)	
Green	W	(2)	
Hancock	182	227	Clays.
Hardin	W	(2)	
Harlan	2,333	(2)	
Harrison	W	(2)	
Hart	W	W	Sand and gravel (construction).
Henderson	(3)	W	Do.
Henry	W	(2)	
Hickman	(3)	--	
Jackson	590	(2)	
Jefferson	22,130	20,541	Cement, sand and gravel (construction), clays.
Jessamine	W	W	Zinc.
Knott	1,450	(2)	
Laurel	267	(2)	
Lee	W	(2)	
Letcher	1,363	(2)	
Lewis	5	2	Sand (industrial), sand and gravel (construction).
Livingston	W	2,443	Sand and gravel (construction).
Logan	W	(2)	
McCracken	(3)	--	
Madison	W	(2)	
Marion	651	(2)	
Martin	(3)	--	
Mason	W	W	Lime, sand and gravel (construction).
Meade	3,312	(2)	
Menifee	1,573	(2)	
Mercer	W	(2)	
Metcalfe	282	(2)	
Monroe	W	(2)	
Montgomery	817	(2)	
Morgan	W	(2)	
Muhlenberg	1,464	(2)	
Nelson	W	(2)	
Nicholas	220	(2)	
Ohio	W	(2)	
Oldham	1,824	W	Sand and gravel (construction).
Pendleton	W	W	Lime.
Pike	W	(2)	
Powell	1,909	285	Clays.
Pulaski	2,949	(2)	
Rockcastle	W	(2)	
Scott	W	(2)	

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Kentucky, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Simpson	W	(2)	
Spencer	$49	$2,348	Sand and gravel (construction).
Taylor	W	(2)	
Todd	W	(2)	
Trigg	W	(2)	
Union	(3)	W	Sand and gravel (construction).
Warren	W	(2)	
Washington	W	(2)	
Wayne	W	(2)	
Whitley	W	W	Clays.
Wolfe	427	--	
Undistributed[4]	136,584	73,848	
Sand and gravel (construction)	e16,070	XX	
Stone (crushed)	XX	e104,300	
Total	208,529	206,947	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Ballard, Bath, Bracken, Breathitt, Butler, Campbell, Clay, Elliott, Fulton, Grant, Greenup, Hopkins, Johnson, Kenton, Knox, Larue, Lawrence, Leslie, Lincoln, Lyon, McCreary, McLean, Magoffin, Marshall, Owen, Owsley, Perry, Robertson, Rowan, Russell, Shelby, Trimble, Webster, and Woodford. County distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2]Crushed stone was produced, data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

Table 3.—Indicators of Kentucky business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,686.0	1,723.4	+2.2
Unemployment	do	244.0	198.4	-18.7
Employment (nonagricultural):				
Mining[1]	do	42.8	40.7	-4.9
Manufacturing	do	233.0	249.0	+6.9
Contract construction	do	39.9	44.7	+12.0
Transportation and public utilities	do	61.0	60.6	-.7
Wholesale and retail trade	do	251.1	269.3	+7.3
Finance, insurance, real estate	do	51.9	53.3	+2.7
Services	do	218.0	221.8	+1.7
Government	do	226.0	219.5	-2.9
Total nonagricultural employment[1]	do	1,123.7	1,158.9	+3.1
Personal income:				
Total	millions	$32,794	$34,030	+3.8
Per capita		$8,893	$9,162	+3.0
Construction activity:				
Number of private and public residential units authorized		7,587	11,187	+47.4
Value of nonresidential construction	millions	$316.3	$388.9	+23.0
Value of State road contract awards	do	$225.5	$452.2	+100.5
Shipments of portland and masonry cement to and within the State	thousand short tons	954	889	-6.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$206.9	$224.5	+8.5
Value per capita, resident population		$56	$60	+7.1
Value per square mile		$5,123	$5,556	+8.4

pPreliminary.

[1]Includes bituminous coal and oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

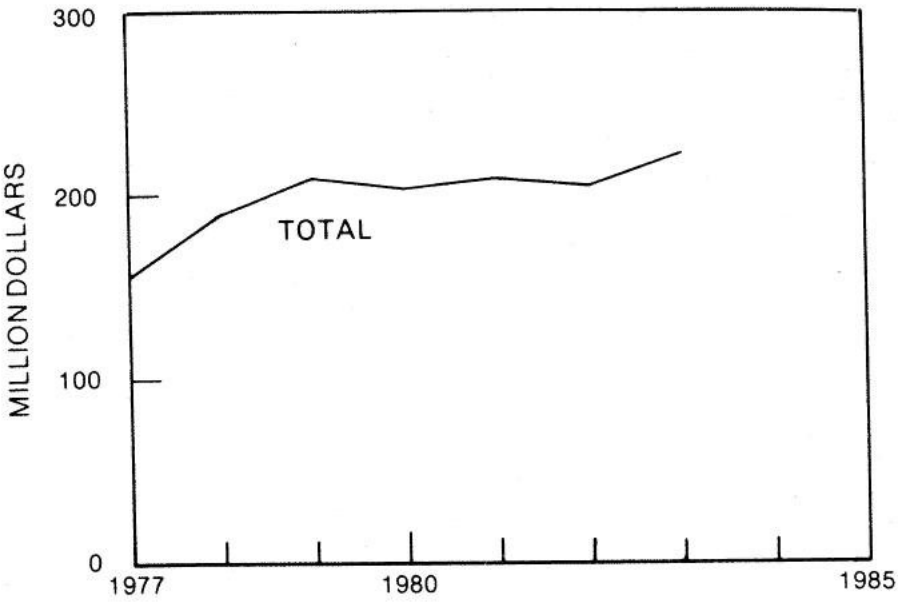

Figure 1.—Total value of nonfuel mineral production in Kentucky.

Trends and Developments.—Recently, much attention has been focused on flue-gas desulfurization and fluidized bed combustion in the State. The Tennessee Valley Authority, coal-fired electric utilities, the University of Kentucky, and State and Federal officials are all looking at new promising ways to burn coal utilizing the State's abundant and widespread limestone and lime resources to remove SO_2 from stack gases. In the case of fluidized bed combustion, limestone reacts with sulfur dioxide to produce calcium sulfate, which then remains in the clinker. Additionally, fewer emissions of nitrogen oxide are produced because the coal burns at relatively low temperatures compared to conventional boilers. In 1983, Kentucky was the leading coal producing State in the Nation.

Because of increasing aluminum prices, improved demand, and declining inventories, both of Kentucky's primary aluminum producers began operating at full capacity during the year. Both ARCO Metals Co., Sebree, and National-Southwire Aluminum Co., Hawesville, reactivated their idled potlines, bringing both smelters to 100% of their operating capacity of 180,000 short tons per year.

Near yearend, Armco Inc., officially canceled its $671 million "operation pipemaker" project. The decision to cancel the project, which would have more than doubled Armco's capacity to produce oil country goods to 750,000 tons annually, was made because of a radical change in the market that included declining drilling rates, a 50% import penetration level, and a massive inventory buildup. Operation pipemaker would have included a hot mill at Ashland, KY, and a finishing plant at Gulfport, MS. The project was originally announced in August 1981 when the market was very strong. As of November 1983, shipments of oil country tubulars were off about 77% from 1982 levels.

A new hydraulically operated rock duster was developed and field tested during 1983 by Speedco Inc., Lexington. Speedco, which manufactures rock dust, agricultural limestone, and other limestone products, is the exclusive distributor of the machine. According to the manufacturer, the new scoop-mounted duster is expected to save underground coal mining operators thousands of dollars per year. The duster, measuring 65 by 43 by 19 inches, fits in the scoop and runs off the scoop's hydraulic system. The hop-

per-type machine, which holds 1,000 pounds of rock dust, is conveyor fed and will accommodate both low and high coal.

The State continued to lead the Nation in the apparent consumption of industrial explosives and blasting agents in 1983. More than 765 million pounds (nearly 21% of the U.S. total) was sold during the year. Although the principal consuming industry was the coal mining sector, the State ranked second in the Nation (after Illinois) in sales for quarrying and nonmetal mining (47 million pounds) and second in sales (55.3 million pounds) for use in construction work.

Legislation and Government Programs.—The Kentucky General Assembly, which convenes every other year, was not in session in 1983. However, during 1983, the State Supreme Court ruled that the State's weight-distance tax was constitutional; the natural resource hauling permit legislation passed in 1982 (Senate bill 144, sections 10 through 18) was still being contested in court. In the meantime, companies eligible to obtain these permits can defer payment of the weight-distance tax until the suit on the hauling permit is settled, provided a statement is filed requesting deferment.

In September, a commission was formed to study the question of taxing unmined coal and other minerals. The commission, headed by the revenue secretary, is to report its findings to the 1984 General Assembly in January 1984. In 1976, the General Assembly enacted an unmined minerals levy but repealed it in 1978 after determining that it was too difficult to administer.

The Kentucky Geological Survey (KGS) continued its extensive assessment of Kentucky's mineral and water resources during 1983. An unprecedented study of the State's coal resources was completed during the year and recently completed estimates for eastern Kentucky indicate almost a 100% increase over previous coal resource figures. Other major research projects focused on coal quality, coalbed methane, inventory and study of injection wells, mapping of mined-out areas, limestone resources, sand and gravel, tar sands, and studies of quality and quantity of both surface and ground water. Near midyear, the KGS computer system became fully operational. The computerization of extensive files of oil, gas, and coal data, as well as many other types of information, will enable KGS to make this information available to the public more effectively.

KGS completed a 7-year study of coal resources in the Eastern Kentucky Coalfield that shows more than 57 billion tons of remaining coal. When this figure is combined with resource estimates for the Western Kentucky Coalfield, the total remaining coal resources for the entire State amounted to 95 billion tons. The recently completed study of eastern Kentucky involved 25,000 coalbed thickness measurements and the construction of more than 4,000 coal resource maps. Other areas of ongoing research include coal quality, stratigraphy, overburden testing and characterization, inventory of mined-out areas, and computer handling of coal data.

During 1983, drilling activity in Kentucky continued at a record level. Approximately 8,000 drilling permits were processed by KGS in 1983, an increase of almost 20% over that of 1982. Increased drilling resulted in corresponding increases in demands upon KGS' well-record facilities and the well sample and core library. Work continued on additional open file oil and gas base maps at a scale of 1:24,000. A study of the subsurface geology of the Knox Dolomite in south-central Kentucky was completed during the year. Continuing progress was made on the computerization of oil and gas records.

Resource investigations by KGS were continuing on carbonate rocks, with current emphasis on applications for coal-related industries, and on subsurface zinc deposits in south-central Kentucky. A new program was initiated to study sand and gravel resources along the Ohio River Valley.

A total of 12 new reports was published by KGS during 1983. These included a study of the impact various control levels of sulfur dioxide emission would have on Kentucky coal, an oil and gas drilling activity summary for 1982, a report on the economic geology of Rowan County, proceedings of the Kentucky Oil & Gas Association's annual meetings, and a nontechnical publication on the geology of Kentucky. Reports on the coal resources of each of the coal districts in eastern Kentucky were also prepared by KGS for publication in the Energy Resource Series by the University of Kentucky Institute for Mining and Mineral Resources.

Morehead State University, in the eastern part of the State, developed a 4-year program in mining, reclamation, and energy studies. The program is designed to give students a total overview of the energy

sector, not only in mining but oil shale, oil, gas, synthetic fuels, and nuclear energy. Students can choose an option of mining, reclamation, energy industry administration, energy economics, industrial technology, or safety and health.

In January, the University of Kentucky's College of Law launched a new entity in its program known as the Mineral Law Center. The center is believed to be the first university-sponsored legal institute in the country devoted mainly to coal-related issues. One of its purposes is to turn out more law graduates who are better trained in such complex subjects as reclamation, mine safety, coal leases, mine financing, and oil shale regulation. The center was also expected to publish a mineral law journal.

The Mining and Mineral Resources Institute at the University of Kentucky received an allotment of $250,000 in 1983 from the U.S. Bureau of Mines. It was affiliated with Virginia Polytechnic Institute and State University's Generic Center on Mine Systems Design and Ground Control Research.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Kosmos Cement Co. Inc., a subsidiary of Moore McCormack Cement Inc., operated the State's only cement plant at Kosmosdale. The 670,000-ton-per-year, coal-fired plant produced both portland and masonry cement utilizing the dry process. The plant's limestone reserves are located at Battletown, approximately 28 miles from the plantsite, and are barged to the plant. Proven limestone reserves at Battletown were estimated at 38 million tons.[2] In addition to the limestone consumed at the plant, both iron ore and gypsum were also used.

Clays.—A total of 12 companies operating 16 pits produced common clay and shale, fire clay, and ball clay.

Common clay and shale was produced by 9 companies at 11 operations in Boyd, Bullitt, Hancock, Jefferson, Powell, and Whitley Counties. Principal uses were in the manufacture of common and face brick, cement, concrete block, structural concrete, and quarry tile.

Fire clay was mined by one company in Carter County, while ball clay was produced by two companies at four operations in Carlisle and Graves Counties. Fire clay was used primarily for fire brick; ball clay was sold for use in pottery, sanitary ware, ceramics, and as a paper filler.

A bidding war by three companies to take over the Kentucky-Tennessee Clay Co. (K-T) was finally won by Ranchers Exploration & Development Corp. when the company acquired more than 50% of K-T's outstanding shares. Total value of K-T from the sale of the shares and a subsequent merger is expected to be about $25.8 million. K-T mines ball and refractory clays in Kentucky, Tennessee, and Mississippi. The company supplies material for refractories, electrical porcelain, dinnerware, sanitary ware, and floor and wall tiles in both the domestic and overseas markets.

Fluorspar.—There was no fluorspar produced in Kentucky in 1983 although several drilling firms continued evaluating deposits in the western Kentucky fluorspar district.

Gem Stones.—Gem material and mineral specimens have been collected in various parts of the State. The State is well known for its Halls Gap millerite and honessite, agate, and coalfield fossils. Some of the other minerals found in the State included barite, calcite, chalcopyrite, fluorite, galena, pyrite, and sphalerite.

Graphite (Synthetic).—Two companies produced synthetic graphite in 1983. Superior Graphite Co. produced graphite powder at Hopkinsville, Christian County, for use as an additive in ironmaking. Sigri Carbon Corp., a U.S. subsidiary of the Sigri Group of the Federal Republic of Germany, produced graphite at a plant in Hickman, Fulton County, primarily for the manufacture of electrodes. In 1983, both shipments and value increased substantially compared with that of 1982.

Lime.—In 1983, Kentucky ranked fourth nationally in lime output after Ohio, Pennsylvania, and Missouri. Two companies each operated underground mines to produce feed for calcining facilities in Mason and Pendleton Counties. These lime facilities are the Nation's second and fourth leading lime plants in terms of total output.

Dravo Lime Co., a subsidiary of Dravo Corp., the Nation's second leading plant in terms of total output, operated a $60 million mine and lime plant near Maysville, Mason County. The underground mine is one of the largest underground limestone mines in North America. More than 2.7 million tons of high-calcium limestone are mined there each year and calcined into Thiosorbic lime in three coal-fired preheater rotary kilns,

which are among the largest in the world. The Thiosorbic lime is shipped to utilities primarily by river barge; other modes of transportation include truck and rail. The material is used at 14 flue gas desulfurization systems in 9 powerplants in the Ohio River Valley, primarily to remove SO_2 from high-sulfur coal emissions. During the year, the company completed the planning and preliminary engineering stages for the addition of a fourth kiln at the site.[3]

The Black River Lime Co., jointly owned by Armco and Jones & Laughlin Steel Corp., produced both quicklime and hydrated lime at the Nation's fourth largest plant at Carntown in Pendletown County. The lime was primarily sold for industrial and chemical use in the Midwest and upper South.

Perlite (Expanded).—Two companies expanded perlite shipped in from out of State. International Permalite Co. operated a plant at Florence in Boone County and W. R. Grace & Co. at Wilder, Campbell County. International Permalite, a newly formed company in California, purchased the plant that was formerly operated by Grefco Inc. International Permalite also purchased the other building products divisions of Grefco at Jamesburg, NJ, and Ontario, CA. The State's expanded perlite was used for roof insulation board, as a horticultural aggregate, and oil absorbent.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Based on these preliminary estimates, output totaled 5.5 million tons valued at $13 million in 1983. In 1982, there were 21 companies or highway departments that mined sand and gravel at 27 operations. Leading counties in order of output were Daviess, Livingston, Jefferson, Boone, and Carroll. Construction sand and gravel was used primarily for concrete aggregate, asphaltic concrete, concrete products, and road base and coverings.

Table 4.—Kentucky: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	4,374	$9,941	$2.27	NA	NA	NA
Gravel	1,648	5,057	3.07	NA	NA	NA
Sand and gravel (unprocessed)	478	937	1.96	NA	NA	NA
Total[1] or average	6,499	15,936	2.45	e5,500	e$13,000	e$2.36
Industrial sand	7	116	15.73	10	124	11.90
Grand total or average	6,506	16,052	2.47	e5,510	e13,124	e2.38

eEstimated. NA Not available.
[1]Data do not add to totals shown because of independent rounding.

Industrial.—Two companies mined industrial sand in the State in 1983. Murray Silica Sand Co. operated a deposit in Calloway County and Industrial Supply House operated a pit in Lewis County. Production in 1983 was 10,000 tons, up from 7,000 tons in 1982. Main uses were for blasting and mold and core. All of the material was shipped by truck.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone was the leading mineral produced and accounted for more than 52% of the State's total value in 1983. In 1983, production amounted to 33.4 million tons valued at $117.8 million. This represents an increase of 13% in both output and value compared with that of 1982. Leading counties in order of output were Livingston, Mason, Pendleton, and Hardin. Limestone was mined at 101 quarries and accounted for the majority of production; a small amount of crushed sandstone was also mined at two quarries.

Table 5.—Kentucky: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	521	1,708
Riprap and jetty stone	1,506	5,070
Filter stone	276	1,003
Other coarse aggregate	145	471
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,284	11,251
Bituminous aggregate, coarse	2,714	9,869
Bituminous surface treatment aggregate	960	3,419
Railroad ballast	532	1,887
Other graded coarse aggregate	1,079	4,873
Fine aggregate (-3/8 inch):		
Stone sand, concrete	285	908
Stone sand, bituminous mix or seal	484	1,653
Screening, undesignated	448	1,764
Other fine aggregate	3,158	11,667
Coarse and fine aggregate:		
Graded road base or subbase	4,273	14,640
Unpaved road surfacing	2,283	7,382
Crusher run or fill or waste	729	2,319
Other coarse and fine aggregate	1,399	5,070
Agricultural: Agricultural limestone	1,526	5,768
Special:		
Mine dusting or acid water treatment	179	1,727
Other[2]	7,617	25,394
Total[3]	33,399	117,842

[1]Includes limestone and sandstone.
[2]Includes other agricultural uses, poultry grit and mineral food, cement manufacture, lime manufacturing, flux stone, asphalt fillers or extenders, other fillers or extenders, and uses not specified.
[3]Data do not add to totals shown because of independent rounding.

Dravo Corp. announced that its subsidiary, Dravo Lime Co., had been awarded a long-term contract valued at more than $3 million to supply Ashland Petroleum Co. with approximately 500,000 tons of limestone over a 5-year period. The limestone, mined at Maysville, would be used as a sorbent material in two fluidized bedstream boilers under construction at Ashland's refinery in Catlettsburg, KY. The fluidized bed boilers are part of the installation of Ashland's Reduced Crude Conversion process, which converts "bottom of the barrel" high-sulfur heavy fuel into higher value products such as gasoline and middle distillates.

Vermiculite (Exfoliated).—Crude vermiculite mined in other States was exfoliated by W. R. Grace at its plant in Campbell County. The product was used primarily in loose-fill and block insulation, fireproofing, lightweight aggregate, and soil conditioning.

METALS

Aluminum.—Kentucky continued to rank third behind Washington and New York in the production of primary aluminum. In 1983, both output and value remained essentially the same as that of 1982. Two companies each operated 180,000-ton-per-year smelters in the State; National-Southwire Aluminum in Hawesville, Hancock County, and ARCO Metals in Sebree, Webster County.

Because of weak demand in 1982, both of the State's two primary aluminum producers curtailed production in 1982. However, because of increasing aluminum prices, improved demand, and declining inventories, both began operating at full capacity during 1983. Early in the year, National-Southwire reactivated a 49,000-ton-per-year potline at Hawesville, which brought the smelter to 100% of its annual rated capacity (180,000 tons per year). In September, ARCO Metals restarted a 60,000-ton-per-year potline at Sebree, which was shut down in 1982, bringing the smelter to its full operating capacity of 180,000 tons per year. However, near the end of December, a 60,000-ton-per-year potline at Sebree was closed, the result of a power switch failure associated with freezing weather. Full capacity was expected to be restored by mid-March 1984.

Near yearend, Alcan Aluminum Ltd., Montreal, Canada, and Atlantic Richfield Co. (ARCO) signed a letter of intent for Alcan to purchase the majority of ARCO's aluminum operations. The purchase would include ARCO's primary smelter in Sebree, KY, and a $450 million can stock rolling facility in Logan County, KY, scheduled to come on-stream during 1984. The agree-

ment would also include the container, laminating and foil plants, and a rolling mill in Louisville; a rolling mill in Terre Haute, IN; and a 25% interest in the $1 billion, Aughinish, Ireland, alumina refinery that came on-stream in November of 1982. The acquisition would make Alcan's U.S. subsidiary, Alcan Aluminum Corp., Cleveland, OH, a major supplier of can stock, foil, and tinstock, and give the company its first primary smelter capacity in this country. A definitive agreement was expected to be signed by mid-February 1984 subject to approval of the U.S. antitrust laws.

Ferroalloys.—SKW Alloys Inc. produced ferroalloys at its plant in Calvert City. The plant produces both 50% and 75% ferrosilicon and other alloys. The plant was idled by a strike on September 1 and remained closed for the rest of the year. However, near yearend, the company indicated that it would reopen the plant in January 1984 utilizing management personnel if the strike was not settled.

Iron and Steel.—Armco continued to produce both pig iron and regenerator iron oxides at its Ashland plant in Boyd County. Near yearend, the company brought on-line a six-strand continuous caster at the Ashland plant. The new $97 million caster, which has an annual capacity to produce 720,000 tons of carbon and alloy blooms, had been under construction since October 1981.

Plans for a $28 million pipe mill expansion at Newport Steel Corp.'s Newport plant were put on hold in 1982. However, because of an anticipated economic recovery in the steel industry, the company was reconsidering the expansion plans near yearend.

In October, Ohio River Steel Corp. began production runs of its 23-inch structural bar mill at its new Calvert City facility. The 170-employee mill was scheduled for a two-shift operation with a range of products, which included 6- to 10-inch flat bars; 6- to 8-inch channels; 4- by 4-inch angles; and 6-inch standard beams. The facility is designed to eventually have a production capacity of 400,000 tons annually.

Green River Steel Corp., Owensboro, began producing and marketing 42-inch rounds up to 28,000 pounds, expanding its range of bottom-poured ingot sizes. Previously, the largest ingots Green River made were 30-inch rounds with a maximum weight of 30,000 pounds. The company now has the capability to produce 45-inch rounds up to 45,000 pounds. The large bottom-poured ingots are used by the open die forging industry and by ring rollers.

Zinc.—Lexington Quarry Co. (Catnip Hill operation) continued to recover and concentrate zinc ore as a byproduct of underground limestone mining. The zinc ore (sphalerite) occurs in a narrow vein deposit in the limestone. The zinc concentrate was shipped to an out-of-State smelter.

---

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.
[2]Moore McCormack Resources Inc. Form 10-K Report. P. 2.
[3]Dravo Corp. Dravo Review, Summer 1983. P. 11.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum (primary):			
ARCO Metals Co	2 Continental Towers 1701 Golf Rd. Rolling Meadows, IL 60008	Smelter	Webster.
National-Southwire Aluminum Co.	Box M Hawesville, KY 42348	do	Hancock.
Cement:			
Kosmos Cement Co. Inc.,[1] a subsidiary of Moore McCormack Cement Inc.	Dixie Highway Kosmosdale, KY 40272	Plant	Jefferson.
Clays:			
Ball clay:			
Kentucky-Tennessee Clay Co	Box 449 Mayfield, KY 42066	Mines and plant	Carlisle and Graves.
Old Hickory Clay Co	Route 2, Box 303 Mayfield, KY 42066	do	Graves.
Common:			
General Shale Products Co	Box 3547 CRS Johnson City, TN 37601	Mine and plant	Jefferson.
Kentucky Solite Corp	Box 27211 Richmond, VA 23261	do	Bullitt.
Sipple Brick Inc	Box 567 Stanton, KY 40380	do	Powell.
Fire clay:			
Burge & Fultz Clay Co	Route 2 Olive Hill, KY 41164	Mine	Carter.
Ferroalloys:			
SKW Alloys Inc	Box 217 Calvert City, KY 42029	Plant	Marshall.
Graphite (synthetic):			
Sigri Carbon Corp	Box 229 Hickman, KY 42050	do	Fulton.
Superior Graphite Co	Box 535 Hopkinsville, KY 42240	do	Christian.
Iron and steel (pig iron):			
Armco Inc	Middletown, OH 45202	do	Boyd.
Newport Steel Corp	9th & Lowell Sts. Newport, KY 41072	Plants	Campbell.
Lime:			
Black River Lime Co	Route 1 Butler, KY 41006	Mine and plant	Pendleton.
Dravo Lime Co., a subsidiary of Dravo Corp.	3600 Neville Rd. Pittsburgh, PA 15225	do	Mason.
Perlite (expanded):			
W. R. Grace & Co.[2]	62 Whittemore Ave. Cambridge, MA 02140	Plant	Campbell.
Grefco Inc	Box 35 Florence, KY 41042	do	Boone.
Sand and gravel (1982):			
Evansville Materials Inc	Box 248 Tell City, IN 47586	Dredge	Daviess.
Ingram Materials Inc	Box 1049 Nashville, TN 37202	do	Livingston.
Martin Marietta Corp.[3]	Box 30013 Raleigh, NC 27622	Dredge and pits	Boone, Carroll, Jefferson, Oldham.
Nugent Sand Co. Inc	Box 6072 1833 River Rd. Louisville, KY 40206	Dredge	Jefferson.
E. T. Slider Inc	1602 East Market Jeffersonville, IN 47130	do	Trimble.
Stone (crushed):			
Dravo Lime Co., a subsidiary of Dravo Corp.	3600 Neville Rd. Pittsburgh, PA 15225	Quarry and plant	Mason.
Kentucky Stone Co	400 Sherburn Lane Louisville, KY 40207	Underground mines, quarries, plants.	Various.
Reed Crushed Stone Co	Box 35 Gilbertsville, KY 42044	Quarry and plant	Livingston.
Three Rivers Rock Co	Box 218 Smithland, KY 42081	do	Do.
Zinc:			
Lexington Quarry Co.[3]	RFD No. 1 Nicholasville, KY 40356	do	Jessamine.

[1]Also clays.
[2]Also exfoliated vermiculite.
[3]Also crushed stone.

The Mineral Industry of Louisiana

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Louisiana Geological Survey for collecting information on all nonfuel minerals.

By James R. Boyle[1] and Charles G. Groat[2]

The value of Louisiana's nonfuel mineral production in 1983 was $446.8 million, an increase of $29.1 million over that of 1982. The increase reversed a 2-year decline in value attributed to the nationwide recession. The State led the Nation in salt output, was second in Frasch sulfur, and was sixth in recovered elemental sulfur from oil refineries. The combined value of salt and Frasch sulfur remained the major portion of the State's total nonfuel minerals value in 1983. Output of minerals used mainly in the construction industry remained at a relatively low level with output increasing by yearend.

Table 1.—Nonfuel mineral production in Louisiana[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	326	[2]$6,216	[3]505	$10,793
Gem stones		NA	1	NA	1
Salt	thousand short tons	[r]12,171	117,569	11,544	100,936
Sand and gravel:					
Construction	do.	16,558	50,966	[e]14,200	[e]46,600
Industrial	do.	378	4,590	291	4,252
Stone (crushed)	do.	W	W	5,758	25,702
Sulfur (Frasch)	thousand metric tons	1,239	W	1,643	W
Combined value of cement, clays (bentonite, 1982), gypsum, lime, and values indicated by symbol W		XX	238,325	XX	258,477
Total		XX	417,667	XX	446,761

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes bentonite; value included with "Combined value" figure.

[3]Excludes bentonite.

Table 2.—Value of nonfuel mineral production in Louisiana, by parish[1]

(Thousands)

Parish	1981	1982	Minerals produced in 1982 in order of value
Allen	(2)	W	Sand and gravel (construction), sand (industrial).
Ascension	W	$3,828	Salt.
Assumption	W	W	Do.
Beauregard	(2)	W	Sand and gravel (construction).
Bienville	$81	W	Clays.
Caddo	W	W	Do.
Calcasieu	W	W	Do.
Cameron	--	W	Do.
Catahoula	(2)	308	Sand and gravel (construction).
Claiborne	W	W	Clays.
East Baton Rouge	W	W	Sand and gravel (construction), sand (industrial).
East Feliciana	(2)	1,581	Sand and gravel (construction).
Grant	(2)	W	Do.
Iberia	56,593	60,801	Salt.
Iberville	W	W	Do.
Jefferson	W	W	Sulfur, salt.
Jefferson Davis	(2)	W	Sand and gravel (construction).
Lafayette	(2)	W	Do.
La Salle	(2)	2,575	Do.
Livingston	(2)	782	Do.
Morehouse	(2)	--	
Natchitoches	24	W	Clays.
Orleans	W	W	Cement, lime.
Ouachita	(2)	1,333	Sand and gravel (construction).
Plaquemines	W	W	Sulfur, salt.
Pointe Coupee	W	W	Clays.
Rapides	(2)	5,944	Sand and gravel (construction).
Red River	W	396	Sand (industrial).
Sabine	(2)	3	Sand and gravel (construction).
St. Bernard	(2)	501	Do.
St. Helena	W	W	Sand and gravel (construction), clays.
St. James	W	--	
St. Martin	W	W	Salt, sand and gravel (construction).
St. Mary	38,403	W	Salt, lime.
St. Tammany	W	W	Sand and gravel (construction), clays.
Tangipahoa	(2)	W	Sand and gravel (construction).
Terrebonne	W	W	Sulfur, salt.
Union	--	254	Sand and gravel (construction).
Vermilion	(2)	252	Do.
Vernon	(2)	1,346	Do.
Washington	(2)	3,634	Do.
Webster	W	W	Sand (industrial), sand and gravel (construction).
West Feliciana	(2)	1,453	Sand and gravel (construction).
Winn	W	W	Gypsum.
Undistributed[3]	417,746	332,677	
Sand and gravel (construction)	e53,550	XX	
Stone (crushed)	XX	W	
Total[4]	566,396	417,667	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]No nonfuel mineral production was reported for Acadia, Avoyelles, Bossier, Caldwell, Concordia, De Soto, East Carroll, Evangeline, Franklin, Jackson, Lafourche, Lincoln, Madison, Richland, St. Charles, St. John the Baptist, St. Landry, Tensas, West Baton Rouge, and West Carroll Parishes. Parish distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2]Construction sand and gravel was produced; data not available by parish.

[3]Includes gem stones that cannot be assigned to specific parishes and values indicated by symbol W.

[4]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Louisiana business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,875.5	1,887.8	+0.7
Unemployment	do.	238.2	200.0	-16.0
Employment (nonagricultural):				
Mining[1]	do.	84.0	79.7	-5.1
Manufacturing	do.	180.1	174.9	-2.9
Contract construction	do.	109.3	113.1	+3.5
Transportation and public utilities	do.	119.9	113.7	-5.2
Wholesale and retail trade	do.	353.7	369.7	+4.5
Finance, insurance, real estate	do.	80.5	83.4	+3.6
Services	do.	301.0	307.2	+2.1
Government	do.	317.6	314.4	-1.0
Total nonagricultural employment[1]	do.	1,546.1	1,556.1	+.6
Personal income:				
Total	millions	$44,652	$46,182	+3.4
Per capita		$10,211	$10,406	+1.9
Construction activity:				
Number of private and public residential units authorized		20,332	33,025	+62.4
Value of nonresidential construction	millions	$1,183.7	$1,163.5	-1.7
Value of State road contract awards	do.	$473.0	$390.0	-17.5
Shipments of portland and masonry cement to and within the State	thousand short tons	2,520	2,564	+1.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$417.7	$446.8	+7.0
Value per capita, resident population		$96	$101	+5.2
Value per square mile		$8,608	$9,356	+8.7

[p]Preliminary.
[1]Includes oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

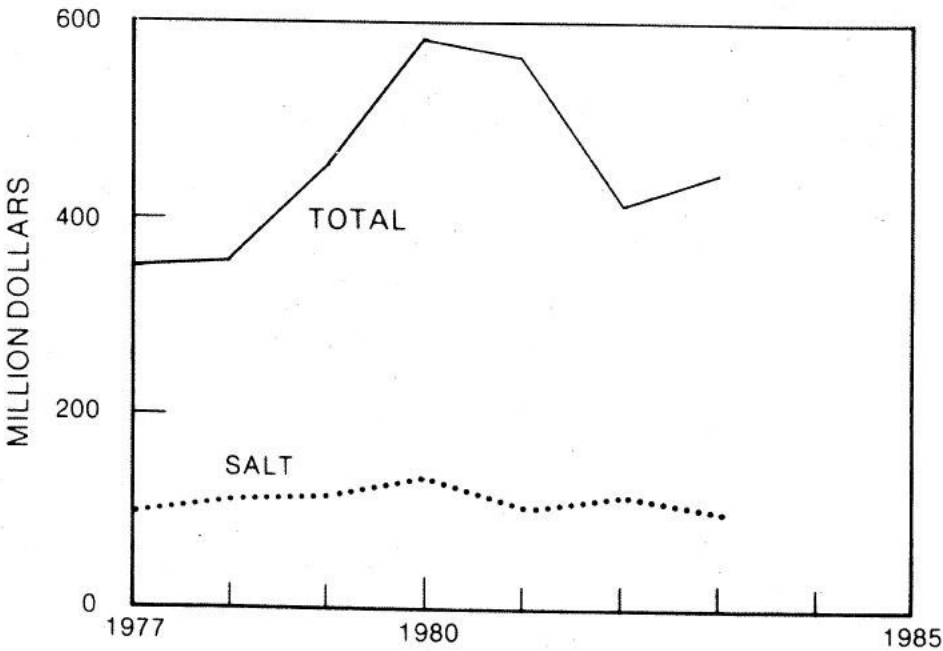

Figure 1.—Value of salt and total value of nonfuel mineral production in Louisiana.

Trends and Developments.—Adverse economic conditions impacted on Louisiana's industries during 1983, with some improvement by yearend. The State's economy entered into the national recession in 1982, later than most States, and emerged from it late in 1983. The unemployment rate in December was 10.1% compared with 11.6% in December 1982; however, employment in mining, stone, and primary metals industries decreased. Manufacturing industries that fared well in 1983 were those strongly affected by construction activity. In 1983, residential construction increased significantly stimulating the stone, clay, and other aggregate industries late in the year.[3]

Severance tax receipts for fiscal year 1983 for nonfuel minerals totaled $2.3 million compared with $3.2 million for fiscal year 1982. Minerals included in the tax were brine, gravel, salt, sand, shells, stone, and sulfur. Severance tax, lease, and royalty income for the 1983 fiscal year provided $1.4 billion to the State, or roughly one-half of all State revenues.

The Louisiana Department of Commerce reported that expansion in 1983 in mining and quarrying of nonmetallic minerals totaled $7.2 million; stone, clays, glass, and concrete totaled $3.9 million; and primary metals totaled $62.3 million.

The New Orleans Customs District led the Nation's customs districts in terms of value of exports, nearly $19 billion in 1983. Shipping activities during the year, however, decreased from that of 1982. Exports of fertilizers, minerals, and metalliferous ores through the Lower Mississippi River decreased from 745,000 short tons in 1982 to 615,000 tons in 1983. Minerals included were abrasives, cement, clays, gypsum, lime, quartz, salt, sand and gravel, and sulfur. Imports of fertilizers, minerals, and metalliferous ores increased from 8.1 million tons in 1982 to 8.3 million tons in 1983. Increases were recorded in bauxite (5.1%), ferroalloys (12.4%), gypsum (42.6%), iron ore (34.2%), and manganese ore (118.5%). Other imports included abrasives, cement, clays, nickel ore, and zinc ore.

Efforts continued to deepen the Mississippi River channel between Baton Rouge and the Gulf of Mexico to 55 feet. Proponents of the proposal contend that deep-draught vessels would increase coal and other mineral exports. Opposition centered on the inability of barges to maintain the channel and possibilities of saltwater intrusion. The Mississippi River Commission, which approves and oversees Corps of Engineers control projects, took no position on the dredging.

Eleven chemical companies agreed to form a joint venture to clean up the abandoned Petro Processors hazardous waste site. The estimated cost to clean up the pits, closed since 1974, was $100 million. The settlement was reached late in the year and avoided a court suit by the Environmental Protection Agency and the Louisiana Department of Natural Resources.

Three shipments of 50% ferrosilicon totaling about 15,000 short tons was imported from the Soviet Union through the Port of New Orleans. These imports were expected to continue with 50,000 tons scheduled to be imported over a 30-month period. Since the 50% ferrosilicon grade is the main product of the already troubled domestic industry, heavy imports of this material would seriously affect the domestic industry's ability to survive.

Georgia-Pacific Corp. planned to build an $80 to $100 million cogeneration facility at its caustic soda and chlorine complex in Plaquemine. The unit will cogenerate 140 megawatts of electricity; the company now purchases 182 megawatts of power from Louisiana Power and Light Co. The facility was expected to be on-stream in 1985.

Electro-Coal Transfer Corp. announced plans to establish a topping-off operation for coal vessels in the Gulf of Mexico. Plans call for the use of ocean-going barges equipped with cranes to transfer the coal. This was the third topping-off proposal announced during the year. In addition, International Marine Terminal completed a $63 million expansion of its coal loading facility south of New Orleans. Capacity was increased from 3.5 to 15.0 million short tons per year.

Toth Aluminum Corp. was expected to begin commercial production of metal chlorides early in 1984 at its plant in Vacherie. The $8.5 million facility would have an initial capacity of 54 million pounds per year with potential to increase to 100 million pounds per year by the end of 1984. The plant will produce silicon chloride, titanium chloride, and aluminum chloride utilizing a kaolin chlorination process. Kaolin was reportedly to be shipped in from Georgia.

The chief of surface mining for the State of Louisiana announced the issuance of the first surface mining permit to Dolet Hills Lignite Surface Mining Co. in De Soto Parish. The 6-million-ton-per-year opera-

tion will mine lignite for the Central Louisiana Electric Co. Inc. in joint venture with South Western Electric Power Co.

Legislation and Government Programs.—Legislation enacted by the Louisiana Legislature in 1983 that could affect the mineral industries was the Louisiana Capital Companies Tax Credit Program. The legislation encourages the development of venture capital companies in the State. Corporate or individual investors in the new capital companies would receive a 20% or 35% tax credit against Louisiana tax liability, based on the amount of capitalization of the companies in which they invest. The capital companies must, in turn, invest 60% of their initial capital in new and developing Louisiana business concerns.

The Governor signed an executive order establishing the Economic Development Advisory Council. The council will develop recommendations for statewide economic development policy objectives; formulate and recommend cost effective productive economic development programs; identify, rank, and address crucial State economic development problems and issues; and recommend legislative initiatives pertaining to economic development.

The Louisiana Geological Survey (LGS) conducted geological research programs to produce information useful in developing the State's natural resources and protecting the environment. Programs were formulated to provide data for use by regulatory offices within the department, industry, academic researchers, and the general public. Expansion of the coastal geology program highlighted LGS activities in 1983. Studies of major peat depositional environments were increased. The assessment of subsidence rates and mechanisms, being carried out as part of the State's $35 million Coastal Protection Program, was a major activity. Along with energy publications, a comprehensive atlas of flood plains and flooding problems was also published. LGS conducted studies of fluvial processes and geomorphology in the parishes east of the Mississippi River and continued ground water investigations in support of the underground injection control program.

The Mining and Mineral Resources and Research Institute at the Louisiana State University in Baton Rouge, which was created under title III of Public Law 95-87, received $150,000 from the U.S. Bureau of Mines in fiscal year 1983 for operations and research.

The U.S. Bureau of Mines Tuscaloosa Research Center conducted preliminary dewatering tests on red muds from a Baton Rouge alumina facility. Since 1981, the U.S. Bureau of Mines has completed mineral assessments on 8,700 acres of wilderness and wilderness suitable lands. Studies were also conducted on methane emissions in a Louisiana domal salt mine to reduce explosion hazards associated with the gas.

The U.S. Bureau of Land Management announced that $637,500 in mineral revenues was given to the State in fiscal year 1983. The Federal Government divides bonuses, rentals, and royalties received from Federal mineral leasing activities on public lands equally with the States in which the minerals occur.

The U.S. Geological Survey (USGS) continued studies in gulf coast lignites and other energy resources during the year. The USGS also conducted several marine geology activities along the gulf coast.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—Imported and domestic barite was crushed and ground at 13 plants for use in oil and gas drilling. China supplied the majority of imported barite shipped through the Port of New Orleans. Demand in the drilling mud market declined to its lowest level in over 5 years. The Bariod Div., NL Industries Inc., placed its grinding plant in Lake Charles in operation early in the year.

Calcium Chloride (Synthetic).—Texas United Chemical Corp. produced calcium chloride from hydrochloric acid and limestone at its plant near Lake Charles. Production and value increased substantially over that of 1982.

Cement.—Lone Star Industries Inc. operated its facilities in New Orleans, which included two wet-process kilns. Most of the output was portland cement with a small amount of masonry cement. Demand increased substantially as residential construction and World's Fair construction increased during the year. Major end uses for portland cement were ready-mix concrete, concrete products, building materials, and highway construction. Prices of portland cement decreased nearly $11 per short ton

from that of 1982.

Lone Star completed a multimillion dollar bulk material handling dock on the Michoud Canal near its plant in New Orleans. The 1,500-short-ton-per-hour facility was constructed to handle imported aragonite and gypsum and domestic coal. The plant, with a reported capacity of 750,000 tons per year, formerly used limestone from Alabama, but now uses aragonite from The Bahamas. In 1983, nearly 1 million tons of aragonite was imported, up from 700,000 tons in 1982. Gypsum was imported from Jamaica with coal coming from domestic sources. The plant was converted from natural gas as the kiln feed to more readily available coal.

Clays.—In 1983, Louisiana's clay industry produced common clay and bentonite. Output and value of both types of clays increased. Common clay was mined by six companies at eight mines in six parishes. End uses of common clay were primarily in manufacturing lightweight aggregates for use in concrete block and structural concrete. An increase in residential construction supplied the stimulus for increased production. Average price of common clay was $20.94 per ton, up from $20.12 per ton in 1982. Harshaw-Filtrol Partnership operated a bentonite mine in Claiborne Parish. Output was used chiefly in clarifying mineral and vegetable oils. Athens Brick Co., Mooringsport, invested $860,000 during the year to upgrade its facilities.

Table 4.—Louisiana: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1979	416	6,073
1980	380	5,841
1981[1]	380	6,338
1982	326	[1]6,216
1983	[1]505	10,793

[1]Excludes bentonite.

Gypsum.—Gypsum and anhydrite were mined by Winn Rock Inc. at its quarry near Winnfield, Winn Parish; output increased as the year progressed, in response to increased construction activity. Unit prices decreased slightly. National Gypsum Co., Jefferson Parish, and United States Gypsum Co., Orleans Parish, produced calcined gypsum from crude material shipped into the State. Calcined gypsum output decreased, while value increased over that of 1982.

Lime.—Production of lime decreased as markets remained weak for much of the year; output was at its lowest level in over 10 years. Both hydrated lime and quicklime output were affected by weak market conditions. U.S. Gypsum continued to produce lime from clam shells at its New Orleans facility. S. I. Lime Co. received quicklime from its parent company operation in Kentucky and converted it to hydrated lime at its plant in Amelia. The product was used in water purification and softening, road stabilization, and sewage and waste treatment.

Perlite (Expanded).—Filter Media Co. of Louisiana expanded perlite from ores shipped into the State. Output increased at its plant in Reserve, St. John the Baptist Parish, and was used as a filter aid, for insulation, and in concrete aggregate.

Salt.—Louisiana maintained its leading position nationally in output of salt with approximately one-third of the Nation's output. Production in 1983, however, dropped to its lowest level in over 15 years. Along with increased imports, most markets for Louisiana salt continued weak resulting in the fifth straight year of declining output. Production decreased 5.2% while value decreased 14.1% from that of 1982. Fourteen companies recovered salt at 17 operations in 11 parishes. Of the operations, five were underground mines with the remainder being solution mines. Sales of evaporated salt declined 24.2% from that of 1982.

Diamond Crystal Salt Co. settled its suit against Texaco Inc. and Wilson Bros. for the 1980 flooding of Diamond Crystal's Jefferson Island salt mine. The $32 million settlement compensated Diamond Crystal for the complete destruction of the mine, including unmined salt and underground machinery and equipment. The surface facilities at Jefferson Island remained in operation on a reduced level utilizing salt from other producers.

Cargill Inc., which operates the Belle Isle Mine near Morgan City, settled its 10-year lawsuit with Cementation of America for $10.5 million. Cargill claimed that Cementation improperly installed concrete lining in a shaft that collapsed in 1973. Cargill operated its facility intermittently during 1983.

Morton Salt Co. closed its hydrochloric acid and sodium sulfate operations at Weeks Island at midyear. Along with declining demand, the age of the plant and declining profitability were cited for the shutdown. Other operations of Morton at Weeks Island were not affected by the

shutdown. Morton sold its entire inventory of salt cake to Chemical Marketing Services, Tulsa.

International Salt Co., Avery Island, shut down its evaporating plant in April. Output from the mine decreased; the product was used in the caustic chlorine industry and for ice control.

PPG Industries Inc. invested $14.4 million in modernizing its facilities at Lake Charles. Areas affected by the modernizing program were the company's precipitated silica operations and one of its two chlorine caustic soda production units.

Sand and Gravel.—Louisiana produced both construction and industrial sand and gravel in 1983. Total sand and gravel was estimated to have decreased for the seventh straight year. The Louisiana Department of Revenue, Severance Tax Division, maintains records for the fiscal year that ends June 30. According to its statistics, total sand and gravel output for the fiscal year ending June 30, 1982, was 19.4 million tons, compared with output for the fiscal year ending June 30, 1983, of 21.6 million tons.

Construction.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

According to estimates, output of construction sand and gravel continued its decline that started in 1977. Many sand and gravel operations operated intermittently during the year, depending on proximity and extent of construction activities. With residential construction increasing and with construction for the World's Fair in New Orleans, output at most operations increased about midyear. According to severance tax statistics, leading producing parishes were St. Helena, Jefferson, St. Tammany, and Washington.

Industrial.—Three companies produced industrial sand in four parishes in 1983, with output decreasing 23.0% and unit value increasing 20.3%. Primary markets in the glass and foundry industries were depressed throughout 1983. The impact of increasing use of plastic containers has adversely affected the glass industry in the area.

Table 5.—Louisiana: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	6,762	$17,635	$2.61	NA	NA	NA
Gravel	8,570	31,261	3.65	NA	NA	NA
Sand and gravel (unprocessed)	1,225	2,070	1.69	NA	NA	NA
Total or average	[1]16,558	50,966	3.08	[e]14,200	[e]$46,600	[e]$3.28
Industrial sand	378	4,590	12.14	291	4,252	14.61
Grand total or average	16,936	55,556	3.28	[e]14,491	[e]50,852	[e]3.51

[e]Estimated. NA Not available.
[1]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Production of crushed stone in Louisiana in 1983 increased 8.6% over that of 1982. Shell accounted for more than 90% of the State's total output and 63% of the national output. Three companies produced shell in Orleans and St. Mary Parishes at five operations. Anhydrite was mined at one quarry in Winn Parish. Crushed stone was used primarily for coarse and fine aggregate, cement manufacture, and lime manufacture. Anhydrite was used basically as a road base, with demand at a low level during the year. Winn Rock, operator of the anhydrite quarry, conducted feasibility studies concerning a possible limestone quarry in Winn Parish. Environmental opposition continued against the companies that dredge coastal Louisiana and Lakes Pontchartrain and Maurepas for shell. Several Corps of Engineer reports revealed a num-

ber of adverse impacts on the environment and the fishing industry from shell dredging. Oyster grounds in five parishes were being monitored for contamination. Dredging continued to be challenged at various levels in State government in attempts to eliminate the shell industry. Several bills attempting to restrict shell dredging were deferred by the Louisiana House Natural Resources Committee, but opposition continued.

Table 6.—Louisiana: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	W	W
Coarse aggregate, graded: Bituminous surface-treatment aggregate	W	W
Coarse and fine aggregate:		
Graded road base or subbase	2,819	13,619
Unpaved road surfacing	1,284	4,199
Other coarse and fine aggregate	W	W
Agricultural: Poultry grit and mineral food	W	W
Chemical and metallurgical:		
Cement manufacture	246	665
Lime manufacture	W	W
Special: Other[2]	1,410	7,219
Total	[3]5,758	25,702

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes shell and miscellaneous stone.
[2]Includes uses not specified and uses indicated by symbol W.
[3]Data do not add to total shown because of independent rounding.

Sulfur.—Louisiana ranked second in the Nation in output of Frasch sulfur, and sixth in recovered elemental sulfur. Sulfur remained the leading nonfuel mineral, valuewise, in Louisiana. Frasch sulfur shipments increased 32.6% while production decreased from that of 1982. Output remained at a relatively low level primarily because of the weakened demand for phosphate fertilizers. Freeport Sulfur Co., with Frasch facilities in Jefferson, Plaquemines, and Terrebonne Parishes, operated at reduced levels to match the weak market demands.

Nine oil companies recovered elemental sulfur from nine refineries in seven parishes. Output was 261,000 metric tons valued at $24.1 million, compared with 232,000 metric tons valued at $25.2 million in 1982.

Table 7.—Louisiana: Sulfur produced and shipped from Frasch mines

(Thousand metric tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1979	2,460	2,858	W
1980	2,309	2,590	W
1981	2,440	2,235	W
1982	1,312	1,239	W
1983	1,286	1,643	W

W Withheld to avoid disclosing company proprietary data.

Vermiculite (Exfoliated).—W. R. Grace & Co. exfoliated vermiculite at its plant in New Orleans, with output decreasing. Principal end uses were in concrete and plaster aggregate, horticulture and loose fill and block insulation.

METALS

Aluminum.—Louisiana remained 1 of 17 States capable of producing aluminum although no production was reported in 1983. Reduced demand nationwide along with reduced prices caused a severe cutback throughout the industry, resulting in a drastic decrease in output. Early in the year Kaiser Aluminum & Chemical Corp. shut down its Chalmette primary refinery, which has nine potlines with a total capacity of 260,000 short tons per year. Kaiser, citing high energy costs of $50 million per year, had generated most of its power utilizing natural gas until 1979. At that time, with reduced availability of natural gas, Kaiser started purchasing power from Louisiana Power & Light Co. With escalating power costs and weak markets, Kaiser announced the shutdown. Late in the year, Kaiser wrote down and charged against profits five of the nine potlines. However, these potlines, with a capacity of 144,000 tons per year, remain installed and potentially available. Company officials, however, believe that at best only a partial restart of the plant would be possible. During negotiations to reopen the plant, workers refused a request for wage and benefit concessions. Kaiser also suspended a modernization program at its Baton Rouge alumina facility.

The $225 million program was scheduled for completion late in 1983. The major section of the plant, the Bayer processing section, was shut down at the end of March 1983. Kaiser's Gramercy alumina plant remained in operation, increasing the operating rate early in the year from 52% to 94% of capacity.

Reynolds Metals Co. purchased the Lake Charles aluminum facility from Consolidated Aluminum Corp. Reynolds acquired the facility for its carbon anode plant, which will be named Lake Charles Carbon Co. The division will produce and market calcined coke and carbon anodes used in the production of primary aluminum. Reynolds had no plans to use the 36,000-ton-per-year aluminum smelter. Modernization of the facility to increase capacity was expected to take 2 years, but initial output of anodes was expected late in 1984. In addition, the aluminum casting facility would be converted to handle scrap aluminum. Total cost reportedly was about $50 million.

Aluminum Co. of America started up its 20-million-pound-per-year activated alumina plant at Videlia. Ormet Corp. operated its alumina plant at Burnside utilizing bauxite from Suriname and Brazil. Ormet operated at reduced capacity during the year, shipping alumina to its refinery at Hannibal, OH. In 1983, the Burnside Port, owned by the Port of Baton Rouge, reported imports of nearly 500,000 tons of bauxite.

Iron and Steel.—Bayou Steel Corp., LaPlace, at midyear proposed a $50 million expansion of its minimill with capacity increasing from 700,000 to 900,000 tons per year. The expansion would add merchant bar, angles, rounds, and channels to its product line. Late in the year, the proposed expansion was delayed indefinitely in favor of a possible purchase of an existing mill. At one time during the year, only one of the two 20-ton furnaces operated, but late in the year, the facility increased output because of increased demand for rebars, merchant bars, and small structural shapes. The facility, in addition to producing light bars and sections, produces forging billets and heavy bars.

Ferrous Foundries.—Iron and steel foundries were not a significant industry in Louisiana. Raw materials consumed included scrap, coal, limestone, and sand, nearly all of which came from sources in the Southeast. The "Directory of Louisiana Manufacturers" listed 11 gray iron foundries, 6 steel foundries, and 1 malleable iron foundry. Of these operations, 7 employed over 100 employees and only 1 employed over 500.

Nickel.—AMAX Inc.'s Port Nickel nickel refinery in Braithwaite was shut down for 2 months during the year. The plant resumed production late in the year at its reported capacity of 80 million pounds of nickel, 47 million pounds of copper, and 100,000 short tons of ammonium sulfate. Cobalt refinery capacity is 2 million pounds, but during the year, cobalt hydroxide was shipped to Canada for refining into powder or electrodes. The plant received a nickel-copper matte from Botswana and Australia. AMAX granted U.S. marketing rights for its by-product ammonium sulfate fertilizer to Superfos America, a U.S. subsidiary of Denmark's Superfos. Imports of nickel matte through the Lower Mississippi decreased from 58,356 tons in 1982 to 54,515 tons in 1983.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, AL.
[2]State geologist, Louisiana Geological Survey, Baton Rouge, LA.
[3]Federal Reserve Bank of Atlanta. Economic Review. Feb. 1984, pp. 48-56.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	Parish
Aluminum:			
Kaiser Aluminum & Chemical Corp	Box 1600 Chalmette, LA 70043	Plant	St. Bernard.
Cement:			
Lone Star Industries Inc	1 Greenwich Plaza Box 5050 Greenwich, CT 06830	do	Orleans.
Clays:			
Big River Industries Inc	Box 66377 Baton Rouge, LA 70806	Mine and plant	Pointe Coupee.
Kentwood Brick & Tile Manufacturing Co. Inc.	Drawer F Kentwood, LA 70444	do	St. Helena.
Gypsum:			
Winn Rock Inc	Box 790 Winnfield, LA 71483	Quarry and plant	Winn.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	Parish
Lime:			
S. I. Lime Co	Suite 204, Three River-chase Office Plaza Birmingham, AL 35244	Plant	St. Mary.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Orleans.
Salt:			
Cargill Inc	Cargill Bldg. Minneapolis, MN 55402	Underground mine	St. Mary.
Diamond Crystal Salt Co	916 Riverside Ave. St. Clair, MI 48079	do	Iberia.
Domtar Chemicals Inc., Shifto Salt Div	4825 N. Scott Shiller Park, IL 60176	do	St. Mary.
The Dow Chemical Co	Midland, MI 48640	Brine wells	Iberville.
International Salt Co	Clarks Summit, PA 18411	Underground mine	Iberia.
Morton Salt Co	110 North Wacker Dr. Chicago, IL 60606	do	Do.
PPG Industries Inc	Box 1000 Lake Charles, LA 70604	Brine and wells	Calcasieu.
Sand and gravel (1982):			
Gifford-Hill & Co. Inc	Box 6615 Shreveport, LA 71136	Dredges, pits, plants.	Jefferson Davis, Rapides, Tangipahoa, Webster.
Louisiana Sand and Gravel Co	Box 963 Baton Rouge, LA 70821	Dredge and plant	St. Helena.
Standard Gravel Co. Inc	Route 7, Box 53 Franklinton, LA 70438	do	St. Tammany and Washington.
Texas Industries Inc	Box 5472 Alexandria, LA 71301	Dredges, pits, plants.	Beauregard, Grant, La Salle, Ouachita, Rapides, St. Tammany, Vernon, Washington.
Stone:			
Crushed:			
Winn Rock Inc	Box 790 Winnfield, LA 71483	Quarry and plant	Winn.
Shell:			
Louisiana Materials Co	Box 8214 New Orleans, LA 70182	Dredge	Orleans.
Pontchartrain Dredging Corp	Box 8005 New Orleans, LA 70182	do	Do.
Radcliff Materials	Box 151 Morgan City, LA 70381	Dredges	Orleans and St. Mary.
Sulfur:			
Native:			
Freeport Minerals Co	200 Park Ave. New York, NY 10166	Frasch process	Jefferson, Plaquemines, Terrebonne.
Recovered:			
Cities Service Oil Co	Box 300 Tulsa, OK 74102	Refinery	Calcasieu.
Exxon Co. U.S.A	Box 551 Baton Rouge, LA 70821	Plant	East Baton Rouge.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	do	Orleans.

The Mineral Industry of Maine

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Maine Geological Survey for collecting information on all nonfuel minerals.

By L. J. Prosser, Jr.,[1] Walter Anderson,[2] and Carolyn Lepage[3]

The value of nonfuel mineral production in Maine in 1983 was $26.4 million, $9 million below the 1982 level and the lowest total reported since 1972. In 1979, Maine recorded an alltime high of $46 million in the value of mineral production and accounted for about 16% of the total value of the six-State New England Region. In 1983, the State's share of New England's mineral sales dropped to 10%.

The decline in value in 1983 compared with 1982 levels reflected a 38% decrease in cement sales. The plant, in Thomaston, is the only cement manufacturing facility in New England. During the year, ownership of the operation changed twice.

Maine's mineral industry also produced clays, garnet, peat, construction sand and gravel, and crushed and dimension stone. Nationally, the State ranked second in garnet production.

Table 1.—Nonfuel mineral production in Maine[1]

Mineral	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
Clays thousand short tons	37	$76	43	$93
Peat do.	r8	r508	W	W
Sand and gravel (construction) do.	6,701	15,118	e4,800	e12,100
Stone (crushed) do.	e1,200	e4,000	848	2,851
Combined value of other nonmetals and value indicated by symbol W	XX	r15,723	XX	11,319
Total	XX	r35,425	XX	26,363

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Maine, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Androscoggin	W	W	Sand and gravel (construction), clays.
Aroostook	$706	$948	Sand and gravel (construction).
Cumberland	W	W	Sand and gravel (construction), clays.
Franklin	138	W	Sand and gravel (construction), garnet.
Hancock	(2)	524	Sand and gravel (construction).
Kennebec	(2)	564	Do.
Knox	W	W	Cement, sand and gravel (construction).
Lincoln	(2)	598	Sand and gravel (construction).
Oxford	(2)	284	Do.
Penobscot	(2)	2,011	Do.
Piscataquis	(2)	284	Do.
Sagadahoc	(2)	W	Do.
Somerset	(2)	1,297	Do.
Waldo	W	W	Do.
Washington	W	716	Peat, sand and gravel (construction).
York	(2)	2,819	Sand and gravel (construction).
Undistributed[3]	23,125	21,380	
Sand and gravel (construction)	e19,400	XX	
Stone (crushed)	XX	e4,000	
Total	43,369	35,425	

e Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]County distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2]Construction sand and gravel was produced; data not available by county.

[3]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

Table 3.—Indicators of Maine business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	512.1	509.7	-0.5
Unemployment	do	55.5	48.1	-13.3
Employment (nonagricultural):				
Mining	do	.1	.1	--
Manufacturing	do	106.3	109.1	+2.6
Contract construction	do	12.7	14.5	+14.2
Transportation and public utilities	do	17.6	17.6	--
Wholesale and retail trade	do	83.5	89.9	+7.7
Finance, insurance, real estate	do	17.3	18.2	+5.2
Services	do	78.2	78.5	+.4
Government	do	85.1	80.9	-4.9
Total nonagricultural employment	do	400.8	408.8	+2.0
Personal income:				
Total	millions	$10,261	$11,021	+7.4
Per capita		$9,031	$9,619	+6.5
Construction activity:				
Number of private and public residential units authorized		3,171	3,755	+18.4
Value of nonresidential construction	millions	$147.2	$162.5	+10.4
Value of State road contract awards	do	$38.1	$45.8	+20.2
Shipments of portland and masonry cement to and within the State	thousand short tons	206	231	+12.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$35.4	$26.4	-25.4
Value per capita, resident population		$31	$23	-25.8
Value per square mile		$1,067	$793	-25.7

pPreliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

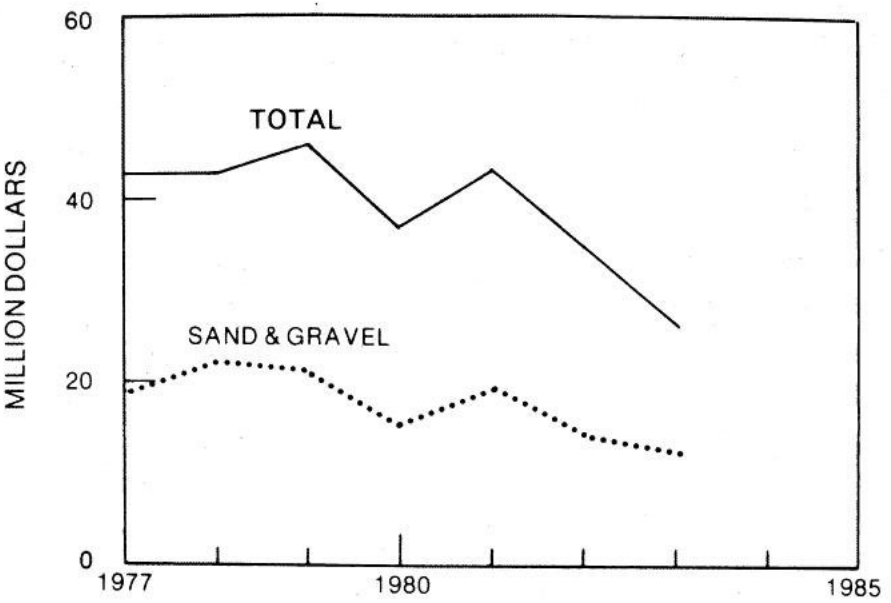

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Maine.

Trends and Developments.—In the past 5 years, the combined output of clays, construction sand and gravel, and crushed stone accounted for 57% of Maine's total value of mineral production. Data on cement, the second leading commodity in value, is proprietary because only one company operates in the State.

Since 1979, production of clays, sand and gravel, and stone dropped by more than 50%. Output in 1983 was also significantly below the 5-year average totals for each of these three commodities.

Commodity	1979		1983		1979-83	
	Production	Value per ton	Production	Value per ton	5-year production	Average value per ton
Clays thousand short tons	90	$1.81	43	$2.16	61	$2.20
Sand and gravel (construction) do	11,022	1.86	4,800	2.52	7,400	2.23
Stone (crushed) do	2,069	3.62	848	3.36	1,324	3.60

In 1979, mineral production in Maine was valued at a record high $45.9 million, of which clays, sand and gravel, and stone accounted for $28.2 million or 61% of the total. In 1983, when mineral output was valued at an 11-year low of $26.4 million; the combined value of these commodities was $15 million or 57% of the total. Based on this data, the combined value of clays, sand and gravel, and stone in relation to the State total value declined 4% in 5 years. However, during this time period, unit prices of sand and gravel and clay increased 35% and 19%, respectively, while stone declined 7%. The change in value per ton of these commodities added about $3 million to the State total.

Also contributing to the decline in Maine's mining sector in 1983 was a 38% drop in cement sales. Ownership of the State's only cement plant changed twice: In March, Cianbro Corp., Pittsfield, purchased

the facilities from Martin Marietta Corp. and resumed limited production; in August, the Passamaquoddy Indian Tribe acquired the operation from Cianbro, which continued to manage and operate the plant under a 15-year lease agreement. The Passamaquoddies bought the plant as part of a long-term plan for investing in the Maine economy using funds received in a 1980 land-claims settlement case with the Federal Government.

Exploration Activities.—Freeport Exploration Co., a division of Freeport McMoRan Inc., announced plans to drill 10 to 20 new holes in 1984 at the 36-million-short-ton copper-zinc deposit discovered in 1977 at Bald Mountain in northern Maine. Freeport Exploration signed an agreement in 1983 with the joint partners of Superior Mining Co. and Louisiana Land & Exploration Co. to become sole owner of the project if the expanded exploration proves the project economically feasible. With copper prices below 80 cents per pound at yearend, potential for development of the deposit was expected to hinge on discovery of higher grades of precious metals previously identified as occurring only in trace amounts.

Getty Mining Co., a subsidiary of Getty Oil Co., announced discovery of a multimetallic ore deposit including copper, lead, zinc, and precious metals north of Patten, Penobscot County. Getty Mining's exploration in that area began around 1980, and the announcement was the first indication that a potentially minable deposit exists. Additional core drilling, sample testing, and other preliminary feasibility studies were scheduled for 1984.

Scintilore Explorations Ltd., Montreal, Canada, purchased additional acreage in Pembroke, increasing its holdings in Washington County to 400 acres. North American Exploration Inc., Kaysville, UT, signed an option to purchase agreement for property also in the vicinity of Pembroke, thereby increasing its holdings in the area to 200 acres. Exploratory drilling for lead, zinc, copper, and silver has been conducted in the Pembroke area by a number of firms since the mid-1960's.

Legislation and Government Programs.—Laws enacted by the State's 111th Legislature relating to mining or mineral processing included Legislative Document 1232, which established and amended air quality standards and established chromium emission standards. The law regulates the emission of hexavalent chromium from fuel-burning equipment, incinerators, or general process sources that handle material containing total aggregate chromium concentration in excess of 500 parts per million by weight. It establishes ambient air quality and emission standards.

Legislative Document 1471 provided continued funding for determination of ground water quality in the State's sand and gravel aquifers. The legislation reauthorized sand and gravel aquifer mapping and identification programs conducted by Maine's Departments of Environmental Protection and Conservation.

Legislative Document 1735 pertained to the identification and hazards of exposure to toxic and hazardous substances. The law authorized the State's Bureau of Labor Standards to adopt rules identifying hazardous substances in the workplace. It required manufacturers of hazardous substances to provide purchasers with information describing health hazards of the substances. Employers were required to conduct training programs during regular working hours on these substances and maintain training records.

In November 1983, Maine voters approved two constitutional amendments updating and clarifying provisions of the excise tax law on the mining of metallic minerals enacted in 1982. As part of the excise tax law, a Mining Excise Tax Trust Fund with a $10 million cap was established. Interest revenues generated from the trust fund were designated for renewable resource projects such as park development, water cleanup, and forest restoration. Principal moneys from the trust fund were also available for these projects with legislative approval. To preclude a simple majority of future lawmakers from spending the trust fund principal for reasons other than the original intent, the new amendment required a two-thirds vote before appropriation.

The second amendment exempted minerals in the ground from valuation as part of the property tax, eliminating the difficulty of placing a value on the potential of mine development. Instead, an excise tax based upon the value or amount of product produced during mining, which was established in the 1982 tax legislation, was to be assessed. Without this amendment, mineral discoveries could conceivably have been taxed, thus discouraging exploration and future mine development.

The Maine Geological Survey's Bedrock and Surficial Geology Division continued

basic geologic mapping in various parts of the State. This work was directed toward the establishment of regional bedrock correlations and completion of reconnaissance surficial mapping for inclusion in two new 1:500,000 geologic maps of Maine. The U.S. Department of Energy (DOE) funded the compilation of these maps as part of the MGS's oversight and review role in the National (High-Level Radioactive) Waste Terminal Storage Program. Both the State maps and an updated "Bibliography of Maine Geology" were scheduled for publication in 1984.

In 1983, the MGS continued crustal warping investigations for the New England Seismotectonic Study with funding from the U.S. Nuclear Regulatory Commission (NRC). This multidisciplinary project found evidence for modern faults in marine sediments by seismic reflection profiling and documented the long-term rate of subsidence and/or sea level rise by coring salt marshes. The Marine Geology Division in addition to conducting the NRC-sponsored seismic reflection profiling began to map offshore sand and gravel deposits by seismic profiling and bottom sampling.

The MGS continued to monitor earthquake activity in cooperation with Weston Observatory and the Maine Bureau of Civil Emergency Preparedness. A map was compiled showing the dates, locations, and magnitude of Maine earthquakes during the period of 1975-83.

The MGS completed the final year of the Maine Peat Resource Evaluation Program funded by DOE. A total of 21 deposits in southern Penobscot County were surveyed to determine estimated peat resources and to collect samples for laboratory analysis. The results of the program, which also included investigations of accumulation rates, surface vegetation, hydrology, and geochemistry of selected peat deposits, were scheduled for publication in 1984.

The Hydrogeology Division, in cooperation with the Maine Department of Environmental Protection and the U.S. Geological Survey (USGS), conducted the third year of a planned 8-year assessment of the geometry, yield, and water quality of significant aquifers. Other cooperative projects with the USGS included a comparative hydrologic analysis of an undisturbed peat deposit and one from which peat is being extracted, and initiation of an interstate aquifer study of the upper Saco River Valley. Mapping of freshwater wetlands in organized townships was completed in 1983.

During 1983, the MGS released 13 open-file maps and reports. The Cartographic Division spent most of 1983 preparing the new 1:500,000 State bedrock and surficial geologic maps for color printing. Black and white open-file versions of these maps will be available in early 1984. Additional information may be obtained from the Maine Geological Survey, State House Station No. 22, Augusta, ME 04333, telephone 207-289-2801.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Production at the State's only cement plant in Thomaston resumed in March following purchase of the operation by Cianbro from Martin Marietta for about $10 million. Subsequently, the plant was bought by the Passamaquoddy Indians with a leaseback agreement in which Cianbro continued operation and management of the facility.

In 1983, shipments of portland cement declined 38% and masonry cement 44% compared with that of 1982. Future production at the 400,000-short-ton-per-year coal-fired, wet-process plant was estimated at 200,000 tons based on 1983 demand.[4]

Clays.—Output increased about 6,000 tons in 1983 compared with 1982 production of 37,000 tons. Morin Brick Co., with pits in Androscoggin and Cumberland Counties, and Royal River Brick Co. Inc., with a pit in Cumberland County, accounted for all the production. The clay was used to manufacture brick and was marketed primarily in-state. In 1983, mining of clay for use in cement manufacture in Knox County was discontinued.

Garnet.—Maine ranked second nationally in garnet production. Industrial Garnet Extractives Inc. (IGE), West Paris, was one of the four garnet producers in the United States; two companies mined garnet in New York, and another, in Idaho. In 1983, the United States again accounted for about 75% of the world's garnet output. Individual company and State data are proprietary; total garnet sold or used by domestic producers for the past 5 years is given below.

Year	Quantity (short tons)	Value (thousands)
1979	23,303	$4,647
1980	26,550	4,934
1981	25,519	5,204
1982	26,660	5,549
1983	28,902	5,816

In 1983, IGE reported a significant increase in production; shipments have increased each year since the company began operations in 1979. Completion of a mill modernization and expansion project, along with improved demand, contributed to IGE's strong performance in 1983.

IGE mined garnet at its quarry in Rangeley, Franklin County, about 65 miles from the West Paris mill in Oxford County. After processing, the garnet was marketed as a nonskid, wear-resistant, surface coating. A garnet containing utility grit was sold for use in sandblasting and water filtration.

Gem Stones.—Maine ranked fourth nationally in the value of gem stones and mineral specimens sold commercially.

Peat.—In 1983, three companies—one in Waldo County and two in Washington County—mined peat. Peat production and value data are proprietary.

In 1982, two companies—United States Peat Co. and Signal Cleanfuels Inc. (formerly Wheelabrator-Frye Inc.)— announced plans to mine peat, which was expected to add significantly to the State's output. However, U.S. Peat's plans to mine the Saco Heath in York County were delayed when the firm was unable to establish that a peat mining permit acquired with purchase of the bog remained valid for the scale of operation intended. As a result, the firm was expected to submit a reclamation plan, financial and technical capability statements, and an environmentally sound mining plan for review by the Department of Environmental Protection.

Signal planned to mine the Sunkhaze and Chemo Bogs in Penobscot County. The $90 million project involved processing peat for use as a heating fuel and was contingent upon receiving financial assistance and price supports from the U.S. Synthetic Fuels Corp. The project received preliminary approval in June, but attempts to cut the Synthetic Fuels Corp. funding in the U.S. Congress left the project on hold at yearend.

Perlite (Expanded).—Chemrock Corp. expanded perlite at Rockland, Knox County. Crude perlite shipped by rail from New Mexico was expanded and sold for use as a filter aid. Maine was one of two New England States that produced expanded perlite in 1983; Massachusetts was the other.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel production in Maine in the 1980's continued on a downward trend. Estimated production in 1983 decreased by 1.9 million tons or about 28% compared with that of 1982. The 4.8 million tons produced in 1983 represented the lowest output since 1950. Average annual production of construction sand and gravel in Maine in the 1960's was 13 million tons; in the 1970's, 10.9 million tons; and in the first 4 years of the 1980's, 6.5 million tons. The past 5 years' totals are given below:

Year	Quantity (thousand short tons)	Value (thousands)	Value per ton
1979	11,022	$20,534	$1.86
1980	6,978	15,434	2.21
1981[e]	7,500	19,400	2.59
1982	6,701	15,118	2.26
1983[e]	4,800	12,100	2.52

[e]Estimated.

Historically, sand and gravel production was reported from all 16 counties in the State. During the past few years, leading counties in output were Cumberland, Penobscot, and York.

Table 4.—Maine: Construction sand and gravel sold or used by producers

	1982			1983[e]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	2,762	$6,360	$2.30	NA	NA	NA
Gravel	2,498	6,524	2.61	NA	NA	NA
Sand and gravel (unprocessed)	1,442	2,234	1.55	NA	NA	NA
Total or average	[1]6,701	15,118	2.26	4,800	$12,100	$2.52

[e]Estimated. NA Not available.
[1]Data do not add to total shown because of independent rounding.

No industrial sand was mined in Maine.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. The data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Production dropped below 1 million tons in 1983 for the first time in 20 years and was the lowest total reported since 1959. Output of 848,000 tons in 1983, a 28% decline compared with that of 1982, reflected the 38% drop in cement shipments at the State's only plant. Traditionally, cement manufacturing has been one of the leading uses of stone in Maine. Since 1981, the amount of the total stone production in Maine for use in cement manufacture decreased 63% compared with 1983 data.

Types of stone mined in the State in 1983 were limestone, sandstone, traprock, and marl. Limestone was produced at one quarry in Aroostook County, one in Kennebec County, and three in Knox County. Sandstone was quarried at two sites and traprock at one site in Cumberland County. Marl was produced at one quarry in Aroostook County.

Dimension.—Mining of dimension stone was resumed at two quarries in 1983. New England Stone Industries Inc. reopened the Crotch Island granite quarry near Stonington, Hancock County. After quarrying, the pink granite was trucked to New England Stone's cutting and polishing facilities in Smithfield, RI. Maine-New Hampshire Granite Corp. reopened the Jonesboro red granite quarry in Washington County.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.
[2]State geologist and Director, Maine Geological Survey, Augusta, ME.
[3]Geologist, Maine Geological Survey, Augusta, ME.
[4]Rock Products. Apr. 1983, pp. 13-14.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Cianbro Dragon Cement Co.[1]	Thomaston, ME 04861	Quarry and plant	Knox.
Clays:			
Morin Brick Co	Mosher Rd. Gorham, ME 04038	Pits and mills	Androscoggin and Cumberland.
Royal River Brick Co. Inc	Box 458 Gray, ME 04039	Pit and mill	Cumberland.
Garnet:			
Industrial Garnet Extractives Inc	Box 56A West Paris, ME 04289	Mill	Oxford.
		Quarry	Franklin.
Peat:			
Deer Hill Farms Inc	Weeks Mills, ME 04361	Bog and plant	Waldo.
Down East Peat Co	Star Route Deblois, ME 04622	do	Washington.
Pioneer Peat Moss Co	Columbia Falls, ME 04623	do	Do.
Perlite (expanded):			
Chemrock Corp	End of Osage St. Nashville, TN 37208	Plant	Knox.
Sand and gravel (construction):			
Cianbro Corp	Box D Pittsfield, ME 04967	Pits and plants	Androscoggin, Franklin, Hancock, Oxford, Penobscot, Somerset.
Harry C. Crooker & Sons Inc	R.F.D. 4, Old Bath Rd. Brunswick, ME 04011	do	Lincoln and Sagadahoc.
Genest Concrete Works Inc	Wilson St. Sanford, ME 04073	Pit and plant	York.
Maine Department of Transportation.	Augusta, ME 04333	Pits and plants	Androscoggin, Aroostook, Franklin, Hancock, Oxford, Penobscot, Somerset, Waldo, Washington.
Tilcon Inc	Box 209 Fairfield, ME 04937	do	Cumberland, Penobscot, Somerset, York.
Stone:			
Crushed:			
Blue Rock Industries	58 Main St. Westbrook, ME 04092	Quarries and mill	Cumberland and Kennebec.
The Cook Concrete Co	960 Ocean Ave. Portland, ME 04103	Quarry and mill	Cumberland.
Lane Construction Corp	Box 627 Presque Isle, ME 04769	Quarry	Aroostook.
Lime Products Corp	Box 357 Union, ME 04862	Quarries and mill	Knox.
Dimension:			
Maine-New Hampshire Granite Corp.	Box 207 Milford, NH 03055	Quarry	Washington.
New England Stone Industries Inc.	Providence Pike Smithfield, RI 02917	do	Hancock.

[1]Also stone.

The Mineral Industry of Maryland

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Maryland Geological Survey for collecting information on all nonfuel minerals.

By William A. Bonin[1]

Maryland's nonfuel mineral production was valued at $199.4 million in 1983, a dramatic $27.9 million increase from that of 1982. Mineral commodity sales, which increased for the first time in the past 4 years, were 16% over 1982 levels and 3% over the alltime high of $193 million reported in 1979. Production included crushed stone and cement, which led the increases, and construction sand and gravel, slag, common clay and shale, dimension stone, and lime. Also produced were ball clay, industrial sand, and peat. Alumina, copper anode, and iron ore concentrate were shipped into the State for the production of metals. Gypsum and vermiculite shipments were received for further processing. Titanium dioxide pigments were also manufactured.

Table 1.—Nonfuel mineral production in Maryland[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2]	thousand short tons	405	$1,346	484	$1,747
Gem stones		NA	2	NA	2
Lime	thousand short tons	7	396	7	383
Peat	do.	r4	rW	4	W
Sand and gravel (construction)	do.	9,720	32,386	e10,600	e37,800
Stone:					
Crushed	do.	e15,100	e73,500	19,284	80,429
Dimension	do.	e32	e1,001	12	682
Combined value of cement, clays (ball clay), and values indicated by symbol W		XX	r62,891	XX	78,366
Total		XX	r171,522	XX	199,409

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes ball clay; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Maryland, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Allegany	W	[2]	
Anne Arundel	[3]	$7,485	Sand and gravel (construction).
Baltimore[4]	W	W	Sand and gravel (construction), clays.
Caroline	[3]	--	
Carroll	W	W	Cement, clays.
Cecil	W	W	Sand and gravel (construction).
Charles	[3]	4,816	Do.
Dorchester	[3]	W	Do.
Frederick	W	W	Cement, clays, lime, sand and gravel (construction).
Garrett	W	W	Sand and gravel (construction), peat.
Harford	W	509	Do.
Howard	W	[2]	
Kent	$27	23	Clays.
Montgomery	10,469	[2]	
Prince Georges	196	7,559	Sand and gravel (construction), clays.
Queen Annes	W	[2]	
St. Marys	[3]	376	Sand and gravel (construction).
Washington	W	W	Cement, clays.
Wicomico	[3]	W	Sand and gravel (construction).
Worcester	[3]	1,168	Do.
Undistributed[5]	132,963	75,081	
Sand and gravel (construction)	[e]31,800	XX	
Stone:			
Crushed	XX	[e]73,500	
Dimension	XX	[e]1,001	
Total	175,455	[6]171,522	

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Calvert, Somerset, and Talbot Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981), and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Stone, either crushed or dimension, was produced; data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes Baltimore City.

[5]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[6]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Maryland business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,165.8	2,200.8	+1.6
Unemployment	do	190.7	149.0	-21.9
Employment (nonagricultural):				
Mining[1]	do	1.7	1.2	-29.4
Manufacturing	do	207.7	212.7	+2.4
Contract construction	do	83.7	91.2	+9.0
Transportation and public utilities	do	84.8	86.0	+1.4
Wholesale and retail trade	do	397.3	416.4	+4.8
Finance, insurance, real estate	do	95.4	95.6	+.2
Services	do	386.4	398.9	+3.2
Government	do	389.8	385.5	-1.1
Total nonagricultural employment[1]	do	1,646.8	1,687.5	+2.5
Personal income:				
Total	millions	$52,243	$55,934	+7.1
Per capita		$12,237	$12,994	+6.2
Construction activity:				
Number of private and public residential units authorized		21,085	37,530	+78.0
Value of nonresidential construction	millions	$918.5	$947.0	+3.1
Value of State road contract awards	do	$219.9	$250.1	+13.7
Shipments of portland and masonry cement to and within the State	thousand short tons	1,158	1,379	+19.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$171.5	$199.4	+16.3
Value per capita, resident population		$40	$46	+15.0
Value per square mile		$16,210	$19,064	+17.6

[p]Preliminary.

[1]Includes bituminous coal and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Trends and Developments.—The trend in the overall State economy, like that of the Nation, has been upward since the December 1982 bottoming of the 1981-82 recession. In Maryland, the number of private and public residential units authorized increased by 78%, while in the United States that indicator increased by 59%. In the area of private nonresidential construction, Maryland's value increased by $28.5 million (+3%), while that value across the Nation increased by 8%. Also significant were the increases in the value of State road contract awards and the shipments of cement to and within the State of Maryland, up 14% and 19%, respectively. And while total unemployment dropped by 22%, employment in contract construction increased by 9%.

After 4 years of economic recession, the producers and processors of the State's industrial minerals, whose fortunes are tied to residential, heavy, and highway construction, rebounded in all areas except for lime production and dimension stone.

Production of crushed stone increased by 28%. Portland cement shipments increased 27%, and masonry cement shipments climbed by 28%, while value soared by 80%. The production of common clay and shale and construction sand and gravel increased 20% and 9%, respectively. Lime production remained essentially unchanged from 1982 levels, while dimension stone fell by 62%.

Shipments of wallboard, like those of cement, extend well beyond the borders of Maryland, as shown by the 17% increase in the value of Maryland calcined gypsum for the manufacture of wallboard. In 1983, the Atlantic region experienced the largest gain in the consumption of portland and masonry cement, and the leading sales region for wallboard products was the South Atlantic region. Parts of these regions comprise the marketing area of Maryland's four cement plants and its wallboard manufacturer.

The economic recovery in 1983 helped some of Maryland's industrial mineral producers more than others. Uncertainties regarding the economy continued to discourage some buyers and developers, and a number of potential property sales in Maryland were delayed by sewer moratoriums and building restrictions.

The Arundel Corp. completed two unusually large supply contracts for construction material in early 1983—stone for the Hart and Miller Island Project and concrete for the Fort McHenry Tunnel. The dike disposal area to confine material dredged from Baltimore Harbor and the access channel required over 300,000 tons of riprap and 100,000 tons of smaller stone. The tunnel required 500,000 cubic yards of concrete and over 2,000,000 tons of aggregate. Increased construction activity on the Eastern Shore of Maryland offset in part the completion of the large supply contracts.

During the recovery of 1983, primary metal producers in Maryland only managed to cut their losses. In 1983, the State's work force in the primary metals sector declined 16% from that of 1982. About 4,000 employees were idled in 1983. This sector lost 4,200 jobs in 1982. Employment in the fabricated metals sector fell by 5.5% for the same period, with 500 workers losing jobs. In 1982, 1,500 fabricated metal workers were idled.

Despite the general economic recovery in 1983, steel consumption in the capital goods markets of machinery, nonresidential construction, rail transportation, shipbuilding, and oil and gas remained severely depressed, even below 1982 steel consumption levels. Demand in the automotive and other consumer durable markets increased during the year, and several of the capital goods markets showed signs of recovery during the latter part of the year. Bethlehem Steel Corp. managed to cut its operating losses from $312 million in 1982 to $81 million in 1983 in basic steel operations, and from $48 million in 1982 to $21 million in 1983 in fabricating and other steel operations. At Bethlehem Steel's Sparrows Point facility, pig iron production was down 37% from the level of 1981 and 11% below that of 1982.

The depressed state of the domestic copper industry continued in 1983, as the excess world supply of copper continued and imports of refined copper increased. Kennecott Refining Corp., which operates a copper refinery and rod mill at Curtis Bay, cut its total company losses from $189 million in 1982 to $91 million in 1983. For Kennecott's refinery in Anne Arundel County, which had been operating on a reduced work schedule since January, poor copper demand and unstable feed suppliers led to closing the refinery in mid-July. The refinery had depended heavily on blister from the company's Ray Mines Division smelter in Hayden, AZ, which had been shut since May 1982. This recently modernized cast rod mill was kept open at a sharply reduced rate in order to meet customer demand.

In primary metals production, one of the most positive responses to the general economic recovery came from the aluminum industry, as apparent total consumption increased significantly in 1983 compared to the previous 3 years. Potlines, which continued to be closed in the first quarter, were restarted as the building and transportation industries recovered and the packaging industry demand remained high. At the Eastalco Aluminum Co. in Frederick, the production rate on July 1 had dropped to 132,000 tons per year, the lowest level since 1976. By yearend, the plant was operating at 90% capacity and full production levels were anticipated in early 1984. Production in 1983 was 7% below 1982 levels and about 22% below the production levels of 1979-81.

Legislation and Government Programs.—The Maryland Geological Survey, an agency of the Department of Natural Resources, conducted applied research in the fields of geology, minerals, water resources, and archeology. Survey expenditures of $1.9 million in fiscal year 1983 were 5.6% over 1982 levels. Of this total, 67% was State general funds, 19% was special funds, 4.5% was Federal funds, and 9.5% was reimbursable funds. The mineral resources aspects of the program include mapping of present and potential resources and mined land, minerals zoning, and monitoring the current extraction of minerals. A booklet, "Building Stones of Maryland," and a leaflet, "Gold in Maryland," were published by the Survey. Maps showing lands for potential mineral resources development for the six western counties were published through a grant from the U.S. Geological Survey. Of further interest to the State's nonfuel minerals industry were studies to be initiated in 1984: geomorphic studies on the Marlboro clay of the Coastal Plain Province and commodity studies on mineral resources statewide. Work on the Marlboro clay and the commodity studies of sand and gravel and carbonate rocks will be completed prior to 1989.

The Avondale Research Center, 1 of 10 U.S. Bureau of Mines research facilities, is located near Washington, DC, in Prince Georges County. Technology developed at the Center was recently proved effective in protecting turbine blades against premature failure due to a lack of erosion resistance. The Bureau's titanium diboride coatings, second only to diamonds in hardness, were produced by electrodeposition techniques.

Foreign Oceanborne Commerce.—The Port of Baltimore experienced an almost record year in the important shipping category of container traffic, while having one of its worst years in the export of coal and grains, down 41.5% and 52.7%, respectively, from 1982 levels. The worldwide demand for coal has diminished, and the flow of grain from the United States, as a whole, to export markets greatly decreased during 1983. About 47,000 tons of coke (including petroleum coke, pitch, and asphalt) was exported in 1983, down 11.3% from 1982 levels. Import trade in fertilizer and fertilizer materials totaled 265,042 tons, up 42.1% from 1982. Less than 5,000 tons was exported.

Import trade of nonfuel mineral commodities in 1983 included iron ore, manganese ore, miscellaneous ores and concentrates (including chrome ore), ferroalloys, salt, gypsum, bauxite, and clay. Of these, manganese ore, ferroalloys, gypsum, and bauxite increased from 1982 levels. The import trade of mineral commodities in short tons at the Port of Baltimore since 1981, as published by the Maryland Port Administration, was as follows:

Commodity	1981	1982	Change, percent	1983	Change, percent
Iron ore	6,070,999	3,889,854	-35.9	3,425,721	-11.9
Manganese ore	89,234	27,238	-69.5	30,660	+12.6
Miscellaneous ores and concentrates, including chrome	180,411	136,312	-24.4	64,349	-52.8
Ferroalloys	--	86,267	--	147,776	+71.3
Salt	136,388	258,721	+89.7	215,333	-16.8
Gypsum	603,112	519,386	-13.9	592,964	+14.2
Bauxite	183,968	128,971	-29.9	316,519	+145.4
Clays	--	19,466	--	18,636	-4.3
Residual fuel oil	1,135,725	922,518	-18.8	592,085	-35.8
Petroleum, crude and partly refined	751,086	556,238	-25.9	185,651	-66.6
Miscellaneous petroleum products	226,854	93,698	-58.7	307,838	+228.5

There continued to be no export trade in mineral commodities.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Lehigh Portland Cement Co. at Union Bridge and Lone Star Cement Inc. at Hagerstown produced both portland and masonry cement. Coplay Cement Co. at Lime Kiln continued to produce only portland cement. In November 1982, Genstar Stone Products Co. discontinued its grinding operation and the manufacture of masonry cement at its ready-mix concrete plant in Frederick. From 1982 to 1983, portland cement shipments increased 27% and value increased 21%. Concurrently, masonry cement shipments increased 28% while value soared by 80%. In spite of these gains, Atlantic Cement Co. Inc. continued to experience weak demand for slag cement produced at its new Sparrows Point plant.

Clays and Shale.—Common clay and shale were mined by five companies at seven pits in Carroll, Frederick, Prince Georges, and Washington Counties for the production of expanded shale, and the manufacture of face and common bricks and portland cement. Production totaled 484,000 tons, up 19.5% from 1982 levels. Value increased to $1.7 million, up 30% from $1.3 million in 1982. Recovery of the construction industry during the year spurred the impressive gains in the production of common clay and shale. The Chestertown Brick Co. Inc. in Kent County, which discontinued brick manufacturing operations in August 1982 owing to weak demand and high energy costs, remained idle throughout 1983. The company had manufactured face brick.

During the year, Kaiser Aluminum & Chemical Corp. was selling its refractory plant in Frostburg. The clay and high-alumina plant had been serving as a distribution point for the company's eastern markets.

Ball clay was produced by Cyprus Industrial Minerals Co. at its operation 5 miles northeast of Baltimore on Route 46. Major end uses of the ball clay were in the manufacture of floor and wall tiles, ceramics, and sanitary ware. Maryland is one of six ball clay producing States. Recovery of the housing industry during 1983 aided impressive gains in ball clay production.

Gypsum (Calcined).—Crude gypsum imported from Nova Scotia and New Brunswick, Canada, was calcined by both National Gypsum Co. and United States Gypsum Co. at facilities in Baltimore for manufacture of wallboard. Production increased 6% over 1982 levels, while value increased 17%. SCM Corp., Glidden Pigments Group plant in Baltimore, produced byproduct gypsum from the neutralization of waste sulfuric acid effluent water resulting from its production of titanium dioxide pigments. In 1983, for the second year, the U.S. Gypsum plant blended into its flow sheet considerable quantities of this chemical gypsum in its manufacture of wallboard. Although this technology has been available and in use in Japan and Europe, U.S. wallboard producers have been reluctant to upset their materials handling equipment with such a high-moisture chemical precipitate.

Lime.—S. W. Barrick & Sons Inc. at its Woodsboro plant in Frederick County produced industrial and agricultural lime as well as crushed limestone. Production and value of lime remained essentially unchanged over 1982 levels at 7,000 short tons and $383,000. Both quicklime and hydrated lime were produced. The hydrate comprised 55% of production and 70% of value. Barrick is the State's only producer.

Peat.—Garrett County Processing & Packaging Corp. mined reed-sedge and humus peat near the town of Accident in the western corner of the State. About 85% of the peat was sold in bulk for agricultural purposes. The remainder was packaged and sold as a soil conditioner under the trade name "Free State Peat." Garrett is the State's sole producer of peat. In May, the company made the top bid for an additional bog at an estate auction. It paid $275,000 for the 470 acres, which contains the 75-acre bog. Only the peat company and the Nature Conservancy were in the bidding after the last coal company dropped out at $200,000.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

Based on these preliminary estimates, production increased 9% while value increased 17% over 1982 levels. These increases compare favorably with U.S. totals, where production and value increased 10% and 16%, respectively.

Within the construction sand and gravel industry, the following were noteworthy developments in 1983:

In Cecil County, York Building Products

Co. Inc. sought approval to mine sand and gravel from beneath Racine School Road and an adjacent 300-acre property south of Racine School Road on Elk Neck while 2,500 feet of the roadway is temporarily relocated. Approval was sought by way of a modification to a special exception that York was granted in April 1981 to mine 607 acres on the north side of Racine School Road. York began mining that property in the fall of 1982 after the Maryland Court of Special Appeals had affirmed the Cecil County Board of Appeals decision. York proposed to shift Racine School Road 300 feet south while the materials are mined. Once mining is completed, that portion of the road would be replaced to its original position and repaved at York's expense. The roadway would be lowered an average of 15 feet and nearly 30 feet in some spots. York is one of Maryland's principal producers of sand and gravel.

In Charles County, B. F. Asher Co. Inc., a sand and gravel producer, wanted its load limit increased from 30 to 50 loads per day and its workday increased by 1-1/2 hours to meet increased orders for construction materials. Asher also requested a special zoning exception to mine sand and gravel on a 19-acre portion of its 113-acre tract fronting on Oaks Road. Both requests were opposed by the Oaks Road Citizen Association.

Industrial.—Harford Sands Inc., the State's sole producer of industrial sands, continued operations in Magnolia.

Table 4.—Maryland: Construction sand and gravel sold or used by producers

	1982			1983[e]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	5,517	$18,977	$3.44	NA	NA	NA
Gravel	3,224	11,330	3.51	NA	NA	NA
Sand and gravel (unprocessed)	979	2,079	2.12	NA	NA	NA
Total or average	9,720	32,386	3.33	10,600	$37,800	$3.57

[e]Estimated. NA Not available.

Slag, Iron and Steel.—The Maryland Slag Co., a wholly owned subsidiary of Arundel, operated under an agreement with Bethlehem Steel at Bethlehem Steel's Sparrows Point Plant. Maryland Slag received molten iron slag from Bethlehem Steel's blast furnaces and then processed and marketed this slag in the form of construction aggregates. In recent years, the amount of blast furnace slag recovered by Maryland Slag declined substantially due to a reduction in the production of slag available to the company and to cutbacks in steel production. Since March 1982, the slag produced at Bethlehem Steel's Giant "L" blast furnace has gone directly to the new 800,000-ton-per-year water-granulated slag cement plant of Atlantic Cement. As a replacement for cement, ground-granulated blast furnace slag offers a savings in the energy required to manufacture cement clinker. Compared to 1981 and 1982 figures, production of iron slag remained essentially unchanged. However, when compared to 1982, value increased by 170%.

In 1983, Arundel entered into an agreement to serve as exclusive distributor in the marketing of steel slag processed by C. J. Langenfelder & Sons Inc. at Bethlehem Steel's Sparrows Point Plant.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—In 1983, 20 companies operated 29 quarries in 10 of Maryland's 23 counties and produced 19.3 million tons of crushed stone valued at $80.4 million. Production increased by 4.2 million tons (28%) from that of 1982, while value increased by $6.9 million (9.4%). The average value per ton fell by 70 cents to $4.17. At 5.6 million tons, Baltimore County was the leading producer in Maryland. Over 90% of shipments were by truck, 3.5% were by waterway from Harford County, and a small amount was shipped by rail from Washington County. A total of 60% of the material was crushed from marble and metalimestone, 20% was from limestone, 10% was from granites and gneiss, and 10% was from sandstone, traprock, quartzite, and other

metamorphic rock types. C. J. Langenfelder & Sons crushed oystershells dredged from Chesapeake Bay for use as aggregate and poultry grit.

Genstar, the States's largest producer of crushed stone and 1 of the top 10 U.S. producers, completed installation of a new $12 million processing plant at its Frederick limestone quarry that will increase capacity from 450 tons to 1,000 tons per hour. The new plant uses a computerized process control system.

Genstar also operates a white calcite quarry at Texas some 15 miles north of Baltimore. The quarry is located within a mile-wide band of the Cockeysville marble. The layered marble member is mined by surface and underground methods and is processed on-site for its high-purity calcium carbonate. The product lines for application as fillers are marketed throughout the Eastern United States and Canada. Approximately 30% of production goes into paint and coatings, 40% into a variety of plastic end uses, and 30% into paper coatings, caulks and sealants, adhesives, and miscellaneous uses. Genstar recently introduced new grades of specialty-type products aimed at specific end uses—stearate-coated grades for the plastics industry and an ultrafine product for the paint and paper industries. Genstar, in a joint venture with Anglo-American Corp., processes and markets the ultrafines from the zone of high-purity, white calcite marble.

Another Maryland crushed stone producer, D. M. Stoltzfus & Son, has upgraded crushing and processing capacity. At the 300-ton-per-hour Conowingo plant in Harford County, the production crew can meet State specifications for materials up to 1-1/2-inch maximum size simply by changing deck panels in a parallel three-deck final screening station. Limestone is drawn from a 100-acre quarry on the Pennsylvania State line. In addition to the immediate 40-mile market area, the product is shipped to Virginia, New Jersey, and Delaware. The Conowingo facility, on-line since March 1979, is one of six corporate plants in operation.

Table 5.—Maryland: Crushed stone[1] sold or used by producers, in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	1,929	6,106
Riprap and jetty stone	396	1,828
Coarse aggregate, graded:		
Concrete aggregate, coarse	2,921	10,223
Bituminous aggregate, coarse	2,210	9,304
Bituminous surface treatment aggregate	307	1,322
Railroad ballast	66	233
Fine aggregate (-3/8 inch):		
Stone sand, concrete	156	1,044
Stone sand, bituminous mix or seal	667	2,325
Coarse and fine aggregate:		
Graded road base or subbase	1,833	8,094
Unpaved road surfacing	4,169	19,512
Crusher run or fill or waste	1,243	3,842
Chemical and metallurgical:		
Cement manufacture	2,275	4,351
Lime manufacture	14	53
Special: Other[2]	1,099	12,190
Total[3]	19,284	80,429

[1]Includes marble, metalimestone, granite, gneiss, sandstone, quartzite, shell, traprock, and miscellaneous stone.
[2]Includes agricultural limestone, other agricultural uses, poultry grit and mineral food, filter stone, flux stone, mine dusting or acid water treatment, asphalt fillers or extenders, whiting or whiting substitute, other fillers or extenders, screening (undesignated), and uses not specified.
[3]Data do not add to totals shown because of independent rounding.

Dimension.—In 1983, eight companies operating eight separate quarries produced 12,193 tons of dimension stone valued at $682,000. Production fell 62% from 1982 levels, while value decreased 32%. Irregular shaped stone, cut stone, rough blocks, flagging, and a small amount of house stone veneer were produced. Of the total production, 70% was granite gneiss and 30% was quartzite and sandstone. Granite gneiss was produced in Montgomery County, quartzite was produced in Baltimore and Howard Counties, and a small amount of sandstone was produced in Garrett County.

Vermiculite (Exfoliated).—The Construction Products Div. of W. R. Grace & Co. at Muirkirk in Prince Georges County exfoliated South Carolina-mined vermiculite. Most of the production was used in insulating fill and Monokote fireproofing. Sales value increased 3% from that of 1982.

METALS

Aluminum.—In August, Alumax Inc. purchased the assets of Howmet Aluminum Corp. The acquisition gave Alumax full ownership of Eastalco in Frederick. At midyear, production of primary aluminum at Eastalco had dropped to 75% of capacity, the lowest level since 1976. By yearend, however, production had climbed to 90%, 960 employees were working full-time, and none were on layoff. Normal production at full capacity is 176,000 short tons annually.

Kaiser discontinued production at its heavy-press extrusion plant in Halethorpe at yearend. The plant was closed because its costs were not competitive with those of other hard alloy extrusion plants. The company could not reach agreement with the union on contract modifications regarding wage and benefit concessions. The plant's 75 hourly workers were laid off, and its 35 salaried workers had their jobs terminated or were transferred. The Halethorpe facility supplied aluminum extruded materials to the aircraft, aerospace, and transportation industries. Kaiser's remaining extrusion plants are located in Dolton, IL, Newark, OH, Los Angeles, CA, Sherman, TX, and Toronto, Canada. In June 1983, Kaiser closed its Woodbury, NY, extrusion plant.

An aluminum beverage bottle, a new type of recyclable container, was manufactured on a pilot line in Baltimore. The container is resealable and can be filled by conventional bottling machinery.

Copper.—Refining operations at Kennecott, Curtis Bay, were shut down at midyear because of depressed copper industry conditions and a lack of raw material availability. About 175 hourly and salaried workers were laid off. Copper refinery operations were maintained on a standby basis throughout the remainder of the year; continuous cast rod operation continued, using cathodes from inventory at Kennecott's Utah operations. Prior to its shutdown, the refinery had been processing primarily toll material, having lost its supply from Kennecott's Hayden, AZ, smelter, and had been on a reduced work schedule since January.

During 1983, American Telephone & Telegraph Co. (AT&T) reduced the work force at its Baltimore Works by over 1,300 because of decreased demand for the facility's output of copper communications cable. Increased use of fiber-optic transmission systems and other technology that increases the capacity of copper wire was cited by AT&T as causing the reduced demand. The plant, built in 1920, employed about 3,500 workers at yearend.

Steel.—Bethlehem Steel signed financial agreements and began site preparation at yearend for the construction of the 2.9-million-ton-per-year continuous caster at Sparrows Point. Startup is scheduled for January 1986. Under the financing agreement, Bethlehem Steel will lease the "concaster" with payments based on steel production. New desulfurization stations and new ladle metallurgy treatment facilities to be completed in early 1984 were also being installed to improve steel quality by reducing sulfur and enhancing internal cleanliness. The company stopped manufacturing pipe at Sparrows Point with the shutdown of the two mills that had been operating on a limited basis for several months. Wire and nail manufacturing operations were also shutdown during the year. In the second half of the year, the company began phasing out its tin mill operation at Burns Harbor, IN; it will concentrate tin-plate production at Sparrows Point.

Armco Inc. began operations at the new rotary forge complex at its Baltimore stainless steel division. The project, including a horizontal continuous caster, came onstream at yearend. The Baltimore Works, the company's main stainless steel plant, produces ingots, billets, bars, rods, and wire products.

Eastern Stainless Steel Corp. (ESS), Baltimore, became the first domestic company to produce "duplex" stainless steel plate. Duplex, containing 22% chromium, 5% nickel, and 3.5% molybdenum, offers a good combination of corrosion resistance and strength. ESS produces flat-rolled stainless steel products and is the country's largest stainless steel plate producer. During 1983, it operated at a capacity utilization rate of 45% to 60%. The company generally uses scrap stainless steel to produce new stainless steel.

Titanium Dioxide (Pigments).—The SCM Glidden Pigments Group plant in Baltimore continued to produce titanium dioxide pigments for use in paints, varnishes, lacquers, paper, and plastics. The plant's pigment

capacity is 66,000 tons per year by the sulfate process and 42,000 tons per year by the chloride process.

SCM also operated a 42,000-ton-per-year chloride-process plant in Ashtabula, OH, and, following a Federal Trade Commission decision not to oppose the acquisition, purchased for $48 million a 35,000-ton-per-year sulfate-process plant at Ashtabula from Gulf + Western Industries Inc. SCM plans to spend $20 million to convert the plant to its chloride process. SCM ended the year with a total annual titanium dioxide capacity of 185,000 tons (20% of U.S. capacity). U.S. production and consumption of titanium dioxide pigments were 760,000 tons and 851,000 tons, respectively—20% and 19% higher than 1982 levels. Consumption of titanium dioxide pigments rose to a new peak, mainly because of recovery in the homebuilding industry. Domestic uses in 1983 were in paints (48%), paper (27%), plastics (13%), rubber (3%), ceramics (1%), and other applications (8%).

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Eastalco Aluminum Co	5601 Manor Woods Rd. Frederick, MD 21701	Reduction plant	Frederick.
Cement:			
Portland:			
Coplay Cement Co.[1]	4120 Buckeystown Pike Lime Kiln, Box D Frederick, MD 21701	Quarry and plant.	Do.
Portland and masonry:			
Lehigh Portland Cement Co.[1 2]	Box L Union Bridge, MD 21791	do	Carroll.
Lone Star Cement Inc.[1]	Box 650 Hagerstown, MD 21740	do	Washington.
Clays:			
Ball clay:			
Cyprus Industrial Minerals Co., Cyprus Mines Corp.	9420 Pulaski Highway Baltimore, MD 21220 Box 188 White Marsh, MD 21162	Pit and plant	Baltimore.
Common clay:			
Baltimore Brick Co	9801 Rocky Ridge Rd. Rocky Ridge, MD 21778	do	Frederick.
Lehigh Portland Cement Co	Box L Union Bridge, MD 21791	Pits and plant	Carroll and Frederick.
Victor Cushwa & Sons Inc	Clearspring Rd. & Route 68N Box 160 Williamsport, MD 21795	Pits	Washington.
Copper:			
Kennecott Refining Corp	Kenbo Rd. Curtis Bay, MD 21226 Box 3407 Baltimore, MD 21226	Refinery	Anne Arundel.
Gypsum:			
Byproduct:			
SCM Corp., Glidden Pigments Group.	3901 Glidden Rd. Baltimore, MD 21226	Plant	Baltimore.
Calcined:			
National Gypsum Co., Gold Bond Building Products.	2301 South Newkirk St. Baltimore, MD 21224	do	Do.
United States Gypsum Co	500 Quarantine Rd. Box 3472 Baltimore, MD 21226	do	Do.
Iron and steel:			
Armco Inc	3501 East Biddle St. Box 1697 Baltimore, MD 21203	Mill (stainless steel).	Do.
Bethlehem Steel Corp	Sparrows Point, MD 21219	Mill	Do.
Eastern Stainless Steel Co	7700 Rolling Mill Rd. Dundalk, MD 21222 Box 1975 Baltimore, MD 21203	do	Do.
Lime:			
S. W. Barrick & Sons Inc.[1]	Woodsboro, MD 21798	Quarry and plant.	Frederick.
Peat:			
Garrett County Processing & Packing Corp.	RFD 1 Accident, MD 21520	Bog	Garrett.
Sand and gravel:			
Construction (1982):			
Charles County Sand & Gravel Co. Inc.	Waldorf Industrial Center Box 548 Waldorf, MD 20601	Pits and plants	Anne Arundel, Charles, St. Marys.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Construction (1982) —Continued			
Genstar Stone Products Co.[3]	Executive Plaza 4 11350 McCormick Rd. Hunt Valley, MD 21031	Pits and plants	Anne Arundel and Baltimore.
J. E. Owens, III	5893 Upper Pindell Rd. Lothian, MD 20820	Pit (bankrun)	Anne Arundel.
York Building Products Co. Inc.	910 Old Philadelphia Rd. Aberdeen, MD 21001	Pits and plants	Cecil.
Industrial:			
Harford Sands Inc.[4]	Box 25 40 Fort Hoyle Rd. Joppa, MD 21085	____do_____	Harford.
Slag:			
Iron:			
Atlantic Cement Co. Inc	Box 6687 Sparrows Point, MD 21219	Plant	Do.
Maryland Slag Co	Sparrows Point, MD 21219	____do_____	Do.
Steel:			
C. J. Langenfelder & Sons Inc	8427 Pulaski Highway Baltimore, MD 21221	____do_____	Do.
Stone:			
Crushed:			
The Arundel Corp	110 West Rd. Baltimore, MD 21204	Quarries and plants.	Baltimore, Frederick, Harford.
Genstar Stone Products Co	Executive Plaza 4 11350 McCormick Rd. Hunt Valley, MD 21031	____do_____	Baltimore, Carroll, Frederick, Harford.
Rockville Crushed Stone Inc	Box 407 13900 Piney Meetinghouse Rd. Rockville, MD 20850	Quarry and plant.	Montgomery.
Dimension:			
Butler Artcraft Stone Corp	1611 St. Paul St. Hampstead, MD 21074	____do_____	Baltimore.
Piccirilli Quarries	795 Marriottsville Rd. Marriottsville, MD 21164	____do_____	Howard.
Stoneyhurst Quarries	Box 34463 8101 River Rd. Bethesda, MD 20817	____do_____	Montgomery.
Titanium dioxide (pigments):			
SCM Corp., Glidden Pigments Group.	3901 Glidden Rd. Baltimore, MD 21226	Chemical plant	Baltimore.
Vermiculite (exfoliated):			
W. R. Grace & Co., Construction Products Div.	12340 Conway Rd. Beltsville, MD 20705	Plant	Prince Georges.

[1]Also crushed stone.
[2]Also common clay and shale.
[3]Also calcite.
[4]Also construction sand and gravel.

The Mineral Industry of Massachusetts

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Massachusetts Department of Environmental Quality, Office of the State Geologist, for collecting information on all nonfuel minerals.

By L. J. Prosser[1] and Joseph A. Sinnott[2]

The value of nonfuel mineral production in Massachusetts in 1983 was $95.7 million, an increase of $6.4 million compared with that of 1982. The $95.7 million in value of mineral production for the State is a record high, surpassing the 1981 total of $94.7 million.

The increased value in 1983 resulted from increases in both production and unit prices. Output of clays, lime, and crushed stone increased compared with that of 1982, but sand and gravel output decreased. A 61-cent-per-ton increase in the value of sand and gravel offset a 1.6-million-ton decline in production.

Table 1.—Nonfuel mineral production in Massachusetts[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	210	$1,115	237	$1,298
Lime do.	135	9,414	156	10,671
Sand and gravel:				
Construction do.	12,003	34,438	e10,400	e36,200
Industrial do.	140	1,615	W	W
Stone:				
Crushed do.	e6,900	e33,500	7,740	36,002
Dimension do.	e51	e9,158	51	10,488
Combined value of gem stones, peat, and value indicated by symbol W	XX	62	XX	1,016
Total	XX	89,302	XX	95,675

eEstimated. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Massachusetts, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Barnstable	(2)	$1,655	Sand and gravel (construction).
Berkshire	$22,363	10,624	Lime, sand and gravel (construction).
Bristol	W	2,662	Sand and gravel (construction).
Dukes	(2)	27	Do.
Essex	3,953	1,115	Do.
Franklin	1,499	W	Do.
Hampden	W	2,378	Do.
Hampshire	W	552	Do.
Middlesex	W	W	Sand and gravel (construction), sand (industrial).
Nantucket	(2)	--	
Norfolk	W	W	Sand and gravel (construction), clays.
Plymouth	1,284	W	Sand and gravel (construction), sand (industrial), clays.
Suffolk	1,600	(3)	
Worcester	W	W	Sand and gravel (construction), peat.
Undistributed[4]	32,738	27,632	
Sand and gravel (construction)	e31,300	XX	
Stone:			
Crushed	XX	e33,500	
Dimension	XX	e9,158	
Total	94,737	[5]89,302	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Massachusetts business activity

	1982	1983p	Change, percent
Employment and labor force, annual average:			
Total civilian labor force thousands	2,888.1	3,011.0	+4.3
Unemployment do	236.3	221.1	-6.4
Employment (nonagricultural):			
Mining do	.9	.9	--
Manufacturing do	613.6	633.7	+3.3
Contract construction do	65.2	72.3	+10.9
Transportation and public utilities do	118.2	118.4	+.2
Wholesale and retail trade do	565.0	604.7	+7.0
Finance, insurance, real estate do	165.5	168.8	+2.0
Services do	685.5	690.2	+.7
Government do	374.8	362.2	-3.4
Total nonagricultural employment do	2,588.7	2,651.2	+2.4
Personal income:			
Total millions	$69,923	$75,479	+8.0
Per capita	$12,153	$13,089	+7.7
Construction activity:			
Number of private and public residential units authorized	15,469	22,472	+45.3
Value of nonresidential construction millions	$997.0	$1,165.0	+16.8
Value of State road contract awards do	$307.0	$125.0	-59.3
Shipments of portland and masonry cement to and within the State thousand short tons	1,023	1,111	+8.6
Nonfuel mineral production value:			
Total crude mineral value millions	$89.3	$95.7	+7.2
Value per capita, resident population	$15	$17	+13.3
Value per square mile	$10,815	$11,594	+7.2

pPreliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Trends and Developments.—Massachusetts again led the six-State New England region in the value of mineral production, accounting for 36% of the regional total in 1983. Massachusetts dominant position in mineral production in New England is reflected in the data given in table 4.

Output of clays, lime, construction sand and gravel, and crushed stone annually accounts for nearly 90% of the State's total value of mineral production. Production of these commodities in 1983 changed about 10% or less based on the past 5 years' averages with the exception of sand and gravel, which declined about 20%.

Table 4.—Massachusetts: Position as a mineral producer in New England in 1983

Commodity	New England		Massachusetts share (percent)
	Producing States	Quantity (thousand short tons)	
Clays	4	[1]366	65
Lime	2	161	97
Sand and gravel:			
Construction	6	[e]28,200	37
Industrial	2	W	54
Stone:			
Crushed	6	19,536	40
Dimension	6	[2]245	21

[e]Estimated. W Withheld to avoid disclosing company proprietary data.
[1]Excludes New Hampshire.
[2]Excludes Maine and Rhode Island.

Table 5.—Massachusetts: Production of selected commodities

(Thousand short tons)

Commodity	1979	1980	1981	1982	1983	Average, 1979-83
Clays	156	210	259	210	237	214
Lime	198	180	170	135	156	168
Sand and gravel (construction)	16,705	13,925	[e]12,500	12,003	[e]10,400	13,107
Stone (crushed)	8,586	7,316	7,997	[e]6,900	7,740	7,708

[e]Estimated.

Legislation and Government Programs.—The Massachusetts Office of the State Geologist, Department of Environmental Quality, continued cooperative programs with the U.S. Bureau of Mines and the U.S. Geological Survey (USGS) relating to the geology and mineral resources of the State. The bedrock geologic map of Massachusetts (scale 1:250,000) was published in 1983 through a cooperative program with the USGS.[3] The maps provide geologic guidelines for engineering studies for roads, bridges, buildings, and other structures and provide documented geologic data for environmental and industrial development projects.

The U.S. Bureau of Mines sponsored 20 contracts with Massachusetts research firms in 1983. Major projects included work to control noise and dust in the mining environment. Funding for the projects totaled about $2.7 million. The Mining and Mineral Resources and Research Institute at the Massachusetts Institute of Technology (MIT) in Cambridge, which was created under title III of Public Law 95-87, received $350,000 in fiscal year 1983 for operations and research from the U.S. Bureau of Mines. Reports completed in the past 2 years included "The Competitive Position of the United States Copper Industry,"[4] "Solids Flow in a Recirculating Fluidized Bed,"[5] and "Combined Stability-Deformation Analysis for Rock Slopes in Open Pit and Strip Mines."[6]

Spire Corp., Bedford, and the U.S. Department of Energy (DOE) Solar Energy Research Institute entered a 3-year, $3 million project to develop and manufacture multijunction amorphous silicon alloy solar cells

with a conversion efficiency of 18%. DOE funded 70% of the project with Spire sharing the costs of the remaining 30% with Polaroid Corp., Cambridge, which paid Spire about $360,000 to participate in the project and for rights to segments of the technology.

Avco Everett Research Laboratory Inc., Everett, received $20 million from DOE for two projects aimed at increasing the use of coal. The projects included magnetohydrodynamics research and development of a retrofit combustion system that converts oil-fired industrial or electric utility boilers for coal use.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—Norton Co. continued manufacturing nonmetallic crude artificial abrasives at its Worcester facilities. Output in 1983 increased compared with that of 1982 as demand from the housing, furniture, and automobile industries improved.

Washington Mills Abrasive Co. processed emery mined in New York at its North Grafton plant. Most of the material was marketed as a skid-resistant additive for floors and pavements.

Clays.—Output of common clay and shale exceeded 200,000 tons for the fourth consecutive year. In the 1970's, clay production in Massachusetts averaged about 185,000 tons per year; in the first 4 years of the 1980's, annual production averaged about 230,000 tons. Continued demand from the Boston area because of building and construction, expansion, and renovation projects provided a stable market for products manufactured from clay. All three of the State's clay producers are within 25 miles of Boston.

Graphite (Manufactured).—Avco Corp. and Stackpole Fibers Co., both in Middlesex County, manufactured synthetic graphite fibers. The aerospace industry was the primary consumer of the fibers because of the lightweight, high-strength characteristics of the material. Massachusetts was one of 15 States that manufactured synthetic graphite in 1983.

Gypsum (Calcined).—United States Gypsum Co., Boston, calcined gypsum imported from company mines in Nova Scotia. The crude gypsum was crushed and calcined for manufacturing wallboard, which was shipped throughout New England for use in construction and home remodeling projects.

Lime.—The State's lime industry consisted of two companies operating in Berkshire County in western Massachusetts. Pfizer Inc., Mineral Pigments & Metals Div., Adams, manufactured quicklime sold for chemical and industrial uses. Lee Lime Corp., Lee, primarily produced hydrated lime and minor quantities of quicklime. About 75% of the company's output was used for agricultural purposes and 25% by the construction industry.

Peat.—Reed-sedge peat was mined by Sterling Peat Co. in Worcester County. The peat was used mainly by greenhouse owners and landscapers.

Perlite (Expanded).—Whittemore Products Inc. expanded perlite shipped from New Mexico at its facility in Andover, Essex County. The material was sold for lightweight aggregate, low-temperature insulation, cavity fill insulation, and horticultural aggregate.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Output of construction sand and gravel dropped for the fifth consecutive year. The 10.4 million tons produced in 1983 was the lowest total since 1958, when 9.9 million tons was reported.

In the past 5 years, the value per ton of sand and gravel sold or used by Massachusetts producers increased 57%, from $2.22 in 1979 to $3.48 in 1983. Nationally, prices increased 30% from $2.27 per ton in 1979 to $2.95 per ton in 1983. Traditionally, Middlesex, Worcester, and Norfolk Counties led the State in production. The leading uses of sand and gravel—concrete aggregate and road base and coverings—accounted for about 60% of the total annual output.

Industrial.—Two companies, one in Middlesex County and one in Plymouth County, produced industrial sand. The sand was sold primarily to foundries.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. The data for even-numbered years are

based on annual company estimates made before yearend.

Crushed.—The crushed stone industry produced 7.7 million tons of traprock, granite, and limestone in 1983, an increase of 840,000 tons compared with that of 1982. Traprock, which accounted for about 77% of the total crushed stone production, was mined at 20 quarries in 9 counties primarily in the central part of the State. About 25% of the traprock was sold for bituminous aggregate and 15% for unpaved road surfaces.

Crushed granite was produced at four quarries in Bristol and Norfolk Counties in eastern Massachusetts. Leading uses for the granite were for bituminous aggregate and dense-graded road base.

Limestone was produced by three companies, all in Berkshire County in western Massachusetts. Three of the four active quarries in the county were operated by the State's two lime manufacturers. The crushed limestone was also used for agricultural limestone, poultry grit, and filler.

Table 6.—Massachusetts: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	510	1,968
Filter stone	149	660
Coarse aggregate, graded:		
Concrete aggregate, coarse	319	1,035
Bituminous aggregate, coarse	1,830	8,852
Railroad ballast	785	2,801
Fine aggregate (-3/8 inch):		
Stone sand, bituminous mix or seal	538	2,306
Graded road base or subbase	563	2,367
Unpaved road surfacing	909	3,394
Crusher run or fill or waste	211	1,072
Agricultural: Agricultural limestone	97	1,541
Chemical and metallurgical: Flux stone	4	62
Special: Other[2]	1,826	9,944
Total	[3]7,740	36,002

[1]Includes limestone, granite, traprock, and miscellaneous stone.

[2]Includes stone used for poultry grit and mineral food, bituminous surface treatment aggregate, stone sand (concrete), lime manufacture, asphalt fillers or extenders, other fillers or extenders, roofing granules, screening (undesignated), and other uses not specified.

[3]Data do not add to total shown because of independent rounding.

Dimension.—Nationally, Massachusetts ranked eighth in dimension stone production. Output of about 51,000 tons (612,000 cubic feet) was slightly lower compared with that of 1982.

Dimension granite was produced at six quarries in Berkshire, Middlesex, and Plymouth Counties. About 80% of the granite was sold for curbing. One company in Berkshire County produced dimension marble sold as rough blocks.

Vermiculite (Exfoliated).—W. R. Grace & Co. exfoliated vermiculite at its Easthampton plant in Hampshire County. Nationally, Massachusetts ranked ninth among the 29 States that exfoliated vermiculite. Output remained about the same in 1983 compared with that of 1982. Major uses were for insulation and fireproofing.

---

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.

[2]State geologist, Massachusetts Department of Environmental Quality, Boston, MA.

[3]Zen, E., and others. Bedrock Geologic Map of Massachusetts. U.S. Geological Survey Special Map, Scale 1:250,000 (9510-00514), 1983. Supersedes OF 81-1327.

[4]Foley, P. T., and J. P. Clark. The Competitive Position of the United States Copper Industry: 1980-2000. (MA Inst. of Technol.) BuMines OFR 105-83, Oct. 1982, 306 pp.

[5]Matsuzaki, T., and J. F. Elliott. Solids Flow in a Recirculating Fluidized Bed. (MA Inst. of Technol.) BuMines OFR 184-83, June 1983, 115 pp.

[6]Kafritsas, J., H. H. Einstein, and G. B. Baecher. Combined Stability-Deformation Analysis for Rock Slopes in Open Pit and Strip Mines. (MA Inst. of Technol.) BuMines OFR 183-83, Sept. 1983, 115 pp.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
K-F Brick Co. Inc	River St. Middleboro, MA 02346	Pit	Plymouth.
Plainville Corp., Masslite Div.[1]	Box 327 Walpole, MA 02081	Pit	Norfolk.
Stiles & Hart Brick Co	Box 367 Bridgewater, MA 02324	Pit	Plymouth.
Gypsum (calcined):			
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	Plant	Suffolk.
Lime:			
Lee Lime Corp.[2]	Marble St. Lee, MA 01238	Plant and pit	Berkshire.
Pfizer Inc.[2]	260 Columbia St. Adams, MA 01220	do	Do.
Peat:			
Sterling Peat Co	Sterling Junction, MA 01565	Bog	Worcester.
Perlite (expanded):			
Whittemore Products Inc	Dundee Park Andover, MA 01810	Plant	Essex.
Sand and gravel:			
Construction:			
S. M. Lorusso & Sons Inc	331 West St. Walpole, MA 02081	Pits	Norfolk.
Nemasket Construction Co. Inc.	Box 710 Middleboro, MA 02341	Pit	Plymouth.
San-Vel Concrete Corp	Ayer Rd. Littleton, MA 01460	Pit	Middlesex.
Worcester Sand & Gravel Co. Inc.	182 Holden St. Shrewsbury, MA 01545	Pits	Worcester.
Industrial:			
Holliston Sand Co. Inc	303 Lowland St. Holliston, MA 01746	Pit	Middlesex.
Whitehead Bros. Co	Box 259 Leesburg, NJ 08327	Pit	Plymouth.
Stone:			
Crushed:			
John S. Lane & Son Inc	730 East Mountain Rd. Westfield, MA 01085	Quarries	Berkshire, Hampden, Hampshire.
S. M. Lorusso & Sons Inc	331 West St. Walpole, MA 02081	do	Middlesex, Norfolk, Suffolk.
Simeone Corp	1185 Turnpike St. Stoughton, MA 02072	do	Bristol and Norfolk.
Tilcon Inc	Box 114 Acushnet, MA 02743	Quarry	Bristol.
Trimount Bituminous Products Co.	1935 Revere Beach Pkwy. Everett, MA 02149	Quarries	Essex.
Dimension:			
H. E. Fletcher Co	West Chelmsford, MA 01863	Quarry	Middlesex.
Williams Stone Co. Inc	Box 278 East Otis, MA 01029	do	Berkshire.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Hampshire.

[1]Also sand and gravel.
[2]Also stone.

The Mineral Industry of Michigan

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey Division, Michigan Department of Natural Resources, for collecting information on all nonfuel minerals.

By James J. Hill[1] and Wanda J. West[2]

Michigan's nonfuel mineral production was valued at $1.2 billion in 1983, up from the $1 billion reported in 1982. This was a 12% increase in value, reversing the downward trend recorded for the past 3 years. Nationally, the State was ranked sixth in the value of nonfuel mineral production, accounting for approximately 5% of the U.S. total. Michigan led the Nation in production of calcium chloride, magnesium compounds, and peat, and in shipments of crude iron oxide pigments. The State was ranked second in bromine, crude iodine, industrial sand, and iron ore output, and fourth in portland cement and pig iron shipments.

Leading mineral commodities in order of value were iron ore, portland cement, magnesium compounds, salt, and stone. Other mineral commodities produced were clays,

Table 1.—Nonfuel mineral production in Michigan[1]

Mineral	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
Cement:				
Masonry thousand short tons	136	$8,752	W	W
Portland do.	3,254	149,533	W	W
Clays do.	1,022	4,370	1,199	$5,693
Gem stones	NA	15	NA	15
Gypsum thousand short tons	682	5,150	1,097	8,104
Iron ore (usable) thousand long tons, gross weight	W	W	10,713	W
Lime thousand short tons	571	26,823	503	23,142
Peat do.	241	4,917	215	4,286
Salt do.	2,002	106,303	1,355	93,306
Sand and gravel:				
Construction do.	20,567	47,726	e23,000	e52,300
Industrial do.	2,920	21,934	3,545	27,577
Stone:				
Crushed do.	e20,700	e67,100	24,763	82,152
Dimension do.	e4	e110	4	112
Combined value of bromine, calcium chloride, copper (1982), iodine, iron oxide pigments (crude), magnesium compounds, silver (1982), and values indicated by symbol W	XX	r592,451	XX	864,004
Total	XX	r1,035,184	XX	1,160,691

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

gypsum, lime, masonry cement, and sand and gravel. Mineral dealers and rockhounds collected semiprecious gem stones and mineral specimens. Perlite, iron and steel slag, and vermiculite were among the mineral commodities processed in the State. Sulfur was recovered as a byproduct at oil refineries and natural gas processing plants.

Table 2.—Value of nonfuel mineral production in Michigan, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Alcona	(2)	$83	Sand and gravel (construction).
Alger	(2)	17	Do.
Allegan	$74	W	Sand and gravel (construction), peat.
Alpena	W	W	Cement, clays, sand and gravel (construction).
Antrim	W	W	Clays, sand and gravel (construction).
Arenac	931	26	Sand and gravel (construction).
Baraga	W	297	Do.
Barry	W	485	Do.
Bay	16,230	9,495	Cement, sand (industrial), lime.
Benzie	(2)	80	Sand and gravel (construction).
Berrien	W	W	Sand (industrial), sand and gravel (construction).
Branch	W	533	Sand and gravel (construction).
Calhoun	W	511	Do.
Cass	W	378	Do.
Charlevoix	W	29,716	Cement, sand and gravel (construction).
Cheboygan	188	29	Sand and gravel (construction).
Chippewa	W	322	Do.
Clare	(2)	320	Do.
Clinton	W	W	Sand and gravel (construction), clays.
Delta	W	498	Sand and gravel (construction).
Dickinson	W	W	Iron ore, sand and gravel (construction).
Eaton	W	W	Sand and gravel (construction), peat.
Emmet	W	W	Sand and gravel (construction).
Genesee	(2)	W	Do.
Gladwin	(2)	4	Do.
Gogebic	67	82	Do.
Grand Traverse	(2)	53	Do.
Gratiot	(2)	304	Do.
Hillsdale	(2)	874	Do.
Houghton	2	W	Sand and gravel (construction), sand (industrial).
Huron	W	W	Lime, sand and gravel (construction).
Ingham	W	W	Sand and gravel (construction), peat.
Ionia	W	71	Sand and gravel (construction).
Iosco	W	W	Gypsum.
Iron	(2)	174	Sand and gravel (construction).
Isabella	(2)	985	Do.
Jackson	W	272	Do.
Kalamazoo	W	1,827	Do.
Kalkaska	(2)	7	Do.
Kent	W	W	Sand and gravel (construction), gypsum, peat.
Keweenaw	--	44	Sand and gravel (construction).
Lake	(2)	W	Do.
Lapeer	W	W	Peat, sand and gravel (construction), calcium chloride.
Leelanau	(2)	W	Sand and gravel (construction).
Lenawee	(2)	W	Do.
Livingston	(2)	2,804	Do.
Luce	(2)	60	Do.
Mackinac	W	183	Do.
Macomb	W	4,596	Sand (industrial), sand and gravel (construction).
Manistee	105,207	101,431	Magnesium compounds, salt, bromine, sand and gravel (construction).
Marquette	W	W	Iron ore, iron oxide pigments, sand and gravel (construction).
Mason	W	W	Calcium chloride, magnesium compounds, lime, bromine, sand (industrial), sand and gravel (construction).
Mecosta	W	W	Sand and gravel (construction), peat.
Menominee	(2)	268	Sand and gravel (construction).
Midland	W	W	Bromine, calcium chloride, magnesium compounds, iodine, salt.
Missaukee	(2)	51	Sand and gravel (construction).
Monroe	W	W	Cement, clays, peat.
Montcalm	(2)	142	Sand and gravel (construction).
Montmorency	(2)	--	

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Michigan, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Muskegon	W	W	Sand (industrial), salt, sand and gravel (construction).
Newaygo	--	W	Sand and gravel (construction).
Oakland	W	W	Sand and gravel (construction), peat.
Oceana	W	W	Sand (industrial), sand and gravel (construction).
Ogemaw	(2)	$853	Sand and gravel (construction).
Ontonagon	W	W	Copper, silver, sand and gravel (construction).
Osceola	(2)	W	Sand and gravel (construction).
Otsego	(2)	80	Do.
Ottawa	W	W	Sand (industrial), sand and gravel (construction).
Presque Isle	$36,582	617	Sand and gravel (construction).
Roscommon	40	12	Do.
Saginaw	1,611	W	Sand (industrial), lime, sand and gravel (construction).
St. Clair	W	W	Salt, sand and gravel (construction).
St. Joseph	W	W	Sand and gravel (construction), peat.
Sanilac	2,328	W	Peat, sand and gravel (construction), lime.
Schoolcraft	W	(3)	
Shiawassee	1,270	1,875	Peat, clays, sand and gravel (construction).
Tuscola	W	W	Sand and gravel (construction), sand (industrial), lime.
Van Buren	(2)	447	Sand and gravel (construction).
Washtenaw	(2)	2,175	Do.
Wayne	68,920	53,774	Lime, cement, salt, sand (industrial), sand and gravel (construction), clays.
Wexford	W	W	Sand (industrial), sand and gravel (construction).
Undistributed[4]	1,138,905	751,085	
Sand and gravel (construction)	e68,050	XX	
Stone:			
Crushed	XX	e67,100	
Dimension	XX	e110	
Total	1,440,405	5 1,035,184	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Crawford and Oscoda Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Michigan business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	4,248.3	4,146.0	-2.4
Unemployment	do	701.0	529.5	-24.5
Employment (nonagricultural):				
Mining[1]	do	8.1	8.4	+3.7
Manufacturing	do	843.9	923.3	+9.4
Contract construction	do	71.9	79.1	+10.0
Transportation and public utilities	do	136.7	138.0	+1.0
Wholesale and retail trade	do	668.3	693.2	+3.7
Finance, insurance, real estate	do	149.8	152.9	+2.1
Services	do	648.7	655.7	+1.1
Government	do	586.0	571.1	-2.5
Total nonagricultural employment[1 2]	do	3,113.5	3,221.8	+3.5
Personal income:				
Total	millions	$99,747	$104,963	+5.2
Per capita		$10,942	$11,574	+5.8
Construction activity:				
Number of private and public residential units authorized		14,276	21,164	+48.2
Value of nonresidential construction	millions	$1,091.5	$1,190.9	+9.1
Value of State road contract awards	do	$186.4	$281.6	+51.1
Shipments of portland and masonry cement to and within the State	thousand short tons	1,371	1,527	+11.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,035.2	$1,160.7	+12.1
Value per capita, resident population		$114	$128	+12.3
Value per square mile		$17,794	$19,832	+11.5

[p]Preliminary.
[1]Includes oil and gas extraction.
[2]Data do not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

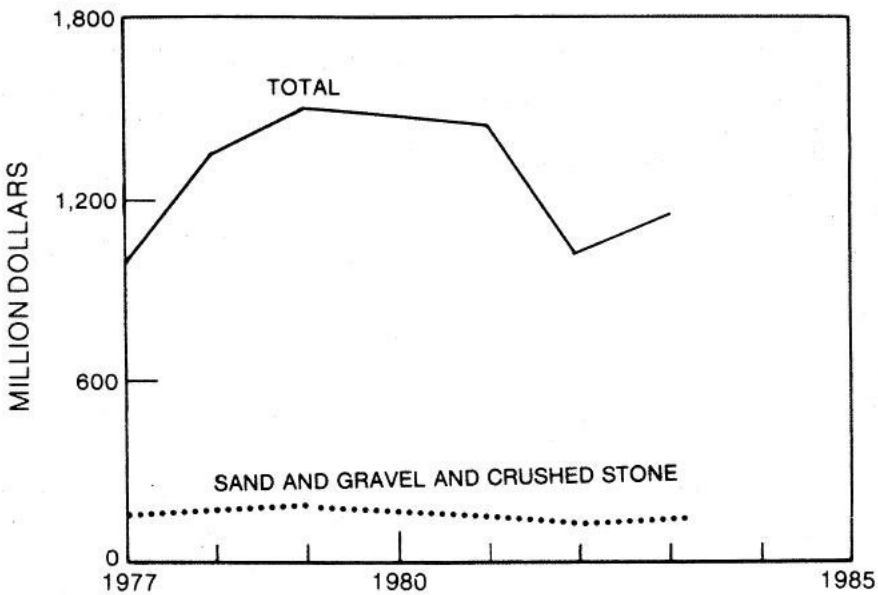

Figure 1.—Value of construction sand and gravel and crushed stone and total value of nonfuel mineral production in Michigan.

Trends and Developments.—Michigan's economy, along with several sectors of the State's mineral industry, began to recover slowly in 1983. In the Upper Peninsula, recovery was slower than in the rest of the State. The Michigan Employment Security Commission, Bureau of Research and Statistics', published statistics showed the unemployment rate for the 15 counties in the Upper Peninsula peaked at 24.1% in March, averaging 17.5% for the year compared with an unemployment rate of 18.9% for 1982. The State's average unemployment rate was 14.2% in 1983, compared with 15.5% in 1982.

According to figures in the Michigan Manufacturers Directory, the number of manufacturing plants in Michigan rose 4.1% in 1983, the first increase since 1980. Most of the gain, recorded in southeastern Michigan, was attributed to the new "just-in-time" inventory policies of the major automobile manufacturers.

Residential building increased during the year, stimulating a demand for construction mineral commodities. Figures compiled by the Southeast Michigan Council of Governments showed that in the first 6 months of 1983 residential building permits issued by communities in southeast Michigan rose 223% over those issued during the same period in 1982. Single-family permits led the gain, increasing 283%; multifamily permits rose 133%. The U.S. Department of Commerce reported a 48% increase in the number of construction permits issued for residential units (public and private) in the State, ending a 4-year decline. Also, the value of private nonresidential construction increased 9% during the year.

Several developments occurred in the State's mineral industry. Callahan Mining Corp. announced in June, following an exploration program performed in 1979-81, that it would proceed with its Ropes Gold Mine project near Ishpeming. A contractor was hired to do the development work, which began in July.

Georgia-Pacific Corp. reopened its underground gypsum mine in Kent County in December; the mine had been idle since August 1982.

Cleveland-Cliffs Iron Co.'s (CCI) taconite mines operated below capacity throughout the year. Production was cut back several times at the Empire and Tilden Mines to adjust inventories to demand. The Republic Mine was idle during the year.

White Pine Copper Co., a division of Copper Range Co., suspended mining operations at the White Pine Mine in October 1982. For the first time in nearly 140 years, no copper production was recorded in the State.

International Salt Co. halted production at its Detroit Mine complex in January because of the unusually mild winter and the decline in sales. This was the first time in the mine's 73-year history that salt mining was discontinued.

Jones & Laughlin Steel Corp. (J&L) closed its Warren stainless steelmaking facility at the end of May and shifted production to its newly acquired Midland, PA, plant. The Midland plant, acquired from Colt Industries Inc., New York, in February, had a continuous-slab caster and newer electric furnaces than the Warren facility.

In December, Ford Motor Co. announced plans to upgrade its Rouge Steel Co. subsidiary by constructing a $200 million continuous-casting plant at its Wayne County facilities. Construction was expected to begin in early 1984, and the continuous caster was expected to be operational by mid-1986.

At yearend, Cyprus Corp. of Pittsburgh, PA, acquired Special Metals Corp., New Hartford, NY, from Allegheny International Inc. Special Metals—with plants in Ann Arbor, MI; Dunkirk and New Hartford, NY; and Princeton, KY—is a producer of superalloys used in jet engines, turbines, and petrochemical operations. The firm's newly patented Vadarmelting melting process permits advanced-level refinement of superalloy metals.

Shipping.—The Great Lakes shipping season began on March 29 with the opening of the American locks at Sault Ste. Marie and ended on December 31. The Corps of Engineers reported that traffic through the locks totaled 78.6 million short tons in 1983, an 18% increase over that reported in 1982. Mineral commodities accounted for 65% of the total tonnage; iron ore alone accounted for 47% of the total. A statistical summary of mineral products traffic through the locks in 1982 and 1983 is given in table 4.

Table 4.—Michigan: Mineral products shipped through the Sault Ste. Marie locks

(Short tons)

Commodity	1982	1983
Cement	410,156	440,572
Coal	7,935,103	9,867,111
Iron ore	28,472,658	37,131,252
Iron and steel (manufactured), pig iron	300,054	284,356
Potash	1,813,252	1,614,064
Salt	236,141	339,981
Scrap (ferrous)	109,452	22,356
Stone[1]	1,163,890	1,708,718
Total	40,440,706	51,408,410

[1]Includes sand and gravel and broken stone.

Source: U.S. Army, Corps of Engineers, Detroit District.

The Lake Carriers Association reported 51.2 million gross tons of iron ore (U.S. and Canadian) moved across the Great Lakes during the 1983 shipping season, a 33% increase over the 38.5 million tons shipped in 1982. Some Canadian ore travels the St. Lawrence Seaway and is delivered to southern Great Lakes ports without passing through the Sault Ste. Marie locks. Total U.S. iron ore shipped in 1983 was 41.0 million tons, compared with 31.4 million tons shipped in 1982.

Michigan's iron ore is shipped through Lake Superior & Ishpeming Railroad's Presque Isle terminal at Marquette, and Chicago & Northwestern Transportation Co.'s terminal in Escanaba. In 1983, the American Iron Ore Association reported that 3.5 million gross tons of iron ore and concentrates were loaded at the Presque Isle terminal, compared with 1.9 million tons shipped through the terminal in 1982. Presque Isle's shipping season began on March 31, 1983, and ended January 3, 1984.

Shipping began on April 13, 1983, at the Escanaba terminal and ended on January 2, 1984. Approximately 7.4 million tons of iron ore and concentrates was shipped in 1983, compared with the 5.3 million tons shipped in 1982.

Exploration.—In April, Michigan had its first metallic mineral lease sale in the Upper Peninsula since a moratorium on mineral leasing went into effect in 1976. Metallic mineral rights to 128,472 acres of State-owned mineral lands in 9 counties were offered at a public auction; of the 26 bidders registered at the sale, 11 won leases on 87,915 acres in 7 counties. Most interest was shown in Dickinson, Iron, Marquette, and Menominee Counties. Leases were also awarded in Baraga, Gogebic, and Houghton Counties. The highest bid per acre was $210, and $1 was the lowest; the average bid per acre was $3.76.

Exploration companies are required to file exploration plans with the State for activities on State-owned minerals under lease. During 1983, exploration companies proposed to run 538 line-miles of geophysical lines, bulk sample 28 trenches, and drill 464 holes for geochemical studies and sampling. This work was expected to continue into 1984.

Actual core drilling during 1983 on both private and State-owned mineral lands was 38 holes totaling 8,511 feet. This figure does not include holes drilled for geochemical studies or holes drilled in the Ropes Gold Mine area, which was under development.

In south-central Michigan, PPG Industries Inc. has been actively exploring for potash for several years. Exploration and leasing are conducted by a wholly owned subsidiary, Willmet Corp., which drilled several holes in 1983. Since February 1980, the firm had spent more than $62 million on exploration and drilling activities in the State.

Legislation and Government Programs.—During 1983, several mineral-related bills were introduced in the State legislature that were still in committee at yearend.

Senate bill 8 provides for unused mineral rights separated from surface ownership to revert to the surface owners unless a claim is filed every 20 years. The bill also provides for mineral rights owned by the Michigan Department of Natural Resources (DNR) under lands of different surface ownership to revert to the surface owner in 25 years unless minerals are actually produced within that period.

Senate bill 231 amends the Sand Dune Protection and Management Act of 1976 and provides for increased fees and bonding requirements for surveillance, monitoring, administering, and enforcing the act.

House bill 5165 amends the Mineral Well Act of 1969. It provides for increased permit fees; reduces the period of confidentiality for logs on brine and test wells; imposes limits and establishes fees for blanket permits; increases maximum fines for violation of the act; and repeals the abandoned salt-well act.

The Institute of Science and Technology at the University of Michigan, Ann Arbor, received a $750,000 grant from the U.S.

Department of Commerce to provide industry with technical and management assistance. The grant was awarded under the Trade Adjustment Assistance Act to enable the institute to establish the Great Lakes Trade Adjustment Assistance Center—1 of 12 in the United States. The center will be responsible for activities in Indiana, Michigan, and Ohio, an area hard hit by foreign competition, with several industries losing sales and jobs to foreign imports.

During the year, the Institute of Mineral Research at Michigan Technological University completed a study on the feasibility of using Quincy Mine shaft water as a heat source for the city of Hancock. The mine, about 9,000 feet deep, was closed in the late 1940's when copper demand dropped at the end of World War II. The study was financed through the city's federally funded Community Development Block Grant Program. Results indicated that capital costs associated with heat recovery from the Quincy Mine would be very high and that cost-effective recovery of the heat would be unlikely in the near future.

In July, the DNR, Lands Division, called for nominations of lands to be included in the second lease sale of State-owned metallic mineral rights, expected to be held in the spring of 1984. Approximately 50,000 acres of land was nominated in eight counties in the Upper Peninsula.

The Geological Survey Division of DNR continued providing information on Michigan's geology and mineral resources to State and local officials and to the public at large. A review of the Survey's organizational structure, mission, and tasks was initiated during the year. Recommendations will be presented to the director of DNR in November 1984. To reemphasize geology programs, the Survey formed a committee to evaluate and approve geologic projects intended to be sponsored in total, or in part, by the Survey. A new "Quaternary Geology Map of Michigan" (1:500,000) was published during the year. Work continued on a series of pilot county-map portfolios.

The Forest Service, U.S. Department of Agriculture, identified 239,139 acres of National Forest System land in Michigan for further study in its Asset Management Program. The program is designed to identify Federal lands that are inefficient to manage or are no longer needed by the Federal Government. Lands identified for further study included 50,130 acres in Hiawatha National Forest, 11,884 acres in Huron National Forest, 139,808 acres in Manistee National Forest, and 37,317 acres in Ottawa National Forest. National legislation is needed before national forest land can be sold. Additional analysis for the possible sale of lands in the further study category was put on hold pending enactment of legislation.

In fiscal year 1983, the State received approximately $943,500 from the Federal Government as its share of funds generated by activities on national forest lands (timbering, mineral leasing, recreation, user fees, etc.), compared with $891,800 the State received in fiscal year 1982.

The U.S. Bureau of Land Management's (BLM) Lake States Office in Duluth, MN, was closed in 1983, and personnel were transferred to Milwaukee, WI. The office's geographic area of responsibility includes Michigan, Minnesota, and Wisconsin. Employees are surveying Federal lands the agency manages in these States for transfer to State and local ownership. Public-domain lands BLM manages in the East tend to be small, widely scattered parcels that could be more efficiently and inexpensively managed by other Government agencies. BLM's policy is to dispose of surface acreage in the eastern half of the United States through transfer or sale. When feasible, management responsibilities are transferred to other Federal, State, or local agencies that can do a better job of on-site management.

In 1983, the U.S. Bureau of Mines had several active contracts and grants with industrial firms, educational institutions, and consulting firms in Michigan for services, equipment, and research. Funding for these items was approximately $551,000. About $300,000 of these funds was awarded to Michigan Technological University to investigate the effectiveness of diesel emissions controls for underground metal mines.

In fiscal year 1983, the Mining and Mineral Resources and Research Institute at Michigan Technological University in Houghton, created under title III of Public Law 95-87, received $150,000 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Bromine.—Michigan and Arkansas were the only States reporting bromine production in 1983. The Dow Chemical Co. produced from brine wells in Mason and Midland Counties; Morton Chemical Co. produced from brine wells in Manistee County. Production and value decreased in 1983 compared with 1982 figures. Bromine was used in manufacturing agricultural chemicals, flame retardants, well-drilling and completion fluids, and other chemicals.

Calcium Chloride.—Michigan and California continued to be the only States reporting calcium chloride production in 1983, with Michigan accounting for the greater share. Dow Chemical produced calcium chloride from brine wells in Mason and Midland Counties. Wilkinson Chemical Corp. produced from brine wells in Lapeer County. Both production and value were estimated to have increased during the year. Calcium chloride was used for deicing and dust control, in oil- and gas-drilling operations, and for other industrial applications.

Cement.—Michigan was ranked fourth nationally in shipping portland cement and seventh in shipping masonry cement; production and value for both types increased in 1983. At the beginning of the year, the U.S. Bureau of Mines initiated new procedures of reporting cement statistics by districts. Because of this change in reporting methods, Michigan's cement statistics cannot be revealed for 1983. Of the six plants active during the year, two—the Aetna Cement Corp. plant near Essexville and the Wyandotte Cement Inc. plant near Wyandotte—were operated as grinding facilities using clinker imported from Canada. Cement was distributed mainly by lake vessel and barge to terminals from which it was shipped to consumers primarily by truck. Most sales of portland cement were to ready-mix companies, concrete-product manufacturers, and highway contractors.

In July, the Michigan Transportation Commission ruled that the "Buy American" rule was in effect for federally funded highway projects in the State, reversing an earlier decision. The Federal Surface Transportation Assistance Act of 1982 required that only U.S. cement be used for Federal highway construction projects. Individual States, however, could apply to the Federal Highway Administration for waiver from this provision if they felt it was warranted. The Michigan Department of Transportation had requested a waiver of the Buy American provision for Canadian clinker ground into cement in the State. Michigan's four other cement producers' protest of this action resulted in the new Buy American ruling.

Clays.—Michigan was ranked seventh nationally in the production of common clay and shale. Compared with 1982 figures, production and value increased approximately 17% and 30%, respectively. Six companies produced common clay and shale from seven operations in five counties; Alpena and Monroe Counties accounted for nearly 88% of the total production. Other producing counties were Antrim, Clinton, and Shiawassee. Michigan clay was used mainly for cement manufacture, accounting for about 95% of the State's output. Other uses were for manufacturing drain tile, face brick, flue linings, pottery, and sewer pipe.

Gem Stones.—Estimated value of mineral specimens and semiprecious gem stones that dealers and rockhounds collected was $15,000 in 1983. Among the rocks and minerals collected were agates, native copper specimens, and petoskey stones (a fossil coral). Michigan has the potential to become a valuable gem-producing State. A report the U.S. Geological Survey published describes a kimberlite deposit (named the Lake Ellen kimberlite) discovered in Iron County and the potential for several other occurrences in Michigan and Wisconsin.[3] Kimberlites, intrusive bodies originating deep in the earth's crust, are known to contain diamonds in several parts of the world. At the State's 1983 mineral-lease sale, the 40-acre tract where the Lake Ellen kimberlite deposit is exposed commanded the highest price per acre. Reportedly, Dow Chemical obtained the lease and took bulk samples for evaluation. Several other companies were known to be exploring for diamonds in the State.

Gypsum.—Michigan was ranked fifth nationally in producing crude gypsum in 1983 after having dropped to sixth place in 1982. Compared with 1982 figures, production and value increased 61% and 57%, respectively. Four companies produced gypsum in two counties. Michigan Gypsum Co., National

Gypsum Co., and United States Gypsum Co. operated open pit mines in Iosco County. Georgia-Pacific reopened its underground mine in Kent County in December after having shut down the mine in August 1982 because of reduced construction activity. The former Grand Rapids Gypsum Co. Mine in Kent County, purchased by Domtar Industries Inc. in 1981, remained idle throughout the year. At yearend, the mine was scheduled to resume production in early 1984.

United States Gypsum's Alabaster Mine in Iosco County was the fourth largest producing mine in the U.S. during 1983.

Michigan was ranked 15th among the States in calcined-gypsum production. Calcining plants were operated by National Gypsum at National City in Iosco County; Georgia-Pacific at Grand Rapids in Kent County; and United States Gypsum at Detroit in Wayne County. Gypsum was used in manufacturing building plaster, cement, wallboard, and for agricultural purposes.

Iodine.—Michigan and Oklahoma were the only States with iodine production in 1983. Dow Chemical recovered iodine from subsurface brines at its operations in Midland County. Production was estimated to have fallen in 1983. Iodine was used in animal-feed additives, catalysts, disinfectants, inks and colorants, pharmaceuticals, and stabilizers.

Lime.—Michigan was ranked 11th nationally in lime production in 1983; output had declined steadily since 1976. Production was by five companies from nine plants in seven counties. All companies produced quicklime; one company, Marblehead Lime Co. in Wayne County, also produced hydrated lime. Lime was used in alkalies, paper and pulp manufacture, sewage treatment, steelmaking, sugar refining, and water treatment. Dow Chemical's plant at Ludington and Marblehead Lime's plant at Detroit won safety awards from Rock Products magazine during the year for the number of man-hours worked without injury.

Magnesium Compounds.—Of the seven States producing magnesium compounds, Michigan was the Nation's leader. Output increased slightly during the year, although value decreased. Production was from the well-brine operations of Dow Chemical in Mason and Midland Counties and from Martin Marietta Corp.'s Magnesia Specialties Div. and Morton Chemical's operations in Manistee County. Magnesium compounds were used mainly in producing high-temperature, basic refractories. Other uses were in animal feeds, construction materials, electrical-heating rods, fertilizers, fluxes, petroleum additives, and rayon.

Martin Marietta's Magnesia Specialties Div. introduced a nontoxic, high-performance refractory mixture for maintaining severe-wear areas in the linings of steelmaking furnaces and related equipment. Successfully tested at several steel mills in the U.S. and Canada, the mixture is produced at the company's Manistee plant.[4]

Peat.—Michigan continued to lead the Nation in peat production, although sales declined about 11% compared with those of 1982. Fourteen companies harvested peat from bogs in 11 counties. Two companies, Black Forest Ranch Peat Moss Inc. in Cheboygan County and Milburn Peat Co. Inc. in St. Joseph County, began peat production during 1983. Lapeer, Sanilac, and Shiawassee Counties accounted for three-quarters of the State's production. About 80% of the peat sales was in packaged form, and approximately 96% of the State's sales was for general soil improvement. Michigan Peat Inc. in Sanilac County and Black Forest were the State's only sources of sphagnum moss. The other producers mined either reed sedge or humus peat.

During 1983, Black Forest sought a 12,000-acre lease from the State to mine peat in Dingman Marsh near Cheboygan. The firm began preparing an environmental impact report for the proposed project, which was expected to provide between 60 and 120 jobs and to produce 3 to 4 million bales of peat per year. The proposal also triggered legislative action to lease and regulate peat mining on State-owned lands.

Perlite (Expanded).—Two companies expanded perlite shipped in from other States during 1983. Harborlite Corp. operated a plant at Vicksburg in Kalamazoo County and sold the material for use as a filter aid. United States Gypsum operated a plant at River Rouge in Wayne County and sold its production for plaster aggregate. Production declined during the year.

Salt.—Michigan was ranked sixth nationally in salt sales. Production has declined every year since 1976 when production reached 4.2 million tons. Unusually mild winters, closure of chloralkali plants, and public reaction to salt intake have contributed to the decreased salt demand. Six companies reported output from seven operations in Manistee, Muskegon, St. Clair, and Wayne Counties. All salt was recovered

from brine-well operations, except for International Salt's production from its underground mine in Wayne County. Salt was used in food and chemical processing, for ice control, and as table salt. The Salt Institute conducted a survey of salt use by State departments of transportation for the winters of 1981-82 and 1982-83. Michigan reportedly used 397,000 tons of salt in the winter of 1981-82 for deicing and 229,000 tons in the winter of 1982-83.

Dow Chemical closed its chloralkali plant in Midland in 1982 and reported no salt production for 1983.

Because of a slump in sales and an unusually mild winter, International Salt shut down its mine in mid-January and layed off personnel. During April through September, International Salt conducted public tours of its mining complex as a source of revenue. Three public tours in 1982 drew a total of 1,080 people. The 2-1/2-hour tours cost $10 per person. Late in the year, the company began dismantling its underground mining equipment. No formal announcement was made regarding future plans for the mine.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend. Sales of construction sand and gravel were estimated to have increased during 1983 owing to the upswing in construction activity.

Industrial.—Michigan continued to rank second in industrial sand production, behind Illinois. Nine companies produced industrial sand from 13 operations in 10 counties. Approximatey one-half of the State output came from operations in two counties—Muskegon and Ottawa. Average value per ton increased about 4% over that reported in 1982. Major sales were for foundry applications.

In 1983, Martin Marietta sold its industrial sand operation near Bridgman in Berrien County, along with nine operations in several other States, to Unimin Corp. of Connecticut.

Table 5.—Michigan: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	6,596	$14,016	$2.12	NA	NA	NA
Gravel	11,698	30,491	2.61	NA	NA	NA
Sand and gravel (unprocessed)	2,272	3,219	1.42	NA	NA	NA
Total[1] or average	20,567	47,726	2.32	e23,000	e$52,300	e$2.27
Industrial sand	2,920	21,934	7.51	3,545	27,577	7.78
Grand total[1] or average	23,486	69,659	2.97	e26,545	e79,877	e3.01

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Slag—Iron and Steel.—Michigan continued to rank fourth in sales of processed iron and steel slag. Edward C. Levy Co. in Wayne County processed slag from McLouth Steel Products Corp.; the Great Lakes Steel Div. of National Steel Corp.; and Rouge Steel, a subsidiary of Ford Motor. Processed iron and steel slag was used for asphaltic concrete aggregate, fill, railroad ballast, and road base material. Sales increased during the year with the renewal of construction activity.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Crushed stone was the fifth leading mineral commodity in value produced in Michigan. Nationally, the State was ranked 15th in the quantity of stone sold. With the revival of the construction industry, sales of crushed stone increased 20%. Crushed stone was produced in 25 counties at 41 quarries. Nine companies produced more than 1 million tons. Leading counties, in decreasing order of tonnage, were Presque Isle, Mackinac, Monroe, Alpena, and Chippewa. Most of the State's

crushed stone output was limestone and dolomite produced at 31 quarries. Other types of stone produced in the State, accounting for less than 1% of the total, were marl, traprock, sandstone, and an unspecified stone.

About 59% of the crushed stone mined in Michigan was transported by water, 40% by truck, and about 1% by rail.

Table 6.—Michigan: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	124	399
Coarse aggregate, graded:	2,453	5,781
Concrete aggregate, coarse	321	928
Bituminous aggregate, coarse	115	356
Bituminous surface treatment aggregate	254	667
Railroad ballast		
Fine aggregate (-3/8 inch):	498	1,483
Stone sand, bituminous mix or seal	42	119
Screening, undesignated		
Coarse and fine aggregate:	1,375	2,844
Graded road base or subbase	1,492	5,739
Unpaved road surfacing	172	526
Crusher run or fill or waste		
Agricultural:	364	1,329
Agricultural limestone	19	39
Agricultural marl		
Chemical and metallurgical:	5,231	11,631
Cement manufacture	4,999	18,537
Lime manufacture	4,787	19,822
Flux stone	2,515	11,954
Other[2]		
Total[3]	24,763	82,152

[1]Includes limestone, dolomite, marl, sandstone, traprock, and miscellaneous stone.
[2]Includes poultry grit and mineral food, filter stone, stone sand—concrete, terrazzo and exposed aggregate, chemical stone for alkali works, paper manufacture, sugar refining, waste material, combined coarse and fine aggregate (not elsewhere classified), and other uses.
[3]Data do not add to totals shown because of independent rounding.

Early in the year, the Michigan Natural Resources Commission awarded leases on two 80-acre sites in Houghton and Baraga Counties for limestone-dolomite mining by White Pine Copper. The deposits, known as Sherman Hill in Houghton County and Limestone Mountain in Baraga County, contain a magnesium level that was expected to increase the efficiency of White Pine Copper's smelting process and to result in a higher copper yield.

Drummond Dolomite Inc., a subsidiary of Bethlehem Steel Corp., announced it would permanently close its stone quarry and crushing plant in Chippewa County on July 29 after failing to receive contract concessions from employees in May. However, last-minute negotiations with the union resulted in the workers ratifying a 21-month contract with concessions, which averted the shutdown.

At the end of August, United States Steel Corp. suspended operating its quarry near Cedarville, Mackinac County, citing the poor economy and high labor costs as the reasons. Approximately 140 workers were placed on layoff status. The plant continued to ship from inventory with shipping crews reporting to work on a "call out" basis.

Dimension Stone.—Four companies produced dimension stone in four counties in 1983. Sandstone was produced in Jackson County, and limestone, in Eaton, Presque Isle, and Schoolcraft Counties. Production remained about the same as reported in 1982. Value of the stone increased about 6% per ton. Stone was used as cut stone, flagging, irregular-shaped slabs, rough blocks, and for general construction.

Sulfur (Recovered).—Sulfur was recovered as a byproduct at petroleum-refining operations of Total Petroleum Inc. at Alma in Gratiot County, Shell Oil Co. at Manistee in Manistee County, and Marathon Oil Co. at Detroit in Wayne County. Most was used in manufacturing sulfuric acid. Production was lower than in 1982 because of the decline in petroleum-product use.

Vermiculite (Exfoliated).—W. R. Grace & Co. processed vermiculite shipped in from other States at its plant in Dearborn, Wayne County. Sales increased about 12%

with the renewal of construction activity in the State. Most sales were for loose fill insulation and fireproofing. Other uses were for agricultural purposes, block insulation, and concrete and plaster aggregate.

METALS

Abrasives (Manufactured).—Three companies manufactured metallic abrasives in Michigan during 1983. Sales of steel shot and grit were reported by Ervin Industries Inc., Lenawee County; Abrasive Materials Inc., Hillsdale County; and Metal Tec Steel Abrasives, Wayne County. Abrasive Materials also reported sales of cut wire shot. Michigan accounted for 24% of the U.S. sales of steel shot and grit and was one of two States reporting sales of cut wire shot. Manufactured abrasives are used primarily by the automotive, foundry, and steel industries. Sales increased during the year with the strengthening of the economy.

Copper and Silver.—White Pine Copper suspended mine, mill, and smelter operations at its complex in October 1982. At the beginning of 1983, about 300 persons were employed at the facilities, operating the firm's new electrolytic copper refinery on processed scrap. In April, the firm laid off 30 additional employees because of the decline in the copper market.

On August 1, union workers at the complex went on strike following a 17-month plea by the company for wage and benefit concessions. The walkout was in force at yearend, affecting 130 union workers. Management and salaried personnel continued to process scrap in the refinery.

During the year, Louisiana Land and Exploration Co., parent of Copper Range, of which White Pine Copper is a division, placed Copper Range's assets up for sale, including the White Pine facilities. Several companies looked at the properties including Noranda Mines Ltd. and the Southern Pacific Railroad. The facilities had not been sold at yearend.

A new copper-related industry began in the Upper Peninsula at midyear. Peninsula Copper Industries Inc. started leaching copper from printed circuit board scrap to produce copper oxide at its plant in Michigan Technological University's Technology Park in Hubbell. Initial annual production was expected to be 2.5 million pounds of copper oxide from approximately 10 million pounds of scrap. The major use of the product would be for wood preservation.

Gold.—In June, Callahan Mining announced plans to spend $3.1 million over the next year to commence mine development at its Ropes gold property near Ishpeming. The firm had conducted an extensive exploration program from 1979 to 1981 at a cost of $2.5 million. Callahan Mining planned to bring the gold-mining project into production at 1,000 tons of ore per day at costs ranging from $17 million to $20 million. Once full-scale production is reached, the mine was expected to produce about 30,000 to 35,000 ounces of gold per year. Reserves at Ropes are estimated to be sufficient for 6 years of production. The ore zone is open at depth, and adjoining property under Callahan Mining's control has potential for additional reserves.

In August, Callahan Mining let a $2.1 million, 12-month contract to Wallace Diamond Mining Inc. of Osburn, ID, for development services on the Ropes project. First-phase development was to include driving a 12- by 15-foot spiral ramp down to the ore zone. By yearend, the ramp was 3,100 feet long, and drifting was nearly completed on the first development level, 300 feet below surface. Negotiations were underway to purchase an inactive flotation mill about 16 miles from the property.

Iron Ore.—Michigan continued to rank second, behind Minnesota, in iron ore shipments, which increased about 38% as the steel industry began to recover from the recession of 1981-82. Throughout most of 1983, CCI operated its taconite mines in Marquette County below capacity. Production was cut back several times at the Empire and Tilden Mines to adjust inventories to demand. The Republic Mine was idle all year. CCI made some shipments from stockpiles at the Mather Mine in 1983. Shipments were also reported from stockpiles at The Hanna Mining Co.'s Groveland operation in Dickinson County. Hanna permanently closed the Groveland facilities in 1982.

During the year, CCI restructured the iron-mining partnerships the company managed. Participants in the Empire Iron Mining Partnership, which has an annual pellet capacity of 8.0 million tons, are Inland Steel Co. (40%); J&L (35%); Wheeling-Pittsburgh Steel Corp. (10%); and CCI (15%). Participants in Tilden Mining Co., which also has an annual pellet capacity of 8.0 million tons, are The Algoma Steel Corp. (30%); J&L (12%); Stelco Inc. (10%); Sharon

Steel Corp. (5%); Wheeling-Pittsburgh Steel (4%); and CCI (39%). CCI became the sole owner of the Marquette Iron Mining Partnership, which has a capacity of 2.7 million tons.

Table 7.—Michigan: Usable iron ore[1] produced (direct shipping and all forms of concentrates), by range

(Thousand long tons, gross weight)

Year	Marquette Range	Menominee Range (Michigan part)	Gogebic Range (Michigan part)	Total		
				Gross weight		
				Ore	Iron content	Iron content (percent)
1854-1978	478,056	312,155	249,625	1,039,836	NA	NA
1979	15,100	2,032	--	17,132	10,933	63.8
1980	14,450	1,970	--	r16,420	10,482	63.8
1981	15,508	75	--	15,583	10,020	64.3
1982	6,874	--	--	6,874	4,426	64.4
1983	9,339	--	--	9,339	6,024	64.5
Total[2]	539,329	[3]316,232	[3]249,625	1,105,185	NA	NA

rRevised. NA Not available.
[1]Exclusive after 1905 of iron ore containing 5% or more manganese.
[2]Data may not add to totals shown because of independent rounding.
[3]Distribution by range partly estimated before 1906.

Iron Oxide Pigments.—Michigan was ranked first of four States in shipping crude iron oxide pigments. Shipments originated from stockpile at the CCI Ore Improvement Plant in Marquette County, which closed in 1979. Finished iron oxide pigments were produced by BASF Wyandotte Corp. at Wyandotte, Wayne County. Iron oxide pigments were used in paint and other coatings.

Pig Iron and Steel.—Michigan was ranked fourth nationally in shipping pig iron. Although shipments rose about 7% over those of 1982, Michigan steel firms still operated below capacity. High imports and slack demand forced the State's steelmakers to lay off personnel several times during the year.

In an effort to make steel operations profitable again, the steel industry and the United Steelworkers of America agreed to a new 41-month contract, which included an immediate $1.25-per-hour pay cut, reduced vacations and holidays, and temporary reductions in cost-of-living raises.

During the year, National Steel restructured into seven business groups and became known as National Intergroup Inc. Only the steel-related portion of the business remained known as National Steel Corp. National Steel opened a new facility in Livonia to help serve domestic automobile makers and other companies produce higher quality steel products. The product-application center employed more than 40 steel technologists in five different disciplines supported by sophisticated steel-testing facilities. A 500-ton sample bank containing hundreds of different types of steel was available to customers for prototype development, production, and testing.

National Steel, Great Lakes Steel Div., was fined $2.5 million by a Federal judge on May 23 for failing to control air pollution at its Ecorse mill. The firm also faced daily penalties of $7,500 until its faulty furnaces were brought into compliance with Federal and Wayne County clean air regulations. The firm was fined $3 million in 1982 for violations of the Clean Air Act.

Ford Motor ended talks in May with Nippon Kokan KK of Japan concerning the sale of 75% of its Rouge Steel subsidiary after failing to resolve labor issues to the satisfaction of the Japanese. About 700 hourly workers were laid off at the plant between August 15 and the end of September when Rouge Steel shut down its electric furnace and related facilities. Previously, about 475 persons were laid off when the company shut down its largest blast furnace and several coke ovens in order to remain competitive.

In September, Ford Motor announced it had ended talks with the United Auto Workers Union seeking concessions aimed at keeping its Rouge Steel subsidiary open and would close the facilities near Detroit, possibly within the next 12 months. A new contract the Auto Workers Union finally ratified in October gave concessions that would allow the firm to be competitive with other steel companies. In turn, Ford Motor promised to modernize the Rouge Steel

plant. At yearend, Ford Motor announced plans to construct a $200 million casting operation.

[1]State Liaison Officer, Bureau of Mines, Minneapolis, MN.
[2]Program assistant, Bureau of Mines, Minneapolis, MN.
[3]Cannon, W. F., and M. G. Mudrey, Jr. The Potential for Diamond-Bearing Kimberlite in Northern Michigan and Wisconsin. U.S. Geol. Surv. Circ. 842, 1981, 15 pp.
[4]Industrial Minerals. New Refractory Mixture for Maintenance. Aug. 1983, pp. 17-18.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Dundee Cement Co., a division of Holderbank Financiere Glaris SA.[1 2]	Box 122 Dundee, MI 48131	Quarry, clay pit, plant	Monroe.
Medusa Cement Co., Medusa Corp., a subsidiary of Crane Co.[1 2]	Box 5668 Cleveland, OH 44101	Quarry and plant Clay pit	Charlevoix. Antrim.
National Gypsum Co., Huron Cement Div.[1 2]	4000 Town Center, Suite 2000 Southfield, MI 48075	Quarry, clay pit, plant	Alpena.
Peerless Cement Co., Gifford-Hill & Co. Inc.	9333 Dearborn St. Detroit, MI 48209	Plant	Wayne.
Clays:			
U.S. Brick Co., Michigan Div., a subsidiary of Canada Brick Co.	3820 Serr Rd. Corunna, MI 48817	Clay pit and plant	Shiawassee.
Gypsum:			
Georgia-Pacific Corp	133 Peachtree St., NE. Atlanta, GA 30303	Underground mine and plant.	Kent.
Michigan Gypsum Co	2840 Bay Rd. Saginaw, MI 48608	Open pit mine and plant.	Iosco.
National Gypsum Co	4100 First International Bldg. Dallas, TX 75270	do	Do.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Do.
Iron ore:			
Cleveland-Cliffs Iron Co.[3]	504 Spruce St. Ishpeming, MI 49849	Open pit mines and plants.	Marquette.
The Hanna Mining Co	Star Route 1, Box 131 Iron Mountain, MI 49801	Stockpile	Dickinson.
Iron and steel:			
McLouth Steel Products Corp	300 South Livernois Ave. Detroit, MI 48217	Plant	Wayne.
National Steel Corp., Great Lakes Steel Div.	Tecumseh Rd. Ecorse, MI 48229	do	Do.
Rouge Steel Co., a subsidiary of Ford Motor Co.	3001 Miller Rd. Dearborn, MI 48121	do	Do.
Lime:			
Detroit Lime Co., a subsidiary of Edward C. Levy Co.	9300 Dix Ave. Dearborn, MI 48120	do	Do.
The Dow Chemical Co., Ludington Div.	2020 Dow Center Midland, MI 48640	do	Mason.
Marblehead Lime Co., a division of General Dynamics Corp.	300 West Washington St. Chicago, IL 60606	Plants	Wayne.
Michigan Sugar Co	Box 1348 Saginaw, MI 48605	do	Huron, Saginaw, Sanilac, Tuscola.
Natural salines:[4]			
The Dow Chemical Co	2020 Dow Center Midland, MI 48120	Brine wells and plants	Mason and Midland.
Martin Marietta Corp., Magnesia Specialties Div.	Executive Plaza II Hunt Valley, MD 21030	Brine wells and plant	Manistee.
Morton Chemical Co., a division of Morton Thiokol Inc.	110 North Wacker Dr. Chicago, IL 60606	do	Do.
Peat:			
Al-Par Peat Co	9551 Krouse Ovid, MI 48866	Bog and plant	Shiawassee.
Hyponex Corp	2013 South Anthony Blvd. Fort Wayne, IN 46803	Bogs and plants	Lapeer and Shiawassee.
Michigan Peat Inc	Box 66388 Houston, TX 77006	do	Sanilac.
Perlite (expanded):			
Harborlite Corp	Box 458 Escondido, CA 92025	Plant	Kalamazoo.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Wayne.
Salt:			
Diamond Crystal Salt Co	916 South Riverside St. Clair, MI 48079	Brine wells and plant	St. Clair.
Hardy Salt Co	Drawer 449 St. Louis, MO 63166	do	Manistee.
International Salt Co., a subsidiary of Akzona Inc.	12841 Saunders St. Detroit, MI 48217	Underground mine	Wayne.
Morton Salt Co., a division of Morton Thiokol Inc.	110 North Wacker Dr. Chicago, IL 60606	Brine wells and plants	Manistee and St. Clair.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Construction (1982):			
American Aggregates Corp	Drawer 160 Greenville, OH 45331	Pits and plants	Kalamazoo, Livingston, Macomb, Oakland.
Blount Inc	Box 1468 Saginaw, MI 48605	do	Oakland and Osceola.
Medusa Aggregates Co., a subsidiary of Crane Co.	3135 Trabue Rd. Columbus, OH 43204	do	Oakland.
Bill Smith Sand & Gravel Inc	Box 23 Otsego, MI 49078	do	Allegan, Barry, Huron, Kalamazoo, Kent, Van Buren.
Whittaker & Gooding Co	5800 Cherry Hill Rd. Ypsilanti, MI 48197	do	Lapeer and Washtenaw.
Industrial:			
Construction Aggregates Corp	Box 68 Ferrysburg, MI 49409	Pit and plant	Ottawa.
Manley Brothers of Indiana Inc	Box 538 Chesterton, IN 46304	do	Macomb.
Nugent Sand Co. Inc	Box 1209 Muskegon, MI 49443	Pits and plant	Muskegon.
Ottawa Silica Co., Michigan Silica Div.	Box 577 Ottawa, IL 61350	Pit and plant	Wayne.
Sand Products Corp	1938 1st National Bldg. Detroit, MI 48226	Pits and plants	Oceana.
Sargent Sand Co	Box 6280 Saginaw, MI 48608	do	Mason, Saginaw, Wexford.
Slag:			
Edward C. Levy Co	8800 Dix Ave. Detroit, MI 48209	Plants	Wayne.
Stone:			
Crushed:			
Limestone:			
Drummond Dolomite Inc., a subsidiary of Bethlehem Steel Corp.	Martin Tower Bethlehem, PA 18016	Quarry and plant	Chippewa.
France Stone Co	Box 1928 Toledo, OH 43603	do	Monroe.
Inland Lime & Stone Co., a division of Inland Steel Co.	Gulliver, MI 49840	Quarries and plants	Mackinac and Schoolcraft.
Presque Isle Corp	Box 426 Alpena, MI 49707	Quarry and plant	Presque Isle.
Rockwood Stone Inc	Box 113 Rockwood, MI 48173	Quarries and plants	Monroe and Wayne.
United States Steel Corp., Michigan Limestone Operations.	Rogers City, MI 49779	do	Mackinac and Presque Isle.
Marl:			
Poehlman & Son	Route 2 Cassopolis, MI 49031	Quarry	Cass.
Sandstone:			
Jude Stone Quarry Co	338 Austin Rd. Napoleon, MI 49261	Quarry and plant	Jackson.
Traprock:			
Houghton County Road Commission.	Box 269 Hancock, MI 49930	Quarries and plant	Houghton.
Dimension:			
Limestone:			
Onaway Stone Co	715 3 Mile Rd. Traverse, MI 49684	Quarry	Presque Isle.
Sandstone:			
Jude Stone Quarry Co	338 Austin Rd. Napoleon, MI 49261	do	Jackson.
Sulfur (recovered):			
Marathon Oil Co	1300 South Fort St. Detroit, MI 48217	Elemental sulfur recovered as a byproduct of oil refining.	Wayne.
Shell Western E&P Inc	Box 1523 Houston, TX 77251	do	Manistee.
Total Petroleum Inc	999 18th St., 23d Floor Denver, CO 80202	do	Gratiot.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Processing plant	Wayne.

[1]Also clays.
[2]Also crushed limestone.
[3]Also iron oxide pigments.
[4]Includes bromine, bromine compounds, calcium compounds, iodine, and magnesium compounds.

The Mineral Industry of Minnesota

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Mineral Resources Research Center, University of Minnesota, for collecting information on all nonfuel minerals.

By James H. Aase[1]

Nonfuel minerals produced in Minnesota during 1983 were valued at $1.5 billion, a 31% increase over that of 1982 but about $700 million below the record high set in 1981. The gain over that of 1982 was attributed primarily to increased iron ore shipments and higher sand and gravel and crushed stone production.

During the year, 4 of the 10 mineral commodities produced had increased output, and the values of 7 increased over those of 1982. Approximately 92 cents of every dollar of the State's total mineral value was credited to iron ore. Among the nonmetallic minerals, construction sand and gravel led in output value, followed by crushed stone, cumulatively comprising about 5% of the State's total value.

Nationally, the State ranked fourth behind California, Texas, and Arizona, respectively, in value of nonfuel mineral production, and accounted for approximately 7% of the U.S. total. Among the individual mineral commodities produced in Minnesota during 1983, iron ore output ranked 1st among the 10 producing States; manganiferous ore, 2d of 2; construction sand and gravel, 5th of 50; peat, 7th of 22; dimension stone, 12th of 39; industrial sand, 12th of 37; lime, 23d of 39; crushed stone, 28th of 48; and clays, 39th of 44.

Table 1.—Nonfuel mineral production in Minnesota[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$5	NA	$5
Iron ore (usable) thousand long tons, gross weight	23,715	1,021,056	30,699	1,342,455
Lime thousand short tons	133	4,694	W	W
Manganiferous ore short tons	16,307	W	11,314	W
Sand and gravel:				
Construction thousand short tons	20,276	44,222	e24,600	e53,000
Industrial do.	694	5,903	685	12,932
Stone:				
Crushed do.	e7,100	e20,900	8,580	25,320
Dimension do.	e40	e11,940	28	11,365
Combined value of clays, peat, and values indicated by symbol W	XX	1,406	XX	9,953
Total	XX	1,110,126	XX	1,455,030

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Minnesota, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Aitkin	$127	$57	Peat, sand and gravel (construction).
Anoka	(2)	W	Sand and gravel (construction).
Becker	(2)	756	Do.
Beltrami	(2)	193	Do.
Benton	(2)	38	Do.
Big Stone	1,513	W	Do.
Blue Earth	1,572	W	Do.
Brown	W	W	Sand and gravel (construction), clays.
Carlton	W	W	Peat, sand and gravel (construction).
Carver	(2)	W	Sand and gravel (construction).
Cass	(2)	188	Do.
Chippewa	(2)	W	Do.
Chisago	(2)	W	Do.
Clay	636	3,730	Sand and gravel (construction), lime.
Clearwater	(2)	W	Sand and gravel (construction).
Cook	(2)	32	Do.
Cottonwood	(2)	--	
Crow Wing	W	W	Sand and gravel (construction), manganiferous ore.
Dakota	W	5,616	Sand and gravel (construction).
Dodge	W	W	Do.
Douglas	(2)	418	Do.
Faribault	(2)	--	
Fillmore	1,085	36	Sand and gravel (construction).
Freeborn	(2)	984	Do.
Goodhue	246	293	Do.
Grant	(2)	--	
Hennepin	W	4,636	Sand and gravel (construction).
Houston	797	811	Do.
Hubbard	(2)	280	Do.
Isanti	--	102	Do.
Itasca	152,964	W	Iron ore, sand and gravel (construction).
Jackson	(2)	--	
Kanabec	(2)	W	Sand and gravel (construction).
Kandiyohi	(2)	W	Do.
Kittson	(2)	W	Do.
Koochiching	(2)	85	Do.
Lac Qui Parle	(2)	107	Do.
Lake	(2)	W	Do.
Lake of the Woods	--	56	Do.
Le Sueur	W	W	Sand (industrial), sand and gravel (construction).
Lincoln	--	8	Sand and gravel (construction).
Lyon	(2)	W	Do.
McLeod	(2)	296	Do.
Mahnomen	(2)	211	Do.
Marshall	(2)	79	Do.
Martin	--	60	Do.
Meeker	(2)	W	Do.
Mille Lacs	283	W	Do.
Morrison	(2)	487	Do.
Mower	269	366	Do.
Murray	(2)	23	Do.
Nicollet	W	W	Do.
Nobles	(2)	--	
Norman	(2)	W	Sand and gravel (construction).
Olmsted	1,200	389	Do.
Otter Tail	20	W	Sand and gravel (construction), peat.
Pennington	(2)	81	Sand and gravel (construction).
Pine	(2)	W	Do.
Polk	1,676	3,343	Lime, sand and gravel (construction).
Pope	(2)	319	Sand and gravel (construction).
Ramsey	(2)	W	Do.
Redwood	W	W	Sand and gravel (construction), clays.
Renville	2,570	W	Lime, sand and gravel (construction).
Rice	(2)	345	Sand and gravel (construction).
Rock	36	W	Do.
Roseau	(2)	63	Do.
St. Louis	W	W	Iron ore, sand and gravel (construction), peat.
Scott	3,636	W	Sand (industrial), sand and gravel (construction).
Sherburne	(2)	529	Sand and gravel (construction).
Sibley	(2)	W	Do.
Stearns	W	239	Do.
Steele	W	960	Do.
Stevens	(2)	W	Do.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Minnesota, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Swift	(2)	W	Sand and gravel (construction).
Todd	(2)	$238	Do.
Wabasha	$244	282	Do.
Wadena	(2)	35	Do.
Waseca	(2)	--	
Washington	W	W	Sand and gravel (construction), sand (industrial).
Watonwan	(2)	48	Sand and gravel (construction).
Wilkin	(2)	84	Do.
Winona	1,525	606	Do.
Wright	W	871	Do.
Yellow Medicine	1,354	15	Do.
Undistributed[3]	1,933,233	1,048,893	
Sand and gravel (construction)	e49,770	XX	
Stone:			
Crushed	XX	e20,900	
Dimension	XX	e11,940	
Total[4]	2,154,761	1,110,126	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Pipestone, Red Lake, and Traverse Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Minnesota business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,125.6	2,149.3	+1.1
Unemployment	do.	223.6	167.1	-25.3
Employment (nonagricultural):				
Mining	do.	7.5	7.9	+5.3
Manufacturing	do.	330.9	348.0	+5.2
Contract construction	do.	44.4	51.2	+15.3
Transportation and public utilities	do.	90.3	92.5	+2.4
Wholesale and retail trade	do.	408.5	426.6	+4.4
Finance, insurance, real estate	do.	98.1	101.4	+3.4
Services	do.	377.7	395.0	+4.6
Government	do.	293.3	293.1	-.1
Total nonagricultural employment	do.	1,650.7	[1]1,715.6	+3.9
Personal income:				
Total	millions	$46,213	$48,348	+4.6
Per capita		$11,155	$11,666	+4.6
Construction activity:				
Number of private and public residential units authorized		18,955	24,878	+31.3
Value of nonresidential construction	millions	$1,006.0	$1,048.0	+4.2
Value of State road contract awards	do.	$216.0	$272.0	+25.9
Shipments of portland and masonry cement to and within the State	thousand short tons	1,145	1,162	+1.5
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,110.1	$1,455.0	+31.1
Value per capita, resident population		$269	$351	+30.5
Value per square mile		$13,205	$17,239	+30.6

pPreliminary.

[1]Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

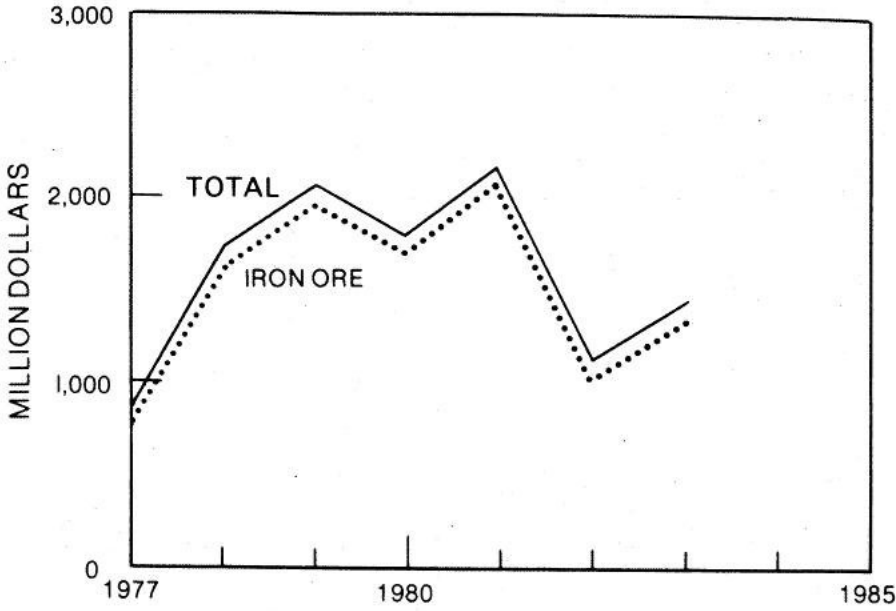

Figure 1.—Value of iron ore shipments and total value of nonfuel mineral production in Minnesota.

Employment.—According to the Minnesota Department of Economic Security, employment in the State's mining and quarrying industries ranged from a high of 10,400 working an average of 34.9 hours weekly during July to a low of 7,000 averaging 39.1 hours weekly during December. Peak employment during the year was approximately 24% below that of 1982.

Workers in metal mining comprised approximately 78% of the total mining and quarrying work force in 1983. At yearend, the average hourly earnings for the entire mining and quarrying work force was $12.36. Those in metal mining received the highest rate, averaging $13.05, an 11% decrease from that for the same period in 1982.

Trends and Developments.—A lag in recovery of the domestic steel industry effected production cutbacks and shutdowns at most of the State's iron ore operations. During the year, all Minnesota taconite production facilities had shutdowns ranging from approximately 4 weeks to 8-1/2 months. Although taconite pellet production increased slightly over that of 1982, it remained at a depressed level equal to about 40% of the State's 62.7-million-long-ton-per-year production capacity.

During the year, the first large lease of State-owned peatland was awarded to a Swedish firm, Rasjo Torv AB, Stockholm, which planned to develop the resource as an alternate energy source for fueling Minnesota industries. The 2,625 acres leased for 25 years in St. Louis County, near Zim, reportedly contain 4.5 million short tons of peat. Minnesota lent the company $1 million for the estimated $2.4 million project cost.

In mid-November, the Minnesota Department of Natural Resources (DNR) offered copper, nickel, and associated mineral exploration leases for sale on 1.1 million acres of State lands in nine northern Minnesota counties. Seventeen companies and individuals submitted 409 bids on 372 mining units that ranged from 40 acres to 1 square mile. Leases were to be awarded to the successful bidders in early 1984.

According to DNR data, 2 companies registered for the first time, and 15 other companies renewed registration to engage in exploration drilling for nonfuel minerals in the State. In 1983, 7 companies completed drilling at 33 sites in 6 counties.

Near midyear, the Duluth, Missabe and Iron Range Railway (DM&IR) dedicated and

began operating its new shiploading system at the Port of Duluth. The project included fitting a battery of 20 shuttle conveyors to one side of the company's dock 6, adapted for loading iron ore into the hatches of newer and larger lake vessels too wide and too high to load at some conventional gravity docks. The new shiploader is linked to DM&IR's adjacent 2.5-million-long-ton-capacity stockpile and storage facility. The shiploader pockets can be charged with iron ore either by reclaiming from the storage facility or by dumping directly from railroad cars.

Legislation and Government Programs.—Among the various mineral-related bills the 1983 Minnesota Legislature introduced and enacted into law were the following:

1. The repeal of the State gravel tax. The original law, the 1982 State Legislature passed, effective January 1, 1983, allowed counties to institute and administer a 10-cent-per-cubic-yard or 7-cent-per-short-ton tax on gravel from pits within their respective counties. The funds were to be used with 60% going to the county road and bridge fund, 30% to townships, and 10% to a special fund for pit restoration. Many county government officials indicated that administering the tax, and other factors, cost them more than they received from the tax, thus prompting the repeal. Only counties specifically requesting retention of gravel taxing powers will be affected.

2. An appropriation of $3.9 million during the 1983-85 budget period for startup of a Natural Resources Research Institute at the University of Minnesota—Duluth. The center will conduct applied research on State minerals and study such other State resources as biomass, timber, and water.

3. An extension of the time in which certain idle open pit mines must be fenced.

4. The inclusion of peat under mined land reclamation laws and the requirement that the commissioner of natural resources amend or adopt new rules for land reclamation before issuing permits to mine metallic minerals.

By Executive Order No. 83-39, the Governor of Minnesota ordered the establishment of an interagency task force to determine priorities for peat research and development and directed that this task force implement peat-related activities through the appropriate member agencies.

During 1983, the Minnesota Geological Survey (MGS) was involved in a variety of activities to achieve a better understanding of the State's geology and mineral resources. The following were included among the projects:

1. MGS published maps at scale 1:500,000 of Paleozoic lithostratigraphy and bedrock topography and isopachs of Cretaceous and Quaternary strata of southeastern Minnesota.

2. MGS drilled 13 holes to basement in the drift-covered area of west-central Minnesota where rocks of the Animikie Basin meet the Great Lakes tectonic zone. The cores are being analyzed for economic potential and for basic geologic information.

3. MGS continued work on karst hydrogeology in southeastern Minnesota to determine the impact of projected changes in world climate on the availability of ground water and influence on surface water in Minnesota.

4. MGS continued high-resolution aeromagnetic mapping in northwestern Minnesota. Resulting data from surveys in northeastern Minnesota were published as 1:250,000 scale color and contour anomaly maps.

5. MGS initiated a program by which the general public would be encouraged to submit geological samples to MGS for identification. Resulting information would be compiled as a county atlas. This program is patterned after a similar one in Finland that has led to discovering new economic minerals and ores, as well as increasing geologic knowledge of the country.

6. MGS continued geologic evaluation of sites for hazardous waste isolation. Emphasis in 1983 was on crystalline rock terranes.

Research at the Twin Cities Research Center of the U.S. Bureau of Mines included investigating new mineral processing technology designed in part to assist the State and the Nation in expanding the mineral resource base. Included among the findings the Bureau published during the year were reports on direct smelting of Duluth Complex sulfide concentrate,[2] beneficiation of nonmagnetic taconite after reduction roasting with lignite,[3] mineralogy and liberation characteristics of western Mesabi Range oxidized taconite,[4] and low-rank coals and waste materials for reduction roasting and metallization of iron oxides.[5]

The Mineral Resources Research Center of the University of Minnesota received a $150,000 grant in Federal fiscal year 1983 from the Bureau under the provisions of title III of Public Law 95-87. The grant was designed to encourage training mining engineers and scientists in mineral-related

studies. The funds, to be matched with non-Federal funds, can be used by the school for research projects, demonstrations, fellowships, and other programs.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Iron Ore.—Ranking first among the States in iron ore production, Minnesota accounted for approximately 69% of the total usable iron ore shipped from all U.S. mines in 1983. Production during the year was from one natural ore and eight taconite open pit mines that seven companies operated in Itasca and St. Louis Counties on the Mesabi Range.

The State's usable iron ore shipments in 1983, 96% as taconite pellets, rose nearly one-third over those of 1982. Pellet shipments, however, remained at about one-half the peak level reached in 1979 and were approximately three-fourths of the 10-year average.

Table 4.—Minnesota: Production and shipments of usable iron ore[1]

(Thousand long tons, gross weight, unless otherwise specified)

Year	Production				Shipments			
	Natural ore and concentrates	Pellets	Total	Iron content (percent)	Natural ore and concentrates	Pellets	Total	Proportion of pellets to total ore (percent)
1979	4,028	55,292	59,320	62.8	3,626	56,056	59,682	93.9
1980	2,050	43,112	45,162	63.4	2,371	43,101	45,472	94.8
1981	1,698	49,327	51,025	63.7	2,719	47,457	50,176	94.6
1982	527	23,372	[2]23,898	64.7	752	22,963	23,715	96.8
1983	865	25,390	26,255	64.4	1,113	29,586	30,699	96.4

[1]Exclusive of ore containing 5% or more manganese.
[2]Data do not add to total shown because of independent rounding.

In 1983, the Northwest Ore Div. of Jones & Laughlin Steel Corp. (J&L) marked its first operating season at the McKinley Extension Mine near Aurora on the eastern Mesabi Iron Range. The McKinley Extension Mine is the largest active natural ore operation in North America. With a production capacity of 2 million long tons of sinter fines annually, the mine ranks as the principal U.S. producer of sinter fines.

The continuing lag in economic recovery of the domestic steel industry adversely affected the demand for State-produced iron ore. During 1983, all the State's taconite pellet facilities produced at levels below their rated capacities and were shut down for various periods. The duration of closure at each of the State's eight taconite operations were as follows: Reserve Mining Co., 37 weeks; Erie Mining Co., 26 weeks; Hibbing Taconite Co. and Butler Taconite Co., 23 weeks; Inland Steel Mining Co., 12 weeks; National Steel Pellet Co. and Eveleth Taconite Co., 11 weeks; and United States Steel Corp., 4 weeks.

The Lake Superior Industrial Bureau reported that payroll costs of the State's taconite industry workers totaled about $207 million in 1983, a 14% decrease from that paid in 1982. Goods and services the taconite companies purchased totaled more than $452 million in 1983, a slight drop from that of 1982.

With one exception, the published prices for various grade classifications of Minnesota iron ore remained unchanged from those at yearend 1982. Effective August 1, 1983, J&L reduced the price of its Mesabi non-Bessemer coarse and fine ores, delivered rail-of-vessel, lower lake port, to $30.03 and $31.53 per gross ton, respectively. The coarse ore reduction reflected a $2.96 per ton or 14.3% reduction in the mine price, and the fine ore reduction represented a $1.30 per ton or 6.8% reduction in mine price. The price at yearend 1983 for Old Range non-Bessemer and manganiferous classifications—all for ore delivered at rail-of-vessel at lower lake ports and based on 51.50% natural iron content—was $32.78 per ton. The lower lake price for pellets was at two levels, 80.5 cents and 86.9 cents per long ton iron unit. The average weighted value of Minnesota iron ore shipped in 1983 was $43.73 per long ton.

Published freight rates, including rail

and water from the Mesabi Range to lower lake ports, ranged from $11.70 to $13.45 per gross ton in mid-1983. These rates exclude any applicable storage and dock handling charges.

Table 5.—Dates of first and final cargoes of Minnesota iron ore shipped from Upper Great Lakes ports

Port and dock	1982			1983		
	First shipment	Final shipment	Total tonnage (thousand long tons)	First shipment	Final shipment	Total tonnage (thousand long tons)
Duluth, MN: DM&IR	Apr. 20	Dec. 4	[1]5,982	Apr. 4	Dec. 16	6,560
Silver Bay, MN: Reserve	Apr. 30	Oct. 22	2,124	Apr. 9	Dec. 21	2,717
Superior, WI: Burlington-Northern	Apr. 13	Dec. 13	7,958	Apr. 5	Dec. 21	8,668
Taconite Harbor, MN: Erie	Apr. 22	Nov. 28	3,624	Apr. 2	Dec. 30	3,861
Two Harbors, MN: DM&IR	Apr. 20	Dec. 24	4,478	Apr. 1	Dec. 28	8,336
Total			24,166			30,142

[1]Includes 909 tons of flue dust from the former Duluth works of the United States Steel Corp.

Sources: American Iron Ore Association and various issues of Skillings' Mining Review.

Manganiferous Ore.—Pittsburgh Pacific Co., the State's only producer of manganiferous ore (containing 5% to 35% manganese, natural) in 1983, processed crude stockpiled material from the Algoma-Zeno Mine at its concentration plant in Crow Wing County on the Cuyuna Range. Shipments during the year decreased about 31% from those in 1982 and were at the lowest level of record.

Table 6.—Minnesota: Shipments of manganiferous ores[1] from the Cuyuna Range

Year	Ferruginous manganese ore (10% to 35% Mn, natural)		
	Quantity (long tons)	Contents (natural)	
		Fe (percent)	Mn (percent)
1979	162,056	28.82	14.09
1980	106,276	32.00	14.04
1981	124,617	29.84	14.84
1982	14,560	r28.99	r15.66
1983	10,102	30.81	14.63

rRevised.

[1]All manganiferous ore shipped from the Cuyuna Range during 1979-83 was ferruginous manganese ore containing 10% to 35% manganese. There have been no shipments of manganiferous iron ore containing 5% to 10% manganese since 1969.

NONMETALS

Clays.—The quantity and value of clay produced in 1983 rose more than twofold over that of 1982. Ochs Brick & Tile Co. extracted the product from pits in Brown and Redwood Counties. The company used the output in face brick manufacturing at its plant near Springfield.

Lime.—Lime produced in 1983 fell significantly below the 1982 level. American Crystal Sugar Co. and Southern Minnesota Sugar Coop., accounting for the entire output, consumed all of their own production in sugar-refining operations. Lime production by American Crystal Sugar was from plants at its sugar refineries in Crookston, East Grand Forks, and Moorhead, and by Southern Minnesota Sugar at its Renville operation. All the high-quality limestone the two companies used in manufacturing quicklime was obtained from out-of-State sources.

Peat.—Four companies produced peat from bogs in Aitkin, Carlton, Otter Tail, and St. Louis Counties. Although the quantity produced in 1983 was about 20% less than the 1982 output, its value increased about 9%. The principal type of peat harvested during the year was reed-sedge, together with lesser quantities of sphagnum and hypnum. Over three-fourths of the peat sold during the year was marketed in packages, the remainder in bulk. The product was used extensively in golf course maintenance and in bedding for nursery stock.

Perlite (Expanded).—At its plant near Cloquet in Carlton County, Conwed Corp. expanded perlite mined in other States. The expanded material was used in manufacturing formed products.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Table 7.—Minnesota: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	5,564	$11,332	$2.04	NA	NA	NA
Gravel	12,480	29,611	2.37	NA	NA	NA
Sand and gravel (unprocessed)	2,232	3,279	1.47	NA	NA	NA
Total or average	20,276	44,222	2.18	e24,600	e$53,000	e$2.15
Industrial sand	694	5,903	8.50	685	12,932	18.87
Grand total or average	[1]20,971	50,125	2.39	e25,285	e65,932	e2.61

eEstimated. NA Not available.
[1]Data do not add to total shown because of independent rounding.

Industrial.—Industrial sand production in 1983 came from operations of Minnesota Frac Sand Co. in Scott County, Unimin Corp. in Le Sueur County, and Twin City Silica Ltd. in Washington County. Production during the year remained at nearly the same level as in 1982. One of the principal uses of the marketed material was as a specialty sand the petroleum industry used in its hydrofracturing process to increase oil recovery from certain type wells. Trucks were the principal mode for transporting the industrial sand output, handling about 87% of the shipments.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Granite, limestone, quartzite, and traprock were all produced in the State during 1983. Stone production increased 21% over the quantity estimated to have been produced in 1982. In 1983, 38 firms quarried stone at 85 sites in 24 counties.

Crushed.—Crushed limestone, the principal rock type produced in 1983, came from 66 quarries in 15 counties. Among the specified uses of the limestone mined, the largest amount was for use as a dense road base material. Scott County led in crushed limestone output.

Four companies produced crushed granite from four quarries in Big Stone, Stearns, and Yellow Medicine Counties, mainly for use as railroad ballast.

Crushed quartzite and crushed traprock were produced at single operations in Nicollet and St. Louis Counties, respectively. The crushed materials were used most extensively as an aggregate in concrete and bituminous mixes.

More than one-half of Minnesota's crushed stone output was by three firms. Production from individual quarry operations during 1983 varied widely, with 34 quarries producing less than 25,000 tons; 10 quarries between 25,000 and 50,000 tons; 18 quarries between 50,000 and 200,000 tons; 6 quarries between 200,000 and 500,000 tons; and 5 quarries in excess of 500,000 tons. Approximately four-fifths of all the crushed stone shipped in 1983 was handled by truck.

Table 8.—Minnesota: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	136	491
Coarse aggregate, graded:		
Concrete aggregate, coarse	389	1,340
Bituminous aggregate, coarse	247	898
Bituminous surface treatment aggregate	161	453
Railroad ballast	1,045	2,967
Fine aggregate (-3/8 inch):		
Stone sand, concrete	9	W
Screening, undesignated	4	11
Coarse and fine aggregate:		
Graded road base or subbase	2,254	6,063
Unpaved road surfacing	501	1,461
Crusher run or fill or waste	60	85
Agricultural: Agricultural limestone	337	1,220
Special: Other[2]	3,438	10,332
Total[3]	8,580	25,320

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes dolomite, granite, limestone, quartzite, sandstone, and traprock.
[2]Includes stone used for poultry grit and mineral food, macadam, filter stone, lime manufacture, other fillers or extenders, stone sand (bituminous mix or seal), coarse aggregate (graded), uses not specified, and value indicated by symbol W.
[3]Data do not add to totals shown because of independent rounding.

Table 9.—Minnesota: Crushed limestone and dolomite sold or used by producers, by county

County	1981			1983		
	Number of quarries	Quantity (thousand short tons)	Value (thousands)	Number of quarries	Quantity (thousand short tons)	Value (thousands)
Fillmore	5	328	$1,085	5	285	$963
Goodhue	9	114	246	5	74	134
Grant	--	--	--	1	109	325
Hennepin	1	3	21	--	--	--
Le Sueur	1	6	12	--	--	--
Mower	1	92	269	1	W	W
Olmsted	13	436	1,200	8	1,218	3,233
Scott	4	1,333	3,636	4	1,603	5,398
Wabasha	7	105	244	4	170	395
Washington	5	1,056	2,534	4	1,057	2,486
Winona	13	257	695	8	173	485
Undistributed[1]	r26	1,187	3,353	26	1,516	4,774
Total[2]	85	4,918	13,295	66	6,206	18,194

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes Blue Earth, Dakota, Dodge, Houston, Steele, and Wright Counties and data indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

Dimension.—Dimension limestone was quarried by three companies in Blue Earth, Le Sueur, and Winona Counties. Cut and sawed stone were the principal products marketed.

Dimension granite was produced at nine quarries operated by two companies in Big Stone, Mille Lacs, Redwood, Renville, and Stearns Counties. The quarried material was marketed most extensively as cut stone and monumental stone. Stearns County led in dimension granite production in the State during 1983.

Table 10.—Minnesota: Dimension stone[1] sold or used in 1983, by use

Use	Quantity (short tons)	Quantity (thousand cubic feet)	Value (thousands)
Rough stone:			
Rough blocks for buildings and other construction	524	7	$52
Irregular-shaped stone	569	7	27
Dressed stone for building and other construction:			
Ashlars and partially squared pieces	21,874	266	8,589
Slabs and blocks	2,160	27	1,350
Other[2]	2,524	31	1,346
Total[3]	27,651	337	11,365

[1]Includes granite and limestone.
[2]Includes rough and dressed monumental and dressed flagging.
[3]Data do not add to totals shown because of independent rounding.

Sulfur (Recovered).—Elemental sulfur was recovered as a byproduct of petroleum refining operations of Koch Refining Co., a division of Koch Industries Inc., near Pine Bend in Dakota County, and by Northwestern Refining Co., a division of Ashland Oil Inc., near St. Paul Park in Washington County. The quantity and value of the sulfur produced and sold in 1983 was appreciably greater than the 1982 levels.

Vermiculite (Exfoliated).—W. R. Grace & Co. exfoliated processed vermiculite from out-of-State sources at its plant in Hennepin County. Output increased modestly over that of 1982. The product was marketed for a variety of uses, including aggregate in concrete, block insulation, fireproofing, horticultural purposes, and loose-fill insulation.

[1]State Liaison Officer, Bureau of Mines, Minneapolis, MN.
[2]Shah, I. D., P. L. Ruzzi, and R. B. Schluter. Low-Iron Cu-Ni-Co Matte From Duluth Complex Sulfide Concentrate by Direct Smelting. BuMines RI 8752, 1983, 10 pp.
[3]Peterson, R. E., and J. E. Moy. Beneficiation of a Western Mesabi Nonmagnetic Taconite After Reduction Roasting With Lignite. BuMines RI 8790, 1983, 19 pp.
[4]Blake, R. L. Mineralogy and Liberation Characteristics of Western Mesabi Range Oxidized Taconites. BuMines RI 8813, 1983, 26 pp.
[5]Peterson, R. E., and W. M. Mahan. Low-Rank Coals and Waste Materials for Reduction Roasting and Metallization of Iron Oxides. BuMines RI 8746, 1983, 17 pp.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Clay:			
Ochs Brick & Tile Co	Box 106 Springfield, MN 56087	Pits and plants	Brown and Redwood.
Iron ore:			
The Hanna Mining Co.:	100 Erieview Plaza Cleveland, OH 44114		
Butler Taconite Project		Mine, concentrator, agglomerator.	Itasca.
National Steel Pellet Project		do	Itasca and St. Louis.
Inland Steel Mining Co.:	30 West Monroe St. Chicago, IL 60603		
Minorca		do	St. Louis.
Jones & Laughlin Steel Corp.	Box 196 Aurora, MN 55705		
Northwest Ore Div.:			
McKinley Extension		Mine and concentrator.	Do.
Oglebay Norton Co.:	1100 Superior Ave. Cleveland, OH 44114		
Eveleth Mines		Mine, concentrator, agglomerator.	Do.
Pickands Mather & Co.:	1100 Superior Ave. Cleveland, OH 44114		
Erie Commercial		do	Do.
Hibbing Taconite		do	Do.
Pittsburgh Pacific Co.:	2521 1st Ave. Hibbing, MN 55746		
Connie, Pittsburgh Pacific Fee, and Silver.		Stockpile shipments.	Do.
Reserve Mining Co	Silver Bay, MN 55614		
Peter Mitchell		Mine and primary crusher.	Do.
Silver Bay plant		Concentrator and agglomerator.	Lake.
Rhude & Fryberger Inc.:	Box 66 Hibbing, MN 55746		
Gross-Nelson, Hull-Rust, Rana, Sharon Culver and Wabigon.		Stockpile shipments.	St. Louis.
United States Steel Corp.	Box 417 Mountain Iron, MN 55768		
Minnesota Ore Operations:			
Minntac		Mine, concentrator, agglomerator.	Do.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lime:			
American Crystal Sugar Co	101 North 3d St. Moorhead, MN 56560	Quicklime and shaft kilns.	Clay and Polk.
Southern Minnesota Sugar Coop	Box 500 Renville, MN 56284	do	Renville.
Manganiferous ore:			
Pittsburgh Pacific Co.:	2521 1st Ave. Hibbing, MN 55746		
Algoma-Zeno		Stockpile shipments.	Crow Wing.
Peat:			
Michigan Peat Co	Box 66388 Houston, TX 77266	Bog and processing plant.	Carlton.
Northern Peat Co	Box 416 Grand Rapids, MN 55744	do	Aitkin.
Power-O-Peat Co	Box 956 Gilbert, MN 55741	do	St. Louis.
Tamarack Peat Moss Co	Underwood, MN 56586	do	Otter Tail.
Perlite (expanded):			
Conwed Corp	Box 43237 St. Paul, MN 55164	Plant	Carlton.
Sand and gravel:			
Construction (1982):			
Arsenal Sand & Gravel Co	Box 2707 New Brighton, MN 55112	Pit and plant	Ramsey.
Barton Contracting Co	10633 89th Ave. North Osseo, MN 55369	Pits and plants	Dakota, Hennepin, Sherburne, Washington, Wright.
Cemstone Products Co	1520 Minnehaha Ave. St. Paul, MN 55106	Pit and plant	Washington.
Duininck Bros. & Gilchrist	Prinsburg, MN 56281	Pits and plants	Becker, Clay, Itasca, Kandiyohi, Kittson, Otter Tail.
Fischer Construction Co. Inc	6801 West 150th St. Apple Valley, MN 55124	Pit and plant	Dakota.
Komatz Construction Inc	Box 498 St. Peter, MN 56082	do	Le Sueur.
Kost Bros. Inc	Box 499 Moorhead, MN 56560	Pits and plants	Clay and Otter Tail.
C. S. McCrossan Inc	Box 322 Osseo, MN 55369	Pit and plant	Hennepin.
McNamara-Vivant Contracting Co.	14605 Johnny Cake Ridge Rd. Apple Valley, MN 55124	do	Dakota.
Mark Sand & Gravel Co	Highway 59 South Fergus Falls, MN 56537	Pits and plants	Otter Tail.
William Mueller & Sons Co	Hamburg, MN 55339	do	Carver and McLeod.
North Star Concrete Co	Box 167 Mankato, MN 56001	do	Le Sueur and Nicollet.
Northwestern Aggregates Inc., a division of Model Stone Co.	Box 1248 Burnsville, MN 55337	Pit and plant	Dakota.
J. L. Shiely Co	1101 North Snelling Ave. St. Paul, MN 55108	do	Washington.
Ulland Bros. Inc	Box 340 Cloquet, MN 55720	Pits and plants	Carlton, Freeborn, Mower, St. Louis, Steele.
Industrial:			
Minnesota Frac Sand Co., a division of J. L. Shiely Co.	1101 North Snelling Ave. St. Paul, MN 55108	Pit and plant	Scott.
Twin City Silica Ltd	499 Cottage Grove Dr. Woodbury, MN 55125	do	Washington.
Unimin Corp	50 Locust Ave. New Canaan, CT 06840	Pits and plants	Le Sueur.
Stone:			
Crushed:			
Granite:			
Cold Spring Granite Co	Cold Spring, MN 56320	Quarries and plant	Stearns.
The Green Co. Inc	200 14th Ave. Granite Falls, MN 56241	Quarry and plant	Yellow Medicine.
Ortonville Stone Co., a subsidiary of L. G. Everist Inc.	Box 829 Sioux Falls, SD 57102	do	Big Stone.
J. L. Shiely Co	1101 North Snelling Ave. St. Paul, MN 55108	do	Stearns.
Limestone:			
Bryan Rock Products Inc	Box 215 Shakopee, MN 55379	Quarries and plants.	Scott and Washington.
Edward Kraemer & Sons Inc.	1000 West 122d St. Burnsville, MN 55378	Quarry and plant	Dakota.
Mankato Aglime & Rock Co	Box 254 Mankato, MN 56001	do	Blue Earth.
Mathy Construction Co., Patterson Quarries Div.	Route 3, Box 15 St. Charles, MN 55972	Quarries and plants.	Olmsted, Wabasha, Winona.
Midwest Asphalt Corp., River Warren Aggregates Inc.	Box 338 Hopkins, MN 55343	Quarry and plant	Scott.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Crushed —Continued			
Limestone —Continued			
Quarve & Anderson Co	2430 Marion Rd. SE. Rochester, MN 55901	Quarries and plants.	Dodge, Goodhue, Olmsted, Wabasha, Winona.
J. L. Shiely Co	1101 North Snelling Ave. St. Paul, MN 55108	do	Scott and Washington.
Quartzite:			
New Ulm Quartzite Quarries Inc.	Route 5, Box 21 New Ulm, MN 56073	Quarry and plant	Nicollet.
Traprock (basalt):			
Arrowhead Blacktop Co	Box 6568 Duluth, MN 55806	do	St. Louis.
Dimension:			
Granite:			
Cold Spring Granite Co	Cold Spring, MN 56320	Quarries	Big Stone, Mille Lacs, Renville.
Do		Quarries and plant	Stearns.
View Quarry Co., a division of Rex Granite Co.	Box 924 St. Cloud, MN 56302	Quarry and plant	Redwood.
Limestone:			
Biesanz Stone Co. Inc	Box 768 Winona, MN 55987	do	Winona.
Minnesota Ouarries Inc	Box 1358 Mankato, MN 56002	do	Blue Earth.
Vetter Stone Co	Route 5, Box 41 Mankato, MN 56001	do	Le Sueur.
Sulfur (recovered):			
Koch Refining Co., a division of Koch Industries Inc.	Box 2302 Wichita, KS 67201	Elemental sulfur recovered as a by-product of oil refining.	Dakota.
Northwestern Refining Co., a division of Ashland Oil Inc.	Drawer 9 St. Paul Park, MN 55071	do	Washington.
Vermiculite (exfoliated):			
W. R. Grace & Co., Construction Products Div.	62 Whittemore Ave. Cambridge, MA 02140	Processing plant	Hennepin.

The Mineral Industry of Mississippi

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Bureau of Geology and Energy Resources, Mississippi Department of Natural Resources, for collecting information on all nonfuel minerals.

By James R. Boyle[1] and Alvin R. Bicker[2]

The value of Mississippi's nonfuel mineral industry in 1983 was $89.7 million, an increase of $17.0 million over that of 1982, reversing a downward trend that started in 1979. Mississippi continued to feel lingering effects from the State's economic slump that lasted longer than the national recession.

Mississippi ranked second nationally in the production of bentonite and recovered sulfur, and fourth in fuller's earth. Major commodities produced were cement, clays, sand and gravel, and stone. Although output increased, total value was still below the peak years of 1978 through 1981. Along with a general upturn in construction, road maintenance programs also increased, developing more markets for mineral products.

Table 1.—Nonfuel mineral production in Mississippi[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	805	$21,181	1,446	$23,846
Sand and gravel (construction) do	9,455	27,115	e11,000	e34,600
Stone (crushed) do	W	W	1,651	4,377
Combined value of cement, sand and gravel (industrial), and value indicated by symbol W	XX	24,389	XX	26,882
Total	XX	72,685	XX	89,705

eEstimated. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Mississippi, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Adams	(2)	W	Sand and gravel (construction).
Benton	W	W	Clays.
Bolivar	(2)	$227	Sand and gravel (construction).
Carroll	$121	W	Do.
Clay	W	W	Do.
Copiah	(2)	4,814	Do.
DeSoto	(2)	2,751	Do.
Forrest	(2)	W	Do.
George	(2)	40	Do.
Hancock	(2)	81	Do.
Harrison	(2)	40	Do.
Hinds	W	W	Clays.
Holmes	(2)	W	Sand and gravel (construction).
Itawamba	(2)	1,654	Do.
Jackson	--	W	Sand and gravel (industrial).
Jasper	104	54	Sand and gravel (construction).
Jefferson Davis	(2)	16	Do.
Jones	W	W	Clays.
Kemper	W	W	Do.
Lauderdale	--	W	Sand and gravel (construction).
Lincoln	W	W	Do.
Lowndes	W	W	Cement, sand and gravel (construction), clays.
Marion	(2)	1,260	Sand and gravel (construction).
Marshall	W	W	Clays.
Monroe	7,060	7,373	Clays, sand and gravel (construction).
Newton	(2)	--	
Noxubee	683	W	Clays.
Panola	W	W	Clays, sand and gravel (construction).
Pearl River	(2)	353	Sand and gravel (construction).
Perry	(2)	11	Do.
Pike	(2)	W	Do.
Rankin	W	(3)	
Smith	27	(3)	
Stone	(2)	W	Sand and gravel (construction).
Sunflower	13	--	
Tate	(2)	--	
Tippah	W	W	Clays.
Tishomingo	W	W	Sand and gravel (industrial), sand and gravel (construction).
Walthall	(2)	154	Sand and gravel (construction).
Warren	(2)	W	Do.
Washington	(2)	W	Do.
Wayne	W	(3)	
Winston	W	W	Clays.
Yalobusha	(2)	W	Sand and gravel (construction).
Yazoo	(2)	W	Do.
Undistributed[4]	54,983	53,854	
Sand and gravel (construction)	e29,260	XX	
Stone (crushed)	XX	W	
Total	92,251	[5]72,685	

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties were not listed because no nonfuel mineral production was reported: Alcorn, Amite, Attala, Calhoun, Chickasaw, Choctaw, Claiborne, Clarke, Coahoma, Covington, Franklin, Greene, Grenada, Humphreys, Issaquena, Jefferson, Lafayette, Lamar, Lawrence, Leake, Lee, Leflore, Madison, Montgomery, Neshoba, Oktibbeha, Pontotoc, Prentiss, Quitman, Scott, Sharkey, Simpson, Tallahatchie, Tunica, Union, Webster, and Wilkinson. County distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2]Construction sand and gravel was produced; data not available by county.

[3]Crushed stone was produced; data not available by county.

[4]Includes mineral production that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Mississippi business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,055.7	1,022.9	-3.1
Unemployment	do.	155.6	113.2	-27.2
Employment (nonagricultural):				
Mining[1]	do.	8.6	9.1	+5.8
Manufacturing	do.	193.3	209.7	+8.5
Contract construction	do.	33.0	31.9	-3.3
Transportation and public utilities	do.	37.6	37.9	+.8
Wholesale and retail trade	do.	157.6	163.9	+4.0
Finance, insurance, real estate	do.	32.9	34.0	+3.3
Services	do.	122.7	125.2	+2.0
Government	do.	182.8	181.4	-.8
Total nonagricultural employment[1 2]	do.	768.7	793.0	+3.2
Personal income:				
Total	millions	$19,833	$20,885	+5.3
Per capita		$7,725	$8,072	+4.5
Construction activity:				
Number of private and public residential units authorized		6,207	9,558	+54.0
Value of nonresidential construction	millions	$169.3	$194.8	+15.1
Value of State road contract awards	do.	$108.0	$202.0	+87.0
Shipments of portland and masonry cement to and within the State	thousand short tons	712	767	+7.7
Nonfuel mineral production value:				
Total crude mineral value	millions	$72.7	$89.7	+23.4
Value per capita, resident population		$28	$35	+25.0
Value per square mile		$1,523	$1,881	+23.5

[p]Preliminary.
[1]Includes oil and gas extraction.
[2]Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

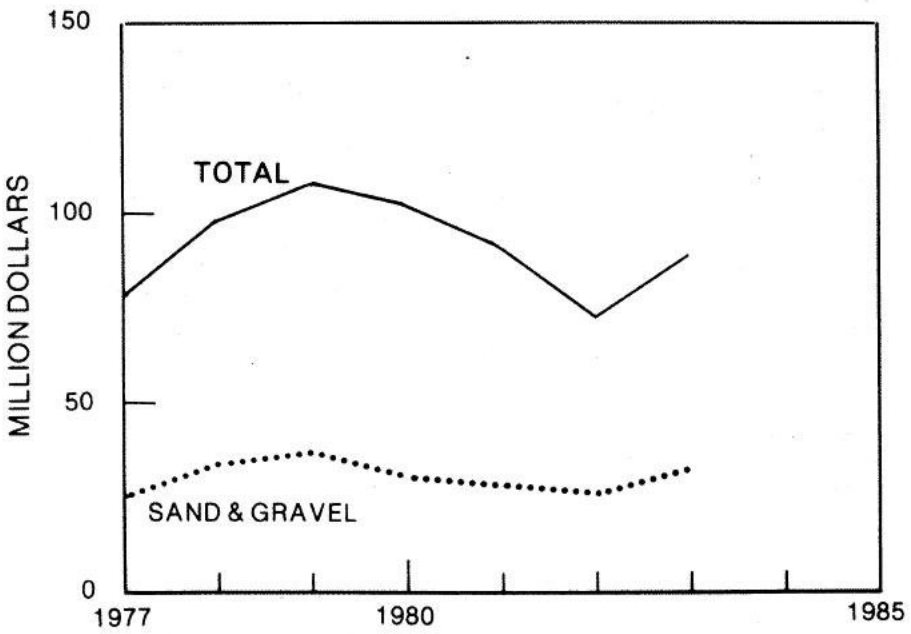

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Mississippi.

Trends and Developments.—Unemployment at yearend 1982 was 11.4%, rose to a peak of 13.8% in midyear, and declined to about 10% by yearend 1983. Virtually every portion of the State's economy improved over that of 1982. The unemployment rate basically paralleled construction activity, which was down early in the year with a resurgence about midyear continuing to yearend; in general, construction minerals output followed the same pattern. Although construction activity improved considerably over that of 1982, the State's recovery remained the weakest in the Southeast.

The State is vulnerable to new economic setbacks because of the relatively high proportion of its work force in manufacturing. This translates into a high risk for construction activities that are the major users of the State's mineral output. It appears, however, that the resurgence that started at midyear will carry through 1984.[3] Construction continued on the Tennessee-Tombigbee Waterway in the northeastern part of the State with completion scheduled for 1985. With the project over 85% complete, the demand for construction aggregates was minimal, lowering demand from nearby crushed stone and sand and gravel producers. Of the total estimated cost of $2 billion for the waterway, by yearend, about $1.5 billion had been expended. Metallic ores, industrial minerals, and primary metals are expected to be the major commodities shipped on the waterway. Several clay, gravel, and crushed stone producers in the area of the waterway have indicated that it would benefit movement of their mineral commodities. During the year, a 7-year-old lawsuit, filed by several groups opposed to the waterway on environmental grounds, was dimissed in Federal court, allowing completion of the project.

E. I. du Pont de Nemours & Co. and Kerr-McGee Chemical Corp. produced titanium dioxide utilizing the chloride process; total rated capacity of the two plants exceeds 200,000 tons per year. During fiscal year 1983, 176,000 tons of ilmenite was imported from Australia and shipped to Du Pont's plant at Pass Christian. Kerr-McGee, Hamilton, received synthetic rutile from its plant in Mobile where raw material from Australia was converted into synthetic rutile. Kerr-McGee also operated an electrolytic manganese plant at Hamilton utilizing pyrolusite from Gabon, West Africa. At Hamilton, Kerr-McGee completed expansion of its sodium chlorate facility, increasing capacity from 40,000 to 62,000 tons per year. Kerr-McGee announced a $4 million expansion of its chloride process titanium dioxide pigment plant, which will increase capacity from 56,000 to 63,000 tons per year. Completion was scheduled for late 1984. Plans were underway to build a 10,000-ton-per-year manganese dioxide plant at the facilities.

Lincoln Dimensional Tube Inc. opened a copper tube mill in Greenville, with plans to produce 2.5 million pounds of tubing per year. The company invested $2 million in new equipment to produce copper capillary tubing used in the instrument and control markets.

Mississippi Chemical Corp., Pascagoula, signed a 10-year potash purchase agreement with the Israeli Dead Sea Works early in the year. Quantities to be supplied may range from 100,000 to 300,000 tons per year at a price related to Carlsbad potash prices. The potash will be shipped to the Port of Mobile, AL, and barged to Pascagoula.

Legislation and Government Programs.—During the year, the Mississippi Bureau of Geology and Energy Resources continued investigation of the geology and mineral resources of the State. The Surface Section continued field investigations in Newton County and published a report in the Vicksburg Formation. The Subsurface Section completed an investigation of the geothermal resources in south and central Mississippi. A project was initiated on subsurface mapping in south Mississippi. The Mineral Lease Section leased State-owned lands for mineral exploration. Income derived from leasing, royalty, and permit activity totaled $10.7 million during the year. The Groundwater Section completed 170 electric logs of water wells. The Surface Mining Section continued to administer the Surface Mining Act of 1977.

The Bureau of Geology continued quarterly publication of "Mississippi Geology." Contents included research articles pertaining to Mississippi, geology news items, and listings of recent geologic literature.

The U.S. Bureau of Land Management announced that $40,000 in mineral leasing payments was given to the State in 1983. Revenue from Federal mineral leasing activities are split equally with the States in which the activity occurs.

The Mississippi Mineral Resources Institute, Oxford, was officially created as a statutory entity through legislation embodied in S.B. 2720 passed by the Mississippi

Legislature in regular session in 1983. The institute's programs included studies of heavy minerals offshore, utilization of zeolites, and analyses of clays and sand and gravel. In addition to other geologic studies, the institute had several energy-related projects on lignite and oil and gas. The institute initiated an ongoing program to aid in the commercialization of minerals in the State. The chief function was to develop a program of continuous and systematic research to identify minerals with potential for commercial development and to assist in solving the problems involved in bringing the minerals into production. In fiscal year 1983, the U.S. Bureau of Mines allotted $150,000 to the institute to foster and support graduate education in mineral sciences and engineering.

The U.S. Bureau of Mines contracted with Jackson State University, Jackson, to conduct a study of characteristics of respirable mine dust. The contract amount was $60,000. Since 1981, the Bureau completed mineral assessment surveys and/or reports on 2,400 acres of wilderness and wilderness-suitable lands in the State.

Mississippi became the first State to receive authorization to manage the entire State Environmental Protection Agency hazardous waste program. The program, administered by the Bureau of Pollution Control, Department of Natural Resources, began in 1976 with the signing of the Resource Recovery Act. The program calls for the State's facilities to be permitted by 1988. About 2 million tons per year of hazardous wastes are now being generated in Mississippi, with most being disposed of on-site.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for all of Mississippi's nonfuel mineral production in 1983. Commodities produced included cement, clays, sand and gravel, and crushed stone.

Cement.—Mississippi's cement industry was composed of one firm, United Cement Co., in Lowndes County in the east-central part of the State. Valuewise, cement remained one of the leading commodities produced in Mississippi. Portland cement shipments increased slightly, reversing a downward trend that started in 1977. The company's primary output was portland cement, with minor amounts of masonry cement. Unit prices of portland cement increased, while that of masonry cement decreased from that of 1982.

Principal portland cement sales were to ready-mix concrete companies, building materials dealers, concrete products manufacturers, highway contractors, and other contractors. Raw materials used in cement manufacture included chalk, gypsum, iron ore, limestone, and sand. The stone used had a high alumina content, eliminating the need for clay; iron ore was shipped in from Alabama. After crushing and grinding of raw material, it was slurried to the kiln and fired with finely ground coal. After grinding with gypsum, the cement was shipped to six southeastern States.

Clays.—Mississippi's clay industry consisted of 17 companies operating mines in 12 counties, primarily in the northern and northeastern parts of the State. Total clay output increased over that of 1982, reversing a downward trend that started in 1978. Common clay, bentonite, and fuller's earth were produced in Mississippi. The State ranked second nationally in output of bentonite, and fourth in fuller's earth. Clays produced in the State were used in the automotive, construction, agricultural, and animal-feed industries. Output of common clays increased substantially, while that of ball clay, bentonite, and fuller's earth increased slightly over that of 1982.

Common clays were mined by 12 companies operating 17 pits in 8 counties, centering in Hinds, Noxubee, and Kemper Counties. Major sales were for brick, concrete block, and structural concrete. Output was 943,000 tons compared with 330,000 tons in 1982, the first increase in production since 1978. The resurgence of construction activities at midyear had a direct effect on brick companies in the State. Delta-Macon Brick and Tile Co., Macon, installed a wood gasifier system to reduce operating costs and become more competitive; the system went on-line late in the year.

Ky-Tenn Clay Co. was the only producer of ball clay in the State; output was from a surface mine in Panola County. The clay was trucked about 10 miles to the plant for processing for a variety of uses. Demand remained at a low level with output slightly over that of 1982. The product was shipped mostly out of State with some being exported. Cypress Industrial Minerals Co. con-

ducted a clay exploration program in Panola County; a small pit was developed with the mined material tested to determine if future mining would be feasible.

Mississippi's bentonite producers, American Colloid Co., Harshaw-Filtrol Partnership, and International Minerals & Chemical Corp. (IMC), operated three surface mines in Monroe County. From 6 to 8 feet of clay was mined after removal of overburden of up to 130 feet. Bentonite was trucked to nearby plants where it was processed for sale to the automotive industry as a foundry binder and to the agricultural industry for use as an animal-feed binder. Demand remained relatively low and at about the same level as that of 1982. Shipments were mostly to out-of-State markets.

Table 4.—Mississippi: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Bentonite		Ball clay, fire clay, fuller's earth		Common clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1979	318	7,128	W	W	1,221	3,162	1,820	21,841
1980	275	6,234	W	W	1,054	3,292	1,596	21,714
1981	285	7,060	W	W	649	2,028	1,218	23,309
1982	232	6,063	W	W	330	1,212	805	21,181
1983	241	5,952	W	W	943	2,694	1,446	23,846

W Withheld to avoid disclosing company proprietary data; included in "Total."

Two companies, IMC and Oil-Dri Production Co., mined fuller's earth from open pits in Tippah County. Overburden of less than 20 feet was removed to recover clay, which averaged up to 25 feet thick. The clay was processed at nearby plants for sale to the agricultural industry. Markets for fuller's earth remained depressed with production slightly over 1982 levels.

Perlite (Expanded).—Manville Products Corp., Natchez, and United States Gypsum Co., Greenville, expanded perlite shipped in from New Mexico. The product was used in roof insulation and in formed products. Commercial construction, which was not as depressed as residential construction, was the primary market. Production and value decreased slightly from that of 1982. Mississippi ranked third nationally in output of expanded perlite.

Sand and Gravel.—Mississippi produced both construction and industrial sand and gravel in 1983. Total sand and gravel production was estimated to have increased to its highest level since 1980 with value increasing significantly. Operations in the State remained relatively small with no operation producing over 1 million tons in 1983.

Construction.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

Table 5.—Mississippi: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	3,046	$7,464	$2.45	NA	NA	NA
Gravel	5,813	18,906	3.25	NA	NA	NA
Sand and gravel (unprocessed)	596	745	1.25	NA	NA	NA
Total or average	9,455	27,115	2.87	e11,000	e$34,600	e$3.15
Industrial sand	W	W	13.41	W	W	12.87

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

Output increased mainly because of accelerated construction and road maintenance activities, which started about midyear. Construction sand and gravel remained the leading commodity in value among the nonfuel minerals produced in Mississippi, accounting for about 50% of the State's total value. Although output increased, it was still below the record year of 1979 when nearly 17 million tons was produced.

Industrial.—Sand for industrial uses was produced by two companies in Jackson and Tishomingo Counties with output increasing. The material was used in sandblasting, cores, and molds.

Stone (Crushed).—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Production decreased 8.3% as reduced local market demands strongly influenced production. The winddown of construction on the Tennessee-Tombigbee Waterway kept production at reduced levels. State operations supplying material for agricultural uses experienced fluctuating market conditions resulting in decreased output.

In 1983, 5 companies produced limestone and marl at 12 quarries in 6 counties. Although no one quarry produced in excess of 800,000 tons of stone, the leading three producers mined 95% of the stone produced in the State. Unit price increased from $2.61 per ton in 1982 to $2.65 per ton in 1983.

Sulfur (Recovered).—Five companies recovered sulfur from refinery and natural gases. Production was reported by Shell Oil Co. in Clarke and Rankin Counties; Chevron USA Inc. in Jackson County; Amerada Hess Corp. in Lamar County; Pursue Gas Processing & Petrochemical Co. in Rankin County; and Koch Hydrocarbon Co. in Clarke County. Mississippi ranked second nationally in output of recovered sulfur. Sulfur sold or used in 1983 totaled 722,000 metric tons, valued at $67.9 million, an increase of 19.9% in shipments and a decrease of 5.4% in value from that of 1982.

METALS

Primary metal production, although not a significant industry in the State, contributed to the economic well-being of Mississippi. Although the major portion of Mississippi's extractive mineral industry is nonmetallic, a significant metals industry existed, which depended mainly on out-of-State raw materials. Shipments of ferroalloys increased 28.8%, while value increased 23.1%.

A list of the major metal producers in Mississippi are shown in the accompanying tabulation.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, AL.
[2]State geologist, Bureau of Geology and Energy Resources, Jackson, MS.
[3]Federal Reserve Bank of Atlanta. Economic Review. Feb. 1984, pp. 66-75.

Company	Location	Product
Biloxi Foundries Inc	Biloxi	Gray iron castings.
C. L. Dews and Son Foundry Inc	Hattiesburg	Do.
Continental Foundry & Machine Works	Olive Branch	Do.
Harper Foundry & Machine Co	Jackson	Do.
Laurel Machine & Foundry	Laurel	Do.
Soule' Steam Feed Works	Meridian	Do.
United Iron Manufacturing Inc	Jackson	Do.
Wilton Corp	Pontotoc	Do.
Esco Corp	Newton	Steel castings.
Metal Parts Inc	Gulfport	Do.
Southern Cast Products Inc	Meridian	Do.
Mississippi Steel & Iron Co	Jackson	Reinforcing bars.
Steel Specialties of Mississippi	Pearl	Do.
Kerr-McGee Chemical Corp	Hamilton	Electrolytic manganese.

Source: Mississippi Research & Development Center (Jackson, MS). Mississippi Manufacturers Directory—1983.

Table 6.—Mississippi: Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
United Cement Co	Box 185 Artesia, MS 39736	Plant	Lowndes.
Clays:			
American Colloid Co	Box 75 Aberdeen, MS 39730	Mine and plant	Monroe.
International Minerals & Chemical Corp	Box 346A Aberdeen, MS 39730	Mine	Do.
Jackson Ready Mix Concrete, a division of Delta Industries Inc.	Box 1292 Jackson, MS 39205	----do	Hinds.
Oil-Dri Production Co	Box 476 Ripley, MS 38663	Mine and plant	Tippah.
Sand and gravel (1982):			
American Sand & Gravel Co	Box 272 Hattiesburg, MS 39401	Stationary plant	Forrest.
Blain Gravel Co	Box 268 Crystal Springs, MS 39059	Stationary plants	Copiah, Itawamba, Marion.
Hammett Gravel Co	Box 207 Lexington, MS 39095	Mine and plant	Holmes and Pike.
Stone:			
Mississippi Stone Products	Box 338 Iuka, MS 38852	Quarry	Tishomingo.
State Department of Agriculture and Commerce.	Box 352 West Point, MS 39773	Quarries	Clay, Noxubee, Wayne.
United Cement Co	Box 185 Artesia, MS 39736	Quarry	Lowndes.

The Mineral Industry of Missouri

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Missouri Department of Natural Resources, Division of Geology and Land Survey, for collecting information on all nonfuel minerals.

By Jane P. Ohl,[1] Heyward M. Wharton,[2] and Ardel W. Rueff[2]

For the second consecutive year, total value of nonfuel minerals declined—from $733.5 million in 1982 to $725.8 million in 1983—and Missouri's rank in the Nation as a nonfuel mineral producer fell from seventh in 1982 to eighth in 1983. Missouri maintained its national dominance in the production of lead and zinc, fire clay, cement, lime, and stone. Mine output of recoverable lead, declining by more than 65,000 metric tons in 1983, was the lowest production in a nonstrike year since the newer mines in southeast Missouri reached significantly high production levels in 1969.

Table 1.—Nonfuel mineral production in Missouri[1]

Mineral	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
Barite thousand short tons	107	$5,703	W	W
Cement:				
Masonry do.	88	4,855	146	$7,339
Portland do.	3,205	120,339	3,499	157,249
Clays[2] do.	1,383	13,409	1,418	11,848
Copper (recoverable content of ores, etc.) metric tons	7,941	r12,745	7,725	13,033
Gem stones	NA	10	NA	10
Iron ore thousand long tons	717	W	877	27,054
Lead (recoverable content of ores, etc.) metric tons	474,460	267,150	409,280	195,620
Sand and gravel:				
Construction thousand short tons	6,359	14,477	e7,700	e17,700
Industrial do.	750	8,997	600	7,541
Silver (recoverable content of ores, etc.) thousand troy ounces	2,241	17,817	2,021	23,124
Stone (crushed) thousand short tons	e38,600	e113,300	39,454	120,700
Zinc (recoverable content of ores, etc.) metric tons	63,680	54,009	57,044	52,052
Combined value of clays (fuller's earth), iron oxide pigments (crude), lime, stone (dimension), and values indicated by symbol W	XX	100,698	XX	92,539
Total	XX	r733,509	XX	725,809

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes fuller's earth; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Missouri, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Andrew	W	(2)	
Atchison	(3)	--	
Audrain	$2,875	$1,485	Clays.
Barry	805	(2)	
Barton	W	(2)	
Bates	654	(2)	
Benton	W	(2)	
Bollinger	(3)	W	Sand and gravel (construction).
Boone	W	W	Sand and gravel (construction), clays.
Buchanan	W	--	
Butler	360	W	Sand and gravel (construction), clays.
Caldwell	241	(2)	
Callaway	3,328	W	Clays, sand and gravel (construction).
Camden	143	132	Sand and gravel (construction).
Cape Girardeau	W	W	Cement, sand and gravel (construction), clays.
Carroll	W	--	
Cass	1,630	(2)	
Cedar	W	(2)	
Christian	862	(2)	
Clark	1,307	170	Sand and gravel (construction).
Clay	4,267	W	Do.
Clinton	407	(2)	
Cole	318	479	Sand and gravel (construction).
Cooper	481	W	Do.
Crawford	W	W	Clays.
Dade	162	(2)	
Dallas	W	(2)	
Daviess	W	W	Sand and gravel (construction).
De Kalb	267	(2)	
Dent	81	(2)	
Douglas	197	43	Sand and gravel (construction).
Franklin	W	W	Sand and gravel (construction), clays.
Gasconade	W	W	Clays, sand and gravel (construction).
Gentry	W	W	Sand and gravel (construction).
Greene	W	W	Lime.
Grundy	542	W	Sand and gravel (construction).
Harrison	591	(2)	
Henry	W	(2)	
Hickory	W	(2)	
Holt	W	(2)	
Howard	W	W	Sand and gravel (construction).
Howell	510	W	Do.
Iron	W	192,461	Lead, zinc, silver, copper.
Jackson	W	W	Cement, sand and gravel (construction).
Jasper	3,944	(2)	
Jefferson	W	W	Cement, sand (industrial), sand and gravel (construction).
Johnson	400	(2)	
Knox	1,290	(2)	
Laclede	W	(2)	
Lafayette	260	69	Sand and gravel (construction).
Lawrence	203	(2)	
Lewis	(3)	681	Sand and gravel (construction).
Lincoln	979	W	Do.
Livingston	W	W	Clays, sand and gravel (construction).
McDonald	W	(2)	
Macon	(3)	--	
Madison	(3)	18	Sand and gravel (construction).
Maries	W	W	Clays.
Marion	83	(2)	
Mercer	427	(2)	
Miller	W	W	Sand and gravel (construction).
Moniteau	W	(2)	
Monroe	1,062	(2)	
Montgomery	2,790	W	Clays, sand and gravel (construction).
Morgan	149	(2)	
Newton	W	(2)	
Nodaway	W	(2)	
Oregon	20	W	Sand and gravel (construction).
Osage	W	W	Clays.
Ozark	(3)	11	Sand and gravel (construction).
Pemiscot	(3)	225	Do.
Perry	688	10	Do.
Pettis	W	(2)	
Phelps	334	152	Sand and gravel (construction).
Pike	W	41,644	Cement, clays, sand and gravel (construction).

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Missouri, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Platte	W	W	Clays.
Polk	W	(2)	
Pulaski	W	$165	Sand and gravel (construction).
Putnam	$238	(2)	
Ralls	W	27,321	Cement, clays.
Randolph	W	(2)	
Ray	332	(2)	
Reynolds	W	127,277	Lead, zinc, silver, copper.
Ripley	(3)	--	
St. Charles	W	W	Sand (industrial), clays.
St. Clair	W	(2)	
St. Francois	W	W	Lime, sand and gravel (construction).
Ste. Genevieve	W	W	Do.
St. Louis	44,350	W	Sand and gravel (construction), sand and (industrial).
St. Louis City	(3)	773	Sand and gravel (construction).
Saline	1,771	(2)	
Scotland	966	(2)	
Scott	W	68	Sand and gravel (construction).
Shannon	57	(2)	
Shelby	749	(2)	
Stoddard	--	W	Clays, sand and gravel (construction).
Stone	59	(2)	
Sullivan	214	(2)	
Taney	484	190	Sand and gravel (construction).
Texas	W	23	Do.
Vernon	637	(2)	
Warren	W	W	Clays.
Washington	93,798	66,343	Iron ore, lead, barite, zinc, copper, silver, iron oxide pigments.
Wayne	4,237	(2)	
Webster	W	10	Sand and gravel (construction).
Worth	213	(2)	
Wright	W	(2)	
Undistributed[4]	677,604	160,457	
Sand and gravel (construction)	e16,900	XX	
Stone:			
Crushed	XX	e113,300	
Dimension	XX	W	
Total[5]	875,268	733,509	

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Adair, Carter, Chariton, Dunklin, Linn, Mississippi, New Madrid, and Schuyler. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Stone, either crushed or dimension, was produced; data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes stone and gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Missouri business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,320.1	2,322.7	+0.1
Unemployment	do.	281.9	237.6	-15.7
Employment (nonagricultural):				
Mining[1]	do.	6.2	6.2	--
Manufacturing	do.	390.3	411.2	+5.4
Contract construction	do.	63.8	64.7	+1.4
Transportation and public utilities	do.	130.8	134.0	+2.4
Wholesale and retail trade	do.	441.6	448.6	+1.6
Finance, insurance, real estate	do.	109.1	108.2	-.8
Services	do.	398.3	403.7	+1.4
Government	do.	331.3	326.6	-1.4
Total nonagricultural employment[1]	do.	1,871.4	1,903.2	+1.7
Personal income:				
Total	millions	$50,423	$53,633	+6.4
Per capita		$10,188	$10,790	+5.9
Construction activity:				
Number of private and public residential units authorized		11,544	18,296	+58.5
Value of nonresidential construction	millions	$882.4	$896.1	+1.6
Value of State road contract awards	do.	$162.0	$364.0	+124.7
Shipments of portland and masonry cement to and within the State	thousand short tons	1,278	1,420	+11.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$733.5	$725.8	-1.0
Value per capita, resident population		$148	$146	-1.4
Value per square mile		$10,530	$10,414	-1.1

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

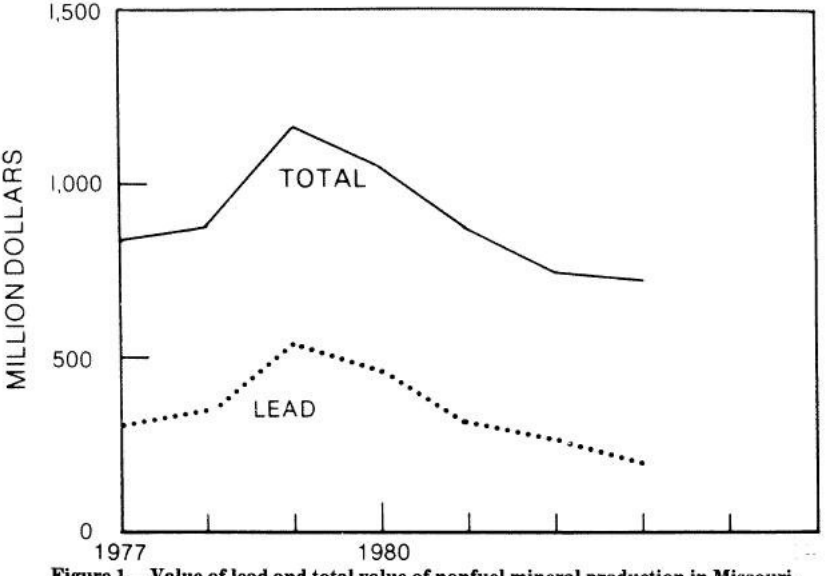

Figure 1.—Value of lead and total value of nonfuel mineral production in Missouri.

Trends and Developments.—Improved nonmetal output was the main reason for optimism in Missouri's mineral industry in 1983. The principal construction commodities—construction sand and gravel and crushed stone—increased substantially in production and value during the year. Industrial leaders, however, cited the following problems leading to the shrinking domestic metal mining industry: foreign competition, large inventories, a strong dollar hurting U.S. exports, and relatively high interest rates. Prices for precious and light metals such as silver and aluminum climbed in 1983; however, the price of lead, although still depressed at yearend, had increased in the last half of the year and reinforced a generally more favorable economic outlook for 1984.

The Missouri Division of Geology and Land Survey issued maps of the southeast Missouri minerals district and the Viburnum Trend in 1983.[3]

Employment.—The number of employees in mining decreased from 6,400 in January 1983 to 6,300 in January 1984.[4]

Environment.—In complying with the Clean Water Act effluent guideline limitations, the AMAX Lead Co. of Missouri Buick smelter-refinery was said to have become the model for the entire nonferrous smelting industry. The plant area was completely concrete paved and graded and all precipitation runoff onto or through the property, including the adjacent main company offices, was captured, resulting in zero discharge and 100% recycling of water. The Clean Water Act guideline limitations were to become fully effective July 1, 1984. Only the AMAX smelter-refinery was approved by the Office of Safety and Health Administration (OSHA) to place personnel on medical removal protection (MRP) (for reasons of high levels of lead in the blood) into other separate production operations.

ASARCO Incorporated's smelter at Glover was the only primary lead smelter and refinery operating under supplementary SO_2 emissions controls. The Intermittent Control System monitored operations relative to ambient air conditions and controlled them by continuous computerized on-site and off-site monitoring that was designed to shut down the plant automatically if emissions reached unacceptable levels. Direct venting was through a 620-foot stack. To enable the company to operate at maximum efficiency, five full-time professional meteorologists were required to evaluate local inversions and other weather conditions at Asarco's own weather station.

In a suit filed against the St. Joe Lead Co. on October 13, 1983, the Environmental Protection Agency (EPA) alleged that St. Joe Lead had been discharging pollutants into the Mississippi River from July 1976 to November 1982. EPA asked a Federal judge to fine St. Joe Lead as much as $10,000 per day for each violation of the Federal Clean Water Act. In a statement outlining the history of the problem, the manager at the Herculaneum smelter declared that St. Joe Lead's $1 million state-of-the-art water treatment plant for waste water discharges was completed in November 1978, and, that after overcoming numerous technical and physical problems with one of the waste water streams, the plant had been in full compliance for more than 1 year (since September 1982).

Exploration Activities.—Depressed lead prices in 1982 continued into 1983 and adversely affected exploration for the metal in Missouri. Because of budget limitations, very little exploratory drilling was done, and several companies terminated exploration programs in the State.

Mining companies filed permit applications with the Bureau of Land Management to prospect on lands in Mark Twain National Forest units in southern Missouri. In addition, about 185 prospecting permits already on file covered some 270,000 acres, mostly in the Fristoe and Poplar Bluff units that are at least 25 miles south and southeast of the nearest lead and zinc mine. Most mining in the Viburnum Trend is on Federal leases in the Salem-Potosi unit of the Mark Twain.

Relatedly, U.S. Geological Survey and U.S. Bureau of Mines investigators were cautiously optimistic that the Fristoe unit of the Mark Twain National Forest had probable mineral-resource potential for lead, silver, and zinc deposits.

Legislation and Government Programs.—The following U.S. Government agency actions during 1983 had immediate and/or long-term consequences on the domestic lead industry:

1. On February 17, EPA published proposed specific point-source effluent limitations, pretreatment standards, and new source performance standards for nonferrous metals manufacturers in order to comply with the 1977 Clean Water Act.

2. On March 1, the final phase of the worker blood-lead level MRP of OSHA's

1979 Lead Standard became effective.

3. OSHA decided to retain the in-plant air-lead permissible exposure limit, but not, as originally scheduled, to enforce ultimate compliance solely by engineering controls.

4. On April 4, EPA published proposed rules for hazardous waste management that affected secondary lead smelters and the lead-acid battery recycling sector in order to implement applicable sections of the Resource Conservation and Recovery Act of 1976. (Additional discussion of these four actions is in the "Lead" chapter in "Minerals Yearbook, Volume I, Metals and Minerals.")

The week of October 1, the Missouri Division of Geology and Land Survey began work on the Joplin and Harrison 1° x 2° quadrangle areas, in cooperation with the U.S. Geological Survey and the States of Kansas and Arkansas, respectively. Later in October, the Missouri Division of Geology geologists began taking samples from five 2,000-foot-deep holes being drilled on Federal and State lands in previously unsampled areas of the Springfield 1° x 2° map area.

The Mining and Mineral Resources and Research Institute, established under title III of the Surface Mining Control and Reclamation Act of 1977 (Public Law 95-87) at the University of Missouri-Rolla, was supplemented in 1982 by a Generic Mineral Technology Center for Pyrometallurgy. The U.S. Bureau of Mines granted $150,000 funding for fiscal year 1983; the same amount was granted for fiscal year 1984. Affiliates of the Pyrometallurgy Generic Center at the University of Missouri-Rolla were Massachusetts Institute of Technology, the University of Minnesota, and Purdue University.

The decade-long controversy over establishing a wilderness in Oregon County was expected to be concluded in early 1984. The clear-cut, reforested, fenced, and lumber-trail-scarred Irish Wilderness may lie over a southern extension of the Nation's largest lead-zinc deposit—called the New Lead Belt or Viburnum Trend —from which 90% of the Nation's lead production has been mined for more than 20 years. When the bill is passed and signed by the President, exploration in all but about a 1,000-acre parcel in the northwestern part of the original area is to be halted until all other possible resources of lead, zinc, and associated metals in Missouri are depleted.[5]

A bill was enacted by the Congress to double royalty payments on minerals mined from acquired national forest lands. For 29 Missouri counties, the additional revenue totaled $1.55 million in fiscal year 1983. Oregon County, an economically depressed, high-unemployment county and the site of the Irish Wilderness, gained $104,342 plus $24,439 from payment in lieu of taxes, the second highest amount in the State of Missouri; only Iron County (from which nearly 56% of the raw lead-zinc-copper-silver ore was mined in 1983) received more, $129,255.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Aluminum.—Noranda Aluminum Inc. opened its third potline on July 29 at its New Madrid plant in the Bootheel of Missouri. The new potline climaxes a $240 million expansion project begun in early 1981 that added 85,000 tons to the reduction plant capacity, bringing it to 225,000 tons per year at yearend 1983. The potline became fully operational at the end of August. Initially, about 300 persons were hired, and Noranda's total employment rose to about 1,350. The plant's annual payroll exceeded $37.5 million, and the company spent more than $94 million on raw materials, about $75 million on services—such as electrical power and gas—and about $5 million on freight charges.[6]

Marnor Aluminum Processing Inc., a subsidiary of Metal Mark Inc., brought its 24-million-pound-per-year processing plant at Miner on-stream in late June. The plant was designed to handle aluminum skimmings, drosses, fluxes, and other wastes, producing 8 million pounds of remelt sows per year, much of which was destined to return to the Noranda aluminum plant. The facility at Miner, Metal Mark's fourth aluminum dross processing plant, brought its capability to process such wastes to more than 64 million pounds per year. To take advantage of the new plant's excess processing capacity, the company opened an office in St. Louis to seek new sources of drosses in the Midwest.

Cobalt.—Anschutz Mining Corp. further curtailed its operation in the Madison cobalt project at Fredericktown, leaving at the mine only a caretaker, by September 1983. The continuing decline in the price of cobalt—from $18 per pound in 1981 when

the project began to $6 per pound in June 1983—plus the lack of Federal Government funding for domestic cobalt production were two reasons for the curtailment.

Copper.—Missouri ranked sixth of 12 copper-producing States in 1983. Production came from eight mines in Iron, Reynolds, and Washington Counties that were operated by AMAX, Cominco American Inc., Ozark Lead Co., and St. Joe Lead. The largest share of the 1983 output came from AMAX's Buick Mine in Iron County.

The Missouri Division of Geology and Land Survey estimated that the cumulative copper production from Viburnum Trend mines, 1962 and 1965-83, was 174,580 short tons of recoverable metal, valued at $240 million.

Iron Ore.—Missouri ranked fourth of 11 iron ore producing States. The quantity of usable iron ore increased more than 22% over that of 1982. Pea Ridge Iron Ore Co., a subsidiary of St. Joe Minerals Corp., operated the only iron mine in the State near Sullivan; Pea Ridge was also the only operating underground iron mine in the Nation.

After several months of intermittent operation at Pea Ridge, regular production was resumed in March 1983 and continued through yearend. The company changed its production process in 1983 by substituting magnesia-rich olivine for quartz in the pelletizing mix. The Pea Ridge olivine-enriched pellets include 1.8% MgO and 3.6% SiO_2.[7] The pellets were tested extensively in the blast furnaces of National Steel Corp. at Granite City, IL, in 1983.

Pea Ridge processed 1.2 million long tons of crude ore, producing 800,592 long tons of concentrates and pellets. The mine's products are used for heavy media, iron oxide pigments, additives to drilling muds, and for the manufacture of ferrites and iron and steel.

Lead.—Missouri's mines accounted for 91.1% of the Nation's lead output in 1983, despite the mines producing nearly 14% less in quantity and 27% less in value than in 1982. Domestic lead consumption began to improve in August and remained strong through the fourth quarter. The turnaround was due to heavy demand from manufacturers of lead-acid batteries, who accounted for 70% of domestic lead consumption in 1983. The average price for lead was 21.68 cents per pound, down from 25.54 cents per pound in 1982.[8]

Repeated short-term smelter closings during 1983 were attributed to decreased lead mining, which, in turn, resulted from depressed lead prices in the early part of the year.[9]

Lead ore production in 1983 came from eight mines: Buick (owned by AMAX and Homestake Mining Co.); Brushy Creek, Fletcher, Viburnum No. 28, Viburnum No. 29, and, the newest, Viburnum No. 35 (all owned by St. Joe Lead); Magmont (owned jointly by Cominco American and Dresser Industries Inc.); and Milliken (owned by the Ozark Lead, a subsidiary of Kennecott).

Production at the Buick Mine was 1.9 million metric tons, falling just 6% short of the 1982 record high. The moderate decline resulted from downtime to replace a cracked underground primary crusher shell; this downtime extended the annual 2-week maintenance shutdown to 4 weeks. Total ore broken for 1983 exceeded the 1982 level by 140,000 tons. Average mill grade of lead was 7.9% and the zinc grade was 1.8%, according to AMAX and Homestake's annual reports for 1983.

Cost reduction and productivity improvement limited the increase in cost per ton of mined ore to slightly under the 1983 inflation rate. The fully automated, state-of-the-art concentrator, including continuous x-ray assaying developed in Finland, required only five or six employees to operate. A 5% reduction in the overall work force was achieved during the year.

The horizontal, tabular ore body, adjacent to the south breccia ore body, continued to be developed at a planned pace. The south mine ore tonnage continued to increase as the north mine development was phased down. The mine is unique in the massive scale of its high-speed mechanized operation in a very large room-and-pillar mining system, usually associated only with the block caving system. Buick's recoverable metal production was expected to peak in the 1984-87 period, because of declining average grades.

Estimated reserves at the Buick Mine at yearend were reportedly 38 million tons of ore averaging 5.7% lead and 1.4% zinc, according to the companies' 1983 annual reports.

Buick won the Sentinels of Safety award for 1983 in the underground metal mines category, achieving 719,952 hours of injury-free operation.

At the AMAX-Homestake Buick smelter in western Iron County, a contract that dedicated one-half of the Buick smelter capacity to smelt concentrates from Comin-

co American and Dresser's Magmont Mine and other mines expired in November 1983 and was not renewed. Following termination of the contract, the entire refining capacity of the Buick smelter was to be devoted to treating concentrates from the Buick Mine, the Nation's largest lead producer.

A new elemental sodium drossing process introduced at the Buick smelter materially increased smelter recovery and eliminated a step in the drossing process and reduced costs. In addition, the new process increased the facility's ability to contain random fumes and smoke. Total smelter production in 1983 was 143,000 tons of refined lead, breaking the 1975 record by more than 7,000 tons, according to Homestake in the 1983 annual report.

Asarco reactivated underground development of the West Fork Mine, northern Reynolds County, October 20, 1983; production, anticipated in midyear 1985, may be delayed until 1986; and ultimate capacity was expected to be about 46,000 metric tons of lead per year.

Although underground development work had been suspended in 1982 to conserve cash, construction on the mill and other surface facilities continued until completed in June 1983. A $2.8 million preparation program to dewater the mine and construct various permanent underground facilities, such as the ventilation shaft, shop rooms, main pumping station, sump pumps, and an ore crushing station, needed to be done before production could begin. When completed, West Fork Mine was to produce concentrates containing 51,000 short tons of lead, 7,500 tons of zinc, and 125,000 ounces of silver annually. The ore body was estimated to contain 15 million tons of ore averaging 5.5% lead, 1.2% zinc, and recoverable amounts of silver and copper.[10]

In 1983, Asarco's Glover smelter-refinery, southeastern Iron County, produced 102,400 short tons of lead in the smelter and 100,500 short tons of lead in the refinery.[11]

A new 18-month labor agreement was reached with the unions at Glover, effective April 1, 1983, but without wage or benefit increases. Operations at Glover were restricted for part of 1983, owing to a shortage of concentrates. Ozark Lead's Milliken Mine, a substantial supplier of concentrates, suspended operations on March 4, leaving Asarco with considerably less contracted supplies of metal than before. Thereafter, the Glover plant was operated on a curtailed basis—receiving materials and shipping refined lead—until August 15. On that date, operations again were suspended until September 19, when Cominco American and Dresser signed a multiyear toll agreement with Asarco, effective November 1, 1983. The Glover smelter was to toll as much as 90,000 tons of lead concentrates annually from Cominco American and Dresser's Magmont Mine, enough to sustain the Glover smelter-refinery capacity until Asarco's own captive West Fork Mine comes on-stream in 1985.[12]

Magmont Mine, in western Iron County, was the third largest producing lead mine in the Nation. Owned by Cominco American and Dresser, the facility milled 1.04 million tons of ore at an average grade of 7.2% lead, according to the companies' annual reports.

Late in 1983, production began from the Magmont West ore body after completion of a 2-mile haulage drift from the main shaft. The Magmont West area has higher grade ore than the older Magmont Mine; lead concentrate production from the complex increased to about 94,700 tons in 1983. Additionally, the measured and indicated reserves at yearend increased nearly 20% to 6.2 million tons averaging 8.0% lead.

Ozark Lead reduced production at its 82,000-metric-ton-per-year Milliken Mine and mill and then closed the facilities in west-central Reynolds County on March 4 because of operating losses, the continuing depressed economy, and low lead prices. Employees who were members of United Steelworkers Union Local 944 voted against accepting pay and benefit reductions to save their jobs, and the mine remained closed throughout the year. Its closing virtually took Kennecott, a wholly owned subsidiary of Standard Oil Co. of Ohio, out of the lead business. Ozark's recently completed expansion at Milliken, once the Nation's second largest lead producer, included two new shafts and increased concentrator capacity.

Early in the year, St. Joe Minerals' headquarters were moved from New York City to Clayton. St. Joe Lead, a subsidiary of St. Joe Minerals, which is owned by Fluor Corp. of Irvine, CA, employed 2,000 people in Missouri. St. Joe Lead, the largest lead producer in the United States, operated four mines and three mills in southeastern Missouri, producing 196,000 tons of lead in concentrates during its fiscal year ending October 31, 1983, an increase of 4% over that of 1982. The three mills treated 4.17 million tons of ore, averaging about 4.8% lead, from five captive mines, during 1983.

Daily estimated mill capacity was 20,000 tons of ore.[13]

Limited production of lead, zinc, and copper began in August at St. Joe Lead's new Viburnum No. 35 Mine, west of Bixby in Iron County. By yearend, the new mine yielded an estimated 4,000 tons of ore per day, helping to return the estimated U.S. lead mine capacity to the 1981 level. Viburnum No. 35 contained higher grade ore than did the company's Indian Creek Mine, which closed in May 1982 due to high costs. Viburnum No. 35 was reported to have a minimum life expectancy of 16 years.[14]

To handle the increased production from the new mine, St. Joe Lead increased its Viburnum mill capacity by 4,000 tons to a total of 12,000 tons per day. No increase was planned in the number of employees needed to operate the mill at its new, higher output.

Most employees laid off at Indian Creek Mine in Washington County were reportedly recalled at the new mine.

At fiscal yearend, St. Joe Lead had proven domestic reserves of 56.3 million tons of ore containing 5.0% lead. Its Fletcher Mine in Reynolds County was the Nation's second largest producing lead mine during the year.

According to the Missouri Division of Geology and Land Survey, cumulative lead production, 1960-83, from all the Virburnum Trend mines (excluding St. Joe Lead's Indian Creek Mine) amounted to 7.4 million short tons of recoverable metal valued at $3.8 billion.

Table 4.—Missouri: Tenor of lead ore milled and concentrates produced in 1983

Total material	metric tons	7,303,066
Metal content of ore:[1]		
Copper	percent	.10
Lead	do.	5.79
Zinc	do.	.89
Concentrates produced and average content:		
Copper	metric tons	12,284
Average copper content	percent	28.85
Lead	metric tons	555,733
Average lead content	percent	75.81
Zinc	metric tons	106,180
Average zinc content	percent	58.08

[1]Figures represent metal content of crude ore only as contained in the concentrate.

Table 5.—Production and value of lead in Missouri and the United States

Year	Missouri			United States	
	Quantity (metric tons)	Value (thousands)	Percent of U.S. production	Quantity (metric tons)	Value (thousands)
1979	472,054	$547,824	89.8	525,569	$609,929
1980	497,170	465,393	90.3	550,366	515,189
1981	389,721	313,870	87.5	445,535	358,821
1982	474,460	267,150	92.6	512,516	288,579
1983	409,280	195,620	91.1	449,038	214,623

Silver.—Missouri ranked seventh in the Nation in silver production, although State output decreased almost 10% from that of 1982. Industrial silver consumers used less of the precious metal than in 1982, owing partly to higher silver prices and partly to a lower-than-expected demand for some manufactured goods, such as electronic products, including personal computers. Among the 25 leading silver-producing mines, the Buick Mine and the Magmont Mine were ranked 14th and 24th, respectively, nationally. The Buick Mine produced 920,000 troy ounces of silver in concentrates in 1983, 12.4% less than in 1982, according to AMAX's 1983 annual report. All silver from Missouri mines was recovered as a byproduct during the smelting of lead concentrates.

According to the Missouri Division of Geology and Land Survey, cumulative silver production from Viburnum Trend mines (excluding St. Joe Lead's Indian Creek Mine) for 1962, 1965, and 1968-83 amounted to 31.3 million troy ounces valued at $203.6 million. The average price of silver in 1983 was $11.44 per troy ounce, compared with an average price of $7.95 per troy ounce in 1982.

Table 6.—Missouri: Mine production (recoverable) of silver, copper, lead, and zinc

	1981	1982	1983
Mines producing: Lode	8	8	8
Material sold or treated: Lead ore thousand metric tons	7,729	8,531	7,303
Production:			
Quantity:			
Silver troy ounces	1,837,011	2,241,159	2,021,343
Copper metric tons	8,411	7,941	7,725
Lead do.	389,721	474,460	409,280
Zinc do.	52,904	63,680	57,044
Value:			
Silver thousands	$19,322	$17,817	$23,124
Copper do.	$15,783	r$12,745	$13,033
Lead do.	$313,870	$267,150	$195,620
Zinc do.	$51,966	$54,009	$52,052
Total[1] do.	$400,942	r$351,721	$283,830

rRevised.
[1]Data may not add to totals shown because of independent rounding.

Zinc.—Missouri ranked second nationally in zinc output, producing 57,044 metric tons of recoverable zinc, a coproduct from the State's eight underground lead mines. The smaller zinc output in 1983 was due mainly to reduced production at the Buick Mine but also to the March closing of the Milliken Mine.

Buick Mine produced 32,534 tons of zinc in concentrates—16% less than in 1982—from 2 million short tons of ore averaging 1.8% zinc. Reserves amounted to 38 million short tons of 1.4% zinc, according to the AMAX 1983 annual report.

According to the Missouri Division of Geology and Land Survey, cumulative zinc production from Viburnum Trend mines (excluding St. Joe Lead's Indian Creek Mine), 1964-83, amounted to 1.03 million short tons of recoverable metal valued at $648.6 million. The average price of zinc in 1983 was 41.39 cents per pound.

NONMETALS

Barite.—No barite was mined in the State in 1983. De Soto Mining Co. shipped barite from stockpiles at its Kingston and Richwoods Mines, both in Washington County. One barite mill in Missouri in operation in late April was not, however, processing barite ore, but olivine. The olivine ore, shipped from North Carolina, was being ground at NL Baroid/NL Industries Inc.'s plant in Washington County for shipment to Pea Ridge, 20 miles to the northwest, where it was used in a new iron ore pelletizing process.

In July, workers at NL Industries' Cadet plant were declared eligible to apply for assistance under the Federal Trade Act. Eligible workers were those laid off on or after May 1, 1982. About 80 of the unemployed barite industry workers, laid off because of competition from barite imports, organized and circulated petitions asking their congressional representatives for changes in Trade Adjustment Assistance (TAA) benefits. The requested changes included increasing the percentage of average weekly wage benefits paid, reconsidering the value of retraining if no work were available, and extending the expiration date of TAA benefits beyond September 30, 1983. The workers also asked for a cessation of barite imports.

Cement.—Portland and masonry cement production in 1983 increased more than 9% and 66%, respectively, reflecting increased activity in the construction industry and improvement in the national economy. Five portland and three masonry plants were active during the year. Average value of shipped portland cement was $44.94, up 19.7% from that of 1982; however, the average value of shipped masonry cement declined from $55.17 in 1982 to $50.27 in 1983.

Table 7.—Missouri: Portland cement salient statistics

(Short tons unless otherwise specified)

	1982	1983
Number of active plants	5	5
Production	3,104,238	3,541,191
Shipments from mills:		
Quantity	3,205,031	3,499,125
Value	$120,339,462	$157,248,651
Stocks at mills, Dec. 31	356,586	444,227

Table 8.—Missouri: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1982	1983
Number of active plants	3	3
Production	75,316	136,557
Shipments from mills:		
Quantity	87,505	146,398
Value	$4,855,257	$7,339,135
Stocks at mills, Dec. 31	9,866	17,903

On January 29, 1983, Continental Cement Co. Inc. laid off approximately 90 of its 130 employees for 6 to 8 weeks from its plant south of Hannibal. The layoff was attributed to the plant's surplus cement stocks, while demand for cement was down. Continental, a subsidiary of Cementa Inc. of Wilmington, DE, is part of the Swedish industrial group Euroc AB.

Clays.—Missouri ranked ninth in the Nation in clay and shale production. Total output increased 2.5%, but total value declined 11.6% compared with 1982 figures. The State ranked first of 17 States that produced fire clay, third of 12 that produced fuller's earth, fourth of 15 that produced kaolin, and ninth of 42 that produced common clay and shale. Quantities of common clay and shale and kaolin rose 18% and 23%, respectively, above those of 1982; quantity of fire clay produced, however, fell nearly 31%.

Table 9.—Missouri: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Fire clay		Common clay		Kaolin		Total[1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1979	799	15,194	1,497	4,350	55	978	2,351	20,522
1980	700	12,808	1,041	2,540	77	1,451	1,817	16,798
1981	669	13,397	974	2,797	104	2,220	1,747	18,414
1982[2]	448	8,833	851	2,605	84	1,971	1,383	13,409
1983[2]	311	5,480	1,004	3,716	103	2,652	1,418	11,848

[1]Data may not add to totals shown because of independent rounding.
[2]Excludes fuller's earth.

Lime.—Value of lime production in 1983 rose more than 26.9% over that of 1982, although output increased just 10%. Quicklime production increased 13.3% from that of 1982 because of renewed demand in the steel industries. Missouri ranked third in lime production during 1983. In addition, the State ranked first among those States producing lime for water purification; it was one of the top four States producing lime for electric-furnace steel production. North American Refractories Co., a division of Allied Chemical Corp., sold its Bonne Terre dolomitic lime and refractory dead-burned dolomite plant in St. Francois County to Resco Products of Missouri Inc. in June. Ash Grove Cement Co. and Mississippi Lime Co. had plants in Greene and Ste. Genevieve Counties, respectively. Ash Grove and Mississippi Lime produced hydrated lime in slightly larger quantities than in 1982.

Perlite (Expanded).—Georgia-Pacific Corp. and Brouk Co. expanded perlite at their plants in Crawford and St. Louis Counties. Georgia-Pacific's Cuba plant produced perlite for fillers; Brouk's plant in St. Louis expanded perlite for cavity-fill insulation, concrete aggregate, horticultural aggregate, low-temperature insulation, and plaster aggregate, as well as fillers. Production and value decreased 17.5% and 26.2%, respectively, below those of 1982.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Although industrial sand output decreased 20% from that of 1982, average price per ton rose from $12 to

$12.56. Pennsylvania Glass Sand Corp., the largest producer in the State, had one pit in St. Charles County and another in St. Louis County. Missouri's other two industrial sand producers were UNIMIN Corp. of New Canaan, CT, in St. Louis County, and Moline Consumers Co., in Jefferson County. UNIMIN closed its industrial sand quarry at Crystal City in January, but later purchased the industrial sand operations of Martin Marietta Aggregates at Festus. UNIMIN is the main supplier for the PPG Industries glass plant at Crystal City. In decreasing order, industrial sand was used for glass making (containers, flats, specialty, and fiberglass); foundries (molding and core and refractory); abrasives (scouring and grinding sand); chemicals; metallurgical (silicon carbide); ground fillers; traction; roofing granules; ceramic (pottery and tile); and other uses. Transportation methods were divided nearly equally between truck and rail.

Table 10.—Missouri: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	4,553	$9,505	$2.09	NA	NA	NA
Gravel	1,467	4,258	2.90	NA	NA	NA
Sand and gravel (unprocessed)	338	713	2.11	NA	NA	NA
Total[1] or average	6,359	14,477	2.28	e7,700	e$17,700	e$2.30
Industrial sand	750	8,997	12.00	600	7,541	12.56
Grand total[1] or average	7,108	23,474	3.30	e8,300	e25,241	e3.04

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Output and value of both crushed and dimension stone increased in 1983.

Crushed.—AgRock Quarries, a division of Ash Grove, opened a new limestone quarry at Foose in southwest Dallas County, about 7 miles from Buffalo. Buffalo was the site of an AgRock quarry in Ordovician Age Jefferson City Dolomite, a soft, magnesium-rich rock. The Buffalo quarry was operated until late 1983 when it was abandoned for reasons of low quality and distance from users. The rock at Foose is the Mississippian Age Burlington Limestone, a hard, durable, and less absorbent rock, which was to be used for paving, in concrete, and other uses. To replenish stocks as necessary, AgRock used a portable crushing system that could be moved to other quarries at Wheatland in Hickory County or at Bolivar in Polk County. In addition to supplying crushed rock, AgRock produced agricultural lime.

At its Jefferson Barracks operation in south St. Louis County, Bussen Quarries began developing an underground mine for storage space.

Hilty Quarries Inc., in Henry County, purchased the Williams Rock Mining Co., also of Henry County; Hilty then operated four crushed stone facilities in west-central Missouri.

More than 95% of the crushed stone produced from 211 quarries in Missouri during 1983 was limestone and dolomite; however, the State's output also included, in decreasing order, small amounts of crushed granite, sandstone, and marble. Crushed limestone was used predominantly in cement manufacture (11.6% of output), as dense-graded road base stone (10.9%), and as riprap and jetty stone (10.1%), and for many other purposes. Crushed dolomite was used for highway, railroad, and other construction and maintenance purposes (90.3%); for agricultural purposes (9.2%); and for fill (0.5%).

Of the 211 quarries in Missouri, 6 each produced more than 1 million short tons of stone during 1983, accounting for 28.5% of the State's total output. In descending order of tonnage produced, the top 5 of 127 companies were Fred Weber Inc., which operated 4 quarries in Jefferson, St. Charles, and St.

Louis Counties; Tower Rock Stone Co., 1 quarry in Ste. Genevieve County; West Lake Quarry & Material Co., 5 quarries in Cape Girardeau, Jefferson, St. Louis, and Scott Counties; Moline Consumers, 12 quarries in Jefferson, Knox, Lewis, Marion, Monroe, Pike, Ralls, St. Louis, and Shelby Counties; and Lone Star Industries Inc., 1 quarry in Cape Girardeau County.

Trucks transported more than 81% of the crushed stone output; railroads, waterways, and unspecified methods transported the remaining crushed stone during 1983. Crushed marble brought the highest unit price, $52.79 per short ton, and crushed sandstone the lowest, $1.90; the average price for all types of crushed stone was $3.06 per short ton.

Table 11.—Missouri: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	2,334	4,607
Riprap and jetty stone	3,936	8,921
Filter stone	120	401
Other coarse aggregate	W	62
Coarse aggregate, graded:		
Concrete aggregate, coarse	2,367	8,228
Bituminous aggregate, coarse	1,640	6,001
Bituminous surface treatment aggregate	902	3,226
Railroad ballast	1,250	2,864
Other graded coarse aggregate	15	67
Fine aggregate (-3/8 inch):		
Stone sand, concrete	52	193
Screening, undesignated	499	1,005
Coarse and fine aggregate:		
Graded road base or subbase	4,167	13,677
Unpaved road surfacing	2,181	7,545
Crusher run or fill or waste	427	1,358
Other coarse and fine aggregate	73	300
Agricultural:		
Agricultural limestone	1,284	4,465
Poultry grit and mineral food	263	2,824
Chemical and metallurgical:		
Cement manufacture	4,402	9,575
Lime manufacture	211	620
Special:		
Asphalt fillers or extenders	82	312
Other[2]	13,250	44,450
Total[3]	39,454	120,700

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes limestone, dolomite, granite, marble, and sandstone.
[2]Includes chemical stone for alkali works, whiting or whiting substitute, other fillers or extenders, glass manufacture, roofing granules, sulfur oxide removal, coarse aggregate-large, fine aggregate and uses not specified.
[3]Data do not add to totals shown because of independent rounding.

Dimension.—Two companies, Keystone Granite Memorial Inc. and Beavers Natural Stone Co., operated dimension stone quarries in 1983. Keystone quarried granite in Iron County, and Beavers quarried sandstone in Camden County. Annual capacity of each quarry was less than 25,000 short tons. Averaging $139.83 per short ton, dimension stone was prepared as cut stone, flagging, monumental stone, rough blocks, and sawed stone.

Vermiculite (Exfoliated).—W. R. Grace & Co. and Brouk Co. plants in St. Louis County produced exfoliated vermiculite from out-of-State sources of crude vermiculite. In decreasing order of quantity, the product was sold for uses as aggregates (concrete and plaster), insulation (block, loose fill, and packing), agriculture (fertilizer carrier, horticulture, and soil conditioning), fireproofing, and filler. Brouk produced and sold 21% less exfoliated vermiculite than in 1982, a year of decreased production and sales, and received an average value of $310.73 per ton, about a 3% price increase over that of 1982.

[1]State Liaison Officer, Bureau of Mines, Denver, CO.
[2]Geologist, Missouri Department of Natural Resources, Division of Geology and Land Survey, Rolla, MO.
[3]Kisvarsanyi, E. B., and W. B. Howe. The Southeast Missouri Minerals District and Its Relationship to Post-Precambrian Igneous Activity. Mo. Dep. Nat. Resour., Div. Geol. and Land Surv., OFM-83-170a-GI, scale 1:250,000.
———. Isopach Map of Volcaniclastic Facies in the Lower Bonneterre Formation Along the Viburnum Trend (Bee Fork area). Mo. Dep. Nat. Resour., Div. Geol. and Land Surv., OFM-83-170d-GI, scale 1:24,000.
[4]Missouri Department of Labor and Industrial Relations. Missouri Area Labor Trends. January 1984, p. 5.
[5]Capital Daily News. July 15, 1983.
Heyl, A. V., and G. S. Ryan. Irish Wilderness Roadless Area, Missouri. Art. in Wilderness Mineral Potential:

Assessment of Mineral-Resource Potential in U.S. Forest Service Lands Studied in 1964-1984, ed. by S. D. Marsh, S. J. Kropsclot, and R. G. Dickinson. U.S. Geol. Surv. Prof. Paper 1300, 1983, pp. 642-644.

[6]Bootheel News & Beacon Hayti. Aug. 9, 1983.

[7]Lherbier, L. W., Jr. Production and Quality of Pea Ridge Olivine Pellets. Skillings' Min. Rev., v. 73, No. 21, May 26, 1984, pp. 6-10.

[8]ASARCO Incorporated Annual Report 1983. P. 7.

[9]ASARCO Incorporated 1983 10K Annual Report. P. 7.

[10]Pages 2 and 8 of work cited in footnote 8.

[11]Page 9 of work cited in footnote 9.

[12]Engineering and Mining Journal. Glover To Toll Magmont Lead Concentrates. V. 184, No. 12, Dec. 1983, p. 17.

[13]Fluor Corp. Annual Report for 1983.

[14]St. Joe Headframe. Missouri Labor Trend. Aug. 1983, p. 3.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
De Soto Mining Co	Box 35 Richwoods, MO 63071	Mines and plant	Washington.
NL Baroid/NL Industries Inc	Box 2808 St. Louis, MO 63111	do	Do.
Cement:			
Continental Cement Co. Inc.[1]	Box 71 Hannibal, MO 63401	Quarry and plant	Ralls.
Dundee Cement Co.[1 2]	Box 67 Clarksville, MO 63336	do	Pike.
Lone Star Industries Inc.[3]	One Greenwich Plaza Box 5050 Greenwich, CT 06836	Quarries and plants	Cape Girardeau, Jackson, St. Louis.
River Cement Co., a subsidiary of IFI International of Italy (Instituto Finanziario Industriale S.p.A.).[4]	180 Weidman Road Manchester, MO 63011	Quarry and plant	Jefferson.
Clays:			
Allied Chemical Corp., Industrial Chemicals Div.	Box 517 Owensville, MO 65066	Mine and plant	Gasconade.
The Carter Waters Corp	Box 19676 Kansas City, MO 64141	Pit and plant	Platte.
A. P. Green Refractories Co., a subsidiary of United States Gypsum Co.	1018 East Breckenridge St. Mexico, MO 65265	Mines	Audrain, Callaway, Gasconade.
Harbison-Walker Refractories Div., Dresser Industries Inc.	2 Gateway Center Pittsburgh, PA 15222	Mines and plants	Callaway, Franklin, Gasconade, Maries, Montgomery, Warren.
Kaiser Aluminum & Chemical Corp	Box 499 Mexico, MO 65265	do	Audrain, Callaway, Gasconade, Montgomery.
Lowe's Southern Clay Inc	Box 1086 Cape Girardeau, MO 63701	Pits and plants	Cape Girardeau and Stoddard.
Iron:			
St. Joe Minerals Corp., Pea Ridge Iron Ore Co.	Route 4 Sullivan, MO 63080	Underground mine and plant.	Washington.
Lead:			
AMAX Lead Co. of Missouri and Homestake Mining Co.[5]	Boss, MO 65440	do	Iron.
Cominco American Inc.[5]	Bixby, MO 65439	do	Do.
Ozark Lead Co., a subsidiary of Kennecott, a subsidiary of Standard Oil Co. of Ohio.[5]	Sweetwater, CPO Ellington, MO 63680	do	Reynolds.
St. Joe Lead Co., a division of St. Joe Minerals Corp., a subsidiary of Fluor Corp.[5 6]	Box 500 Viburnum, MO 65566	Underground mines and plants.	Iron, Reynolds, Washington.
Lime:			
Ash Grove Cement Co.[7]	8900 Indian Creek Pkwy. Suite 600, Box 25900 Overland Park, KS 66225	Plant	Greene.
Mississippi Lime Co	7 Alby St. Alton, IL 62002	Quarry and plant	Ste. Genevieve.
Resco Products of Missouri Inc., Bonne Terre Limekiln.	Box 1110 Clearfield, PA 16830	Plant	St. Francois.
Perlite (expanded):			
Brouk Co	1367 South Kingshighway Blvd. St. Louis, MO 63110	do	St. Louis.
Sand and gravel (construction):			
Holiday Sand & Gravel Co., a subsidiary of List & Clark Construction Co.	6811 West 63d St. Overland Park, KS 66204	Dredges and plants	Buchanan and Clay.

See footnotes at end of table.

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel (construction) — Continued			
Limited Leasing Co., a subsidiary of St. Charles Sand Co.	Route 1, Box 158 Hazelwood, MO 63042	Dredges and plants	St. Charles and St. Louis.
Missouri Gravel Co., a subsidiary of Moline Consumers Co.	313 R.R.1 Hannibal, MO 63401	Pits and plants	Lewis and St. Louis.
Winters Bros. Material Co	13098 Gravois Rd. St. Louis, MO 63127	Dredge and plant	St. Louis.
Sand (industrial):			
Martin Marietta Aggregates[8]	Two Cross Roads of Commerce Rolling Meadows, IL 60008	Pit and plant	Jefferson.
Masters Bros. Silica Sand Co	Route 1, Box 204 Pevely, MO 63070	do	Do.
Pennsylvania Glass Sand Corp	Box 187 Berkley Springs, WV 25411	Pits and plants	St. Charles and St. Louis.
UNIMIN Corp	258 Elm Street New Canaan, CT 06840	Mine and plant	Jefferson.
Stone:			
Missouri Pacific Corp	210 North 13th St. St. Louis, MO 63103	Quarry	Wayne.
Moline Consumers Co	313 16th St. Moline, IL 61265	Quarries	Jefferson, Knox, Lewis, Marion, Monroe, Pike, Ralls, St. Louis, Shelby.
Tower Rock Stone Co	Box 69 Columbia, IL 62236	Quarry	Ste. Genevieve.
Fred Weber Inc	7929 Alabama Ave. St. Louis, MO 63111	Quarries	Jefferson, St. Charles, St. Louis.
West Lake Quarry & Material Co	13570 St. Charles Rock Rd. Bridgeton, MO 63044	do	Cape Girardeau, Jefferson, St. Louis, Scott.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	St. Louis.

[1]Also clays.
[2]Also stone in Pike County.
[3]Also stone in Cape Girardeau County.
[4]Also stone in Jefferson County.
[5]Also silver, copper, and zinc.
[6]Also stone in St. Francois County.
[7]Also stone in Bates, Dallas, Greene, Hickory, Polk, and Vernon Counties.
[8]Also stone in Andrew, Gentry, Harrison, Holt, Jackson, Mercer, Nodaway, and Worth Counties.

The Mineral Industry of Montana

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Montana Bureau of Mines and Geology for collecting information on all nonfuel minerals.

By W. L. Rice,[1] Mervin J. Bartholomew,[2] and D. C. Lawson[3]

Montana's nonfuel mineral production value rose in 1983 to $293 million, an 8% increase over the $271 million recorded in 1982. A doubling of the State's gold production and higher silver prices offset a 46% decrease in the value of copper produced in 1983.

Gold was the leading commodity in terms of value, followed by silver, copper, and portland cement. Metals—antimony, copper, gold, iron, lead, and silver—accounted for 65% of the total nonfuel mineral value for the year. Montana ranked 23d in the Nation in the value of its nonfuel minerals production for 1983.

On June 29, the Butte copper operations of The Anaconda Minerals Co. were suspended indefinitely, and the last 700 employees of a work force onetime estimated at 20,000 were laid off. Anaconda cited weekly losses of $1 million over the last 2 years as the primary reason for the closure. By yearend, the company expected to have between 50 and 70 permanent employees in

Table 1.—Nonfuel mineral production in Montana[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony short tons	209	W	253	W
Barite thousand short tons	W	W	10	$750
Clays do.	[2]218	[2]$8,064	194	6,205
Copper (recoverable content of ores, etc.) metric tons	[r]64,951	[r]104,245	33,337	56,245
Gem stones	NA	225	NA	300
Gold (recoverable content of ores, etc.) troy ounces	75,171	28,258	161,436	68,449
Lead (recoverable content of ores, etc.) metric tons	661	372	1,163	556
Lime thousand short tons	45	2,331	86	W
Sand and gravel (construction) do.	5,338	12,794	[e]5,000	[e]10,200
Silver (recoverable content of ores, etc.) thousand troy ounces	6,169	49,041	5,708	65,299
Stone (crushed) thousand short tons	[e]1,400	[e]4,700	872	2,344
Zinc (recoverable content of ores, etc.) metric tons	W	W	--	--
Combined value of cement, clays (fire clay, 1982), graphite, gypsum, iron ore, molybdenum (1983), peat, phosphate rock, sand and gravel (industrial), stone (dimension), talc, tungsten ore and concentrate (1982), vermiculite, and values indicated by symbol W	XX	[r]60,723	XX	82,947
Total	XX	[r]270,753	XX	293,295

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes fire clay; value included with "Combined value" figure.

Butte; these employees were to be a core of professional, technical, and supervisory personnel who could expedite reopening the operation.

Table 2.—Value of nonfuel mineral production in Montana, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Beaverhead	$402	$427	Sand and gravel (industrial), silver, sand and gravel (construction), zinc, lead, gold, copper.
Big Horn	(2)	W	Sand and gravel (construction).
Broadwater	W	490	Lime, gold, graphite, tungsten, silver, lead, copper.
Carbon	W	W	Clays, sand and gravel (construction).
Carter	W	W	Clays.
Cascade	W	1,714	Sand and gravel (construction).
Chouteau	(2)	--	
Custer	--	1	Sand and gravel (construction).
Daniels	(2)	--	
Dawson	(2)	494	Sand and gravel (construction).
Deer Lodge	6,053	209	Sand and gravel (construction), tungsten, clays.
Fergus	852	W	Gypsum, sand and gravel (construction).
Flathead	206	2,970	Sand and gravel (construction).
Gallatin	21,949	W	Cement, sand and gravel (construction), clays.
Granite	W	9,580	Silver, copper, gold, zinc, lead, sand and gravel (construction).
Hill	(2)	W	Sand and gravel (construction).
Jefferson	19,529	14,178	Cement, silver, gold, sand and gravel (construction), copper, zinc, clays.
Judith Basin	W	W	Gypsum.
Lake	6	W	Sand and gravel (construction), peat.
Lewis and Clark	W	531	Sand and gravel (construction).
Liberty	(2)	W	Do.
Lincoln	W	77,444	Silver, copper, vermiculite, lead, gold, sand and gravel (construction).
Madison	W	8,529	Talc, gold, sand and gravel (construction), silver, copper.
Meagher	W	W	Iron ore, gold, silver.
Mineral	(2)	29	Sand and gravel (construction).
Missoula	4,269	W	Barite, sand and gravel (construction).
Musselshell	(2)	45	Sand and gravel (construction).
Park	155	W	Sand and gravel (construction), sand and gravel (industrial).
Petroleum	(2)	44	Sand and gravel (construction).
Phillips	W	27,350	Gold, silver, copper, lead.
Pondera	(2)	22	Sand and gravel (construction).
Powell	W	W	Phosphate rock, sand and gravel (construction).
Ravalli	W	W	Sand and gravel (construction), peat.
Richland	W	1,564	Lime, sand and gravel (construction).
Rosebud	(2)	W	Sand and gravel (construction).
Sanders	W	W	Antimony.
Sheridan	(2)	62	Sand and gravel (construction).
Silver Bow	W	W	Copper, silver, sand and gravel (construction), gold.
Stillwater	10	(3)	
Teton	--	--	
Toole	(2)	159	Sand and gravel (construction).
Valley	W	W	Clays, sand and gravel (construction).
Wibaux	(2)	8	Sand and gravel (construction).
Yellowstone	W	W	Sand and gravel (construction), lime.
Undistributed[4]	236,736	120,203	
Sand and gravel (construction)	e12,910	XX	
Stone:			
Crushed	XX	e4,700	
Dimension	XX	W	
Total	[5]303,081	270,753	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Blaine, Fallon, Garfield, Glacier, Golden Valley, McCone, Powder River, Prairie, Roosevelt, Sweet Grass, Treasure, and Wheatland Counties, and Yellowstone National Park are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Crushed stone was produced; data not available by county.

[4]Includes gem stones and some stone production that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Montana business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	382.4	390.1	+2.0
Unemployment	do.	43.0	40.7	-5.4
Employment (nonagricultural):				
Mining[1]	do.	7.3	6.4	-12.3
Manufacturing	do.	20.7	20.2	-2.4
Contract construction	do.	10.0	10.4	+4.0
Transportation and public utilities	do.	19.9	19.8	-.5
Wholesale and retail trade	do.	68.4	70.2	+2.6
Finance, insurance, real estate	do.	12.6	13.0	+3.2
Services	do.	55.7	57.2	+2.7
Government	do.	68.5	69.0	+.7
Total nonagricultural employment[1 2]	do.	263.2	266.1	+1.1
Personal income:				
Total	millions	$7,677	$8,165	+6.4
Per capita		$9,544	$9,999	+4.8
Construction activity:				
Number of private and public residential units authorized		2,052	2,940	+43.3
Value of nonresidential construction	millions	$121.6	$117.1	-3.7
Value of State road contract awards	do.	$79.4	$144.5	+82.0
Shipments of portland and masonry cement to and within the State	thousand short tons	229	266	+16.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$270.8	$293.3	+8.3
Value per capita, resident population		$333	$359	+7.8
Value per square mile		$1,812	$1,995	+10.1

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.
[2]Data do not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

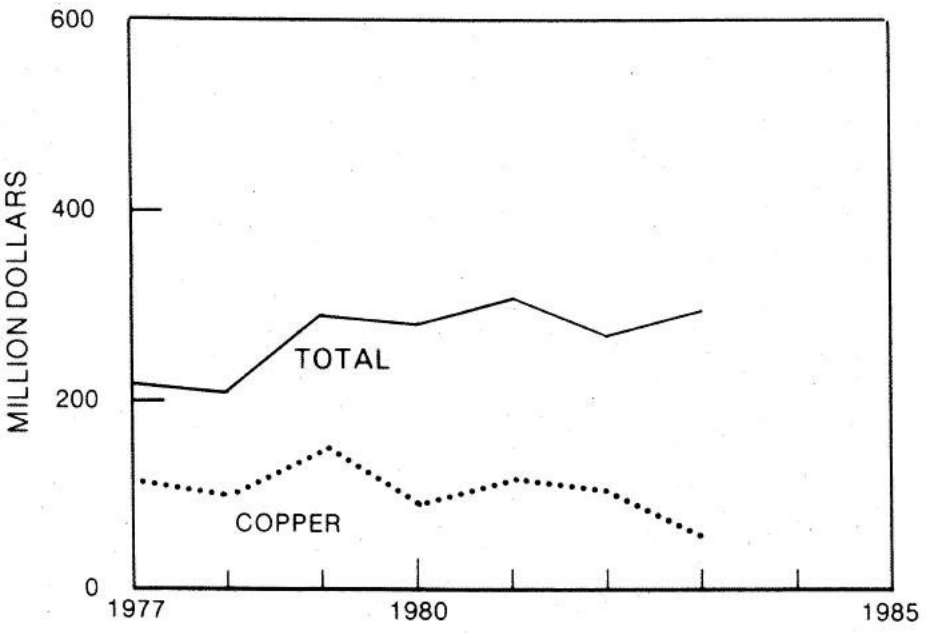

Figure 1.—Value of copper and total value of nonfuel mineral production in Montana.

Exploration Activities.—Exploration activity in Montana, largely for precious metals, was up from the level of 1982. The number of exploration licenses granted by the State increased from 161 granted to 64 companies in 1982 to 201 licenses issued to 75 companies in 1983. The number of small mine exclusion permits, however, decreased from 1,360 as of September 1982 to 1,220 in September 1983.

ASARCO Incorporated and United States Borax and Chemical Corp. continued exploration for stratabound silver-copper deposits in the Cabinet Mountains Wilderness in Lincoln County. Asarco announced that its Chicago Peak discovery appears to be larger than the Troy Mine; U.S. Borax drilled one 2,400-foot hole and obtained permission from the U.S. Forest Service to resume drilling on claims in the wilderness area.

Hecla Mining Co. conducted followup underground exploration at the Florence-Queen silver-lead property near Niehart, Cascade County; a surface drilling program was completed in 1982. Hecla and AMAX Exploration Inc. began a joint-venture exploration project for precious and base metals at Hughesville, in the Barker mining district, Judith Basin and Cascade Counties.

Plexus Resources Corp. continued its diamond drilling program at the New World project in Park County. The 1983 effort consisted of fill-in drilling to firm up stratigraphically controlled gold-silver reserves discovered in 1982.

Noranda Exploration Inc. evaluated the Nancy Lee silver-copper property near Superior in Mineral County. Detailed geologic mapping and soil sampling over 4 square miles were done prior to diamond drilling.

The Argentine and Silver Chief claim groups in the Wickes mining district, Jefferson County, were drilled by Utah International Inc. The properties produced high-grade silver ores in the 1900's.

Cominco American Inc. and Exxon Minerals Co. continued exploration work in the Little Belt Mountains.

Mines Management Inc. completed a drilling program on the White Penny silver-copper prospect near Trout Creek, Sanders County, and carried out a surface mapping, sampling, and geophysical campaign on its Janstan property north of Thompson Pass on the Montana-Idaho border.

Legislation and Government Programs.—Environmental group-sponsored measures designed to substantially increase the severance tax on hard-rock minerals died in taxation committees of the 1983 Montana Legislature. Two laws were enacted; one places two-thirds of the metal mines license tax into permanent trust accounts, and the other requires prepayment of property taxes in mining impact areas. These laws will help the mining industry mitigate socioeconomic impacts in communities where it operates. Another measure, beneficial to nonmetal producers, was passed that provides additional deductions in calculation of the net proceeds of mines tax.

A contract was signed by the Montana Bureau of Mines and Geology (MBMG) with the U.S. Geological Survey for cartographic support to produce Conterminous U.S. Map Program (CUSMAP) 2° geologic maps for incorporation into Montana's Atlas Series; the project was underway at yearend. During the 1983 fiscal year, the MBMG issued 10 new publications and placed 10 reports on open file.

The Mining and Mineral Resources Research Institute at the Montana College of Mineral Science and Technology at Butte received an allotment of $150,000 from the U.S. Bureau of Mines in 1983. An additional research grant for $36,000 was made to the college for training and research in the generic mineral technology center in the areas of mineral industry waste treatment and recovery of critical minerals and metals from waste.

Employment.—An increase in employment in the State's precious metals industry was not large enough to offset the loss of mining-related jobs caused by the suspension of Anaconda's Butte copper operations. Overall mining employment in Montana for 1983 was 6,400, a decrease of 12.3% from that of 1982.

Average weekly earnings for mineral industry production workers was $534.36 in 1983; it was the second highest in the State, next to wages paid to construction workers. This figure represented an increase of $8.93 per week over that of 1982.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Antimony.—U.S. Antimony Corp. operated its mine, mill, and recovery plant in Sanders County, at a slightly higher level than in 1982. U.S. Antimony was one of two

domestic antimony producers in 1983, and was the sole producer of primary antimony from stibnite ore.

Copper.—Copper production was reported from 19 mines in 11 counties in 1983, compared with that from 12 mines in 8 counties during 1982. Montana's copper production ranked fourth in the Nation, accounting for about 3% of primary production in 1983 compared with 6% in 1982.

The State's two major producers were Anaconda's Butte operation and Asarco's Troy Mine in Lincoln County. Total production was down more than 49% from that of 1982. The shutdown of Anaconda's Butte copper operations in late June reduced the company's share of the State's total production.

The company emphasized that the suspension of Butte copper operations was not a permanent shutdown. Company officials stated that factors prerequisite to reopening were higher copper prices, a new labor contract, improved processing, and relief in the areas of freight charges, electric power rates, and State property and mining taxes.

Gold.—Gold production was reported from 24 lode mines in 10 counties in 1983, compared with production from 22 mines in 9 counties in 1982. Two placer operations reported gold production, and gold was recovered from the retreatment of old mine tailings. Montana's gold production ranked fourth in the Nation, accounting for about 8% of the national total in 1983, up from 5% in 1982; the State's 1983 gold production was slightly more than twice that reported in 1982.

Placer U.S. Inc.'s wholly owned Golden Sunlight Mines Inc. began full-scale production at the new Golden Sunlight open pit mine in February. The operation near Whitehall, Jefferson County, reached full production 5 months ahead of schedule and $28 million under projected cost. The mill, a cyanide vat leach, carbon-in-pulp with electrowinning plant, maintained the design throughput of 5,000 tons per day throughout the year. Golden Sunlight was Montana's first-ranked gold producer in 1983, accounting for 49% of the State's production.

Pegasus Gold Ltd. increased gold-silver production at its Zortman and Landusky Mines in the Little Rockies District, Phillips County. The operation, which runs only 7 to 8 months a year because of the severe winter climate, has been described as the world's lowest grade hard-rock gold operation and one of the largest heap-leaching facilities. The Zortman and Landusky Mines produced 48% of the gold recovered in the State in 1983.

Montoro Gold Co. was at the public hearing stage of permitting by yearend for its proposed 50,000-ounce-per-year, open pit, heap-leach gold operation at German Gulch, Silver Bow County. Montoro Gold expected to have the new Beal Mine in operation by late 1985.

Homestake Mining Co. continued exploration and development work at the Jardine gold deposit in Park County; preliminary work on processing the McClaren Mine tailings at Cooke City was done by Blue Range Mining Co.

Judith Gold Corp. undertook additional development drilling on its Judith Gold property at the old ghost town of Kendall, in the Judith Mountains, Fergus County.

Gulf Titanium Ltd. and Goldsil Mining and Milling Co. carried out exploration and development work at Marysville in Lewis and Clark County. Gulf started an underground drilling program at the North Star Mine, and continued dewatering, rehabilitation, and underground sampling at the Cruse-Belmont Mine; Goldsil spent $2 million rebuilding and modernizing the Drumlummon mill and had a drilling program underway at yearend.

Lead.—Lead was recovered as a byproduct from 17 base and precious metal mines in 10 counties and from reprocessing old tailings. Montana ranked fifth in the Nation for lead production in 1983; the State's lead production increased 76% over that of 1982.

Asarco's East Helena smelter, the only remaining lead smelter in the Northwestern United States, produced 58,400 short tons of lead bullion in 1983. A new $2.9 million stack for the smelter baghouse was completed. The zinc fuming plant placed on standby in 1982 did not operate in 1983.

Molybdenum.—Molybdenum concentrate produced as byproduct from copper ores mined at Anaconda's East Berkeley pit in Butte was down 9% compared with 1982 production. Molybdenum production in Montana ceased when the Butte operations were shut down by Anaconda in June 1983.

Platinum-Palladium.—In midyear, a joint venture was formed by the principal operators in the Stillwater Complex in Stillwater and Sweet Grass Counties. Manville Products Corp. and Chevron Resources Co., joint-venture partners in Stillwater PGM

Resources Inc. since 1979, formed a joint venture with Anaconda to explore and evaluate platinum-group resources in the Stillwater Complex. The new company, called Stillwater Mining Co., contracted to extend the Minneapolis adit on Anaconda's property 3,000 feet and to complete 60,000 feet of diamond drilling to prove up reserves. A production decision was expected by 1985.

Silver.—Although Montana's 1983 silver production was down 7% from that of 1982, the value increased by 33% owing to higher silver prices. The State produced 13% of the Nation's silver in 1983, and advanced to second ranking in total silver production. Silver production in 1983 was reported from 28 mines in 12 counties and from the retreatment of old tailings, compared with production from 28 mines in 9 counties during 1982.

Asarco's Troy Mine in Lincoln County was again Montana's top silver producer, accounting for 69% of the State total; the Troy Mine was also the third-ranked silver producer in the Nation for 1983. Inspiration Mines Inc.'s Black Pine Mine in Granite County was the State's second largest silver producer. Contact Mining Co. continued to operate its 1,200-ton-per-day mill at Philipsburg, Granite County; Contact Mining beneficiates ore from the Black Pine operation. Preparation by Contact Mining to reopen the old Granite-Bimetallic shaft was underway by yearend. The suspension of Anaconda's Butte operations in midyear dropped Anaconda's share of Montana's silver production to 5% from 12% in 1982. Following a 4-month shutdown in 1982 because of low silver prices, Midnite Mines Inc. resumed underground mining activity at its Polaris Mine in Beaverhead County.

CoCa Mines Inc. completed exploration work on an open pit minable silver ore body at the old Flathead Mine in the Hog Heaven District, Flathead County. The company was completing exploration work on a zone that could be developed for underground mining and was finishing a feasibility study at yearend.

Table 4.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Dry gold[2]	10	5,283,827	157,413	196,859	3	W	--
Gold-silver	7	7,141	673	22,706	5	84	--
Silver	7	3,078,859	1,567	5,173,136	W	W	--
Total[3]	24	8,369,828	159,653	5,392,701	W	W	--
Copper	1	6,283,449	1,383	313,093	16,454	111	--
Total	25	14,653,277	161,036	5,705,794	W	W	--
Other lode material:							
Gold tailings	--	W	W	W	W	W	--
Silver cleanup	--	W	--	W	W	W	--
Copper precipitates	1	W	--	--	W	--	--
Total lode	25	[4]14,765,932	W	[4]5,707,963	W	[4]1,163	--
Placer	2	--	W	--	--	--	--
Grand total	27	[4]14,765,932	[4]161,436	[4]5,707,963	[4]33,337	[4]1,163	--

W Withheld to avoid disclosing company proprietary data.
[1]Details may not add to total because some mines produce more than one class of material. Operations from which gold, silver, copper, and lead were recovered only from tailings or from cleanup are not counted as producing mines.
[2]Includes material that was leached.
[3]Data may not add to totals shown because of independent rounding.
[4]Includes items indicated by symbol W.

Table 5.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1981, total	41	1	14,824,914	54,267	$24,943,285	2,988,810	$31,437,409
1982, total	26	--	19,327,764	75,171	28,257,533	6,168,711	49,041,253
1983:							
Beaverhead	2	--	W	W	W	W	W
Broadwater	3	--	W	W	W	W	W
Cascade	1	--	W	W	W	W	W
Granite	3	--	W	W	W	W	W
Jefferson	6	--	W	W	W	37,255	426,197
Lewis and Clark	2	--	W	W	W	W	W
Lincoln	1	--	2,819,835	W	W	3,963,701	45,344,739
Madison	3	--	539	146	61,904	281	3,215
Meagher	--	1	--	1	424	--	--
Mineral	--	1	W	W	W	W	W
Phillips	2	--	3,825,186	77,445	32,836,680	178,584	2,043,000
Powell	1	--	W	--	--	W	W
Silver Bow	1	--	6,287,086	1,383	586,392	313,093	3,581,784
Total	25	2	[3]14,765,932	[3]161,436	[3]68,448,864	[3]5,707,963	[3]65,299,096

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1981, total	62,485	$117,257,165	194	$156,574	25	$24,166	$173,818,599
1982, total	r64,951	r104,244,568	661	372,410	W	W	W
1983:							
Beaverhead	W	W	W	W	--	--	W
Broadwater	W	W	W	W	--	--	W
Cascade	W	W	W	W	--	--	W
Granite	W	W	W	W	--	--	W
Jefferson	5	7,657	W	W	--	--	W
Lewis and Clark	W	W	W	W	--	--	W
Lincoln	14,444	24,369,385	W	W	--	--	70,045,316
Madison	W	W	W	W	--	--	65,897
Meagher	--	--	--	--	--	--	424
Mineral	W	W	W	W	--	--	W
Phillips	(4)	383	(4)	102	--	--	34,880,165
Powell	--	--	--	--	--	--	W
Silver Bow	18,694	31,539,783	111	53,020	--	--	35,760,979
Total	[3]33,337	[3]56,245,432	[3]1,163	[3]556,076	--	--	[3]190,549,468

rRevised. W Withheld to avoid disclosing company proprietary data.

[1]Operations from which gold, silver, copper, and lead were recovered only from tailings or from cleanup are not counted as producing mines.

[2]Does not include gravel washed.

[3]Includes items indicated by symbol W.

[4]Less than 1/2 unit.

Table 6.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Cyanidation	156,778	192,114	--	--	--
Smelting of concentrates from:					
Ore	W	5,473,990	31,088	1,071	--
Tailings	W	1,575	W	W	--
Direct smelting of:					
Ore	W	W	8	91	--
Cleanup	--	W	W	W	--
Precipitates	--	--	W	--	--
Total	W	[1]5,707,963	[1]33,337	[1]1,163	--
Placer	W	--	--	--	--
Grand total	[1]161,436	[1]5,707,963	[1]33,337	[1]1,163	--

W Withheld to avoid disclosing company proprietary data.
[1]Includes items indicated by symbol W.

Table 7.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in Silver Bow County

Year	Mines producing	Material sold or treated (thousand metric tons)	Gold (troy ounces)	Silver (thousand troy ounces)
1979	1	15,545	21,336	2,655
1980	1	8,244	11,541	1,596
1981	1	13,729	14,394	2,028
1982	1	12,847	3,361	739
1983	1	6,287	1,383	313
1882-1983	--	[1]542,016	2,685,622	683,350

Year	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)	Total value[2] (thousands)
1979	69,133	--	--	$177,800
1980	37,467	--	--	124,602
1981	59,477	--	--	139,555
1982	48,144	--	--	[r]84,410
1983	18,694	111	--	35,761
1882-1983	8,702,830	415,553	2,406,823	6,031,194

[r]Revised.
[1]Complete data not available for 1882-1904.
[2]Derived from average values of the metals; included average value of copper produced in wire bars prior to 1982 and average value of copper produced in cathodes for 1982 and 1983.

NONMETALS

Barite.—NICOR Mineral Ventures purchased the Montana Barite Co. Inc. operations, including the Missoula mill. The continued low level of activity in the oil and gas drilling industry resulted in a slow barite market; barite was not mined in Montana in 1983, but was shipped from previously stockpiled ore.

Cement.—Cement production in Montana was up slightly over that of 1982, but the low level of construction activity precluded a significant change in the amount produced. Portland and masonry cements were produced by Kaiser Cement Corp. at Montana City in Jefferson County, and by Ideal Basic Industries Inc. at Trident, Gallatin County. Ideal Basic resumed production in May 1983 following a 5-month layoff in the manufacturing phase of its operations. Reasons cited for the shutdown were the sluggish construction industry, poor weather, and excess cement inventories. Cement produced in the State was used by ready-mix companies (65%); other contractors (16%); highway contractors (11%); concrete products manufacturers (5%); and building material dealers, government agencies, and miscellaneous customers (3%). Raw materials consumed in cement manufacture were limestone, clays, sandstone, sand, iron ore, gypsum, and other additives. Shipments to users were mostly by truck and rail.

Clays.—Montana ranked third in bentonite production in 1983, although produc-

tion was down 14% in quantity and 23% in value from that of 1982. Bentonite was produced by 4 companies from 10 deposits in Carbon, Carter, and Valley Counties. Continued low demand for bentonite in the drilling industry and depressed requirements related to the steel industry resulted in a slow market for this commodity. A large share of Montana's bentonite was sold for drilling mud, iron ore pellet binder, and foundry sand.

Gem Stones.—Montana tied with California for fifth rank in gem stone production in 1983. Intergem Inc. recovered commercial quantities of gem-quality sapphires at its Yogo Gulch property in Fergus County. Sapphire-bearing intrusive dike rock was surface mined, allowed to weather, and the sapphires then recovered by gravity methods.

Graphite.—Montana was the Nation's only producing State for amorphous graphite in 1983. Production by National Minerals Corp. in Broadwater County decreased in both quantity and value from that reported in 1982.

Gypsum.—Gypsum production in the State increased 80% in quantity and 65% in value over that of 1982. The increase was due primarily to an upswing in the wallboard industry. United States Gypsum Co. mined gypsum from its underground Shoemaker Mine at Heath in Fergus County; the gypsum was used by the company's wallboard plant. Maronick Construction Co. Inc. mined gypsum from open pit mines near Raynesford, Judith Basin County. The product was shipped to the Kaiser Cement plant at Montana City and to the Ideal Basic cement plant at Trident.

Lime.—Continental Lime Inc., Holly Sugar Corp., and Great Western Sugar Co. produced lime in Broadwater, Richland, and Yellowstone Counties, respectively. The 1983 production nearly doubled in quantity and value from that of 1982. The lime produced was used in metallurgical processes, pollution abatement, and sugar refining.

Phosphate Rock.—Phosphate production in the State increased 1% in quantity and 67% in value over that of 1982, owing to a partial recovery in the agricultural fertilizer market. Montana's only producer, Cominco, continued to mine phosphate at its underground Warm Springs Mine near Garrison in Powell County. Near yearend, Cominco announced plans for a substantial expansion of its operation to enable compliance with a new 5-year contract to supply phosphate rock to a Canadian company.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Estimated construction sand and gravel production and value for 1983 were down from those of 1982 because of a general slowdown in the construction industry.

Table 8.—Montana: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	891	$2,508	$2.82	NA	NA	NA
Gravel	3,455	8,937	2.59	NA	NA	NA
Sand and gravel (unprocessed)	993	1,349	1.36	NA	NA	NA
Total or average	[1]5,338	12,794	2.40	[e]5,000	[e]$10,200	[e]$2.04
Industrial:						
Sand	W	W	5.20	W	W	10.00
Gravel	--	--	--	W	W	4.99
Total or average	W	W	5.20	W	W	5.69
Grand total or average	W	W	2.42	W	W	[e]2.05

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

The State's 1983 output of crushed stone declined 38% in quantity and 50% in value from that estimated for 1982. Decreased activity in highway and secondary road construction, in heavy construction in general, and a temporary shutdown in railroad ballast manufacture contributed toward the production decline. Five counties—Beaverhead, Cascade, Gallatin, Jefferson, and Park—accounted for 95% of the State's crushed stone production; Ideal Basic, Kaiser Cement, and Maronick Construction were the leading producers. Travertine building stone was produced by the Livingston Marble and Granite Works and by Hallett Minerals Co. from quarries near Gardiner in Park County.

Table 9.—Montana: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse and fine aggregate: Unpaved road surfacing	10	50
Chemical and metallurgical: Cement manufacture	348	948
Special:		
Asphalt fillers or extenders	3	7
Other[2]	512	1,340
Total[3]	872	2,344

[1]Includes limestone, marble, sandstone, quartzite, and traprock.
[2]Includes riprap and jetty stone, lime manufacture, flux stone, and uses not specified.
[3]Data do not add to totals shown because of independent rounding.

Sulfur (Recovered).—Montana Sulphur & Chemical Co. and Farmers Union Central Exchange recovered sulfur as a byproduct from petroleum refineries in Yellowstone County.

Talc.—Montana ranked third in talc production for 1983, down from its leading producer status in 1982. The 1983 production was down 31% in quantity and 30% in value from that of 1982. All of the State's talc was open pit mined from deposits in the Ruby and Gravelly Ranges in Madison County. Cyprus Industrial Minerals Co. completed a new sorting facility at its Yellowstone Mine near Ennis, and formulated plans for new development at its Beaverhead Mine, which was inactive in 1983. A 3-week-long strike at Cyprus' talc processing plant at Three Forks was settled in late July. Pfizer Inc. continued production at its Regal and Treasure Pit Mines near Dillon, and processed talc at its Barretts mill south of Dillon. Principal uses for talc produced in Montana were in paint, paper, ceramics, cosmetics, and other uses including roofing and rubber.

Exploration for talc deposits was active in the Precambrian of southwestern Montana during 1983, with at least four companies involved.

Vermiculite.—Montana was again the leading producing State for vermiculite, although 1983 production was down 12% in quantity and 6% in value from that of 1982. Production in 1983 was about 84% of the yearly average for the 5-year period (1979-83); the value of production was 4% less than the yearly average for the 5-year period. W. R. Grace & Co. continued to mine and mill vermiculite ore at its Rainy Creek operation north of Libby in Lincoln County. Robinson Insulation Co. at Great Falls, Cascade County, produced exfoliated vermiculite, which was sold for building aggregates, insulation, and agricultural applications.

[1]State Liaison Officer, Bureau of Mines, Spokane, WA.
[2]Chief, Geology and Mineral Resources Division, Montana Bureau of Mines and Geology, Butte, MT.
[3]Staff field agent, Montana Bureau of Mines and Geology, Butte, MT.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
The Anaconda Aluminum Co., a division of Atlantic Richfield Co.	Columbia Falls, MT 59912	Reduction plant	Flathead.
Antimony:			
U.S. Antimony Corp	Box 643 Thompson Falls, MT 59873	Mine and plant	Sanders.
Barite:			
Montana Barite Co. Inc	Box 3296 Missoula, MT 59806	do	Missoula.
Cement:			
Ideal Basic Industries Inc., Cement Div.[1]	Box 8789 Denver, CO 80201	Plant	Gallatin.
Kaiser Cement Corp.[1]	300 Lakeside Dr. Oakland, CA 94612	do	Jefferson.
Clays:			
American Colloid Co	5100 Suffield Ct. Skokie, IL 60078	Pits and plant	Carbon and Phillips.
Federal Bentonite Div., Aurora Industries Inc.	609 5th Ave. Belle Fourche, SD 57717	Pit and plant	Valley.
International Minerals & Chemical Corp., Industrial Minerals Div.	Box 460 Belle Fourche, SD 57717	Pits	Carter.
NL Industries Inc., Baroid Div	Box 1675 Houston, TX 77251	Pit and plant	Do.
Copper:			
The Anaconda Minerals Co.[2]	Box 689 Butte, MT 59701	Open pit mine and plant	Silver Bow.
Gold:			
Golden Sunlight Mines Inc., a subsidiary of Placer U.S. Inc.[3]	Box 678 Whitehall, MT 59759	do	Jefferson.
Pegasus Gold Ltd.[3]	Zortman, MT 59546	do	Phillips.
Gypsum:			
Maronick Construction Co. Inc.[4]	East Helena, MT 59635	Open pit mine	Judith Basin.
United States Gypsum Co	Heath, MT 59457	Underground mine and plant.	Fergus.
Lime:			
Continental Lime Inc	268 West 400 South, Suite 201 Salt Lake City, UT 84101	Open pit mine	Broadwater.
Great Western Sugar Co	1530 16th St. Denver, CO 80217	Surface mine and plant	Yellowstone.
Holly Sugar Corp	Box 1052 Colorado Springs, CO 80901	do	Richland.
Phosphate rock:			
Cominco American Inc	Box 638 Garrison, MT 59731	Underground mine	Powell.
Sand and gravel (1982):			
Gilman Excavating Inc	Continental Dr. Butte, MT 59701	Pit	Silver Bow.
Pioneer Ready-Mix Co	Box 1387 Bozeman, MT 59715	Pit	Gallatin.
Shellinger Construction Co	Box 517 Columbia Falls, MT 59912	Pits	Flathead.
United Industries, Northern Materials Co. Inc.	Box 1690 Great Falls, MT 59401	Pits and plant	Cascade and Yellowstone.
Yellowstone County Highway Department.	Box 35023 Billings, MT 59101	Pit	Yellowstone.
Silver:			
ASARCO Incorporated[5]	Box 868 Troy, MT 59935	Underground mine and plant.	Lincoln.
Black Pine Mining Co.[5]	Box 610 Philipsburg, MT 59858	Underground mine	Granite.
Midnite Mines Inc.[5]	15600 Redmond Way Redmond, WA 98052	do	Beaverhead.
Stone:			
Stauffer Chemical Co	Box 3146 Butte, MT 59702	Quarry	Do.
U.S. Forest Service, Region 1	340 North Pattee Missoula, MT 59802	Quarries	Various.
Sulfur (recovered):			
Montana Sulphur & Chemical Co	Box 31118 Billings, MT 59107	Plant	Yellowstone.
Talc:			
Cyprus Industrial Minerals Co., a subsidiary of Amoco Minerals Co.	Box 3299 7000 South Yosemite Englewood, CO 80155	Open pit mine and plant	Madison and Gallatin.
Pfizer Inc	Box 1147 Dillon, MT 59725	Open pit mines and plant	Madison and Beaverhead.
Vermiculite:			
W. R. Grace & Co., Zonolite Div	1114 Avenue of the Americas New York, NY 10036	Open pit mine and plant	Lincoln.

[1]Also clays and stone.
[2]Also gold, molybdenum, and silver.
[3]Also silver.
[4]Also stone.
[5]Also copper, gold, and lead.

The Mineral Industry of Nebraska

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Conservation and Survey Division of the University of Nebraska (Nebraska Geological Survey), for collecting information on all nonfuel minerals.

By Karl E. Starch[1] and Raymond R. Burchett[2]

The value of nonfuel minerals produced in Nebraska rose to $87.4 million in 1983, 16% over the 1982 value. Gains in output of all nonfuel minerals except lime and industrial sand effected this increase, the first since 1979. Nonfuel minerals mined in Nebraska were limited to the industrial minerals including cement, the largest individual product, followed by sand and gravel and stone. Output of crushed stone increased the most, but crushed stone remained third in importance behind cement and sand and gravel. These production gains among industrial minerals can be ascribed to the significant increase in residential building, reported to be about 44% greater than in 1982, and in road construction, up nearly 74%. Metals processed in the State were confined largely to output of the large lead refinery located in Omaha.

Table 1.—Nonfuel mineral production in Nebraska[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	134	$392	164	$501
Sand and gravel:				
Construction do.	r9,713	r23,851	e10,100	e25,000
Industrial do.	14	105	4	W
Stone (crushed) do.	e3,100	e14,300	2,442	2,612
Combined value of cement, gem stones, lime, and value indicated by symbol W	XX	36,632	XX	39,296
Total	XX	r75,280	XX	87,409

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Data differ from those in the Stone and Statistical Summary chapters owing to receipt of later information.

Table 2.—Value of nonfuel mineral production in Nebraska, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Antelope	(2)	W	Sand and gravel (construction).
Box Butte	$2	(3)	
Brown	(2)	$1	Sand and gravel (construction).
Buffalo	(2)	711	Do.
Burt	(2)	6	Do.
Butler	(2)	267	Do.
Cass	W	26,525	Cement, sand and gravel (construction), clays.
Cedar	(2)	721	Sand and gravel (construction).
Chase	(2)	122	Do.
Cheyenne	(2)	66	Do.
Clay	(2)	W	Do.
Colfax	(2)	288	Do.
Cuming	(2)	W	Do.
Custer	(2)	158	Do.
Dawson	(2)	959	Do.
Deuel	(2)	136	Do.
Dixon	(2)	W	Do.
Dodge	(2)	541	Do.
Douglas	2	W	Sand and gravel (construction), clays.
Dundy	(2)	--	
Fillmore	(2)	W	Sand and gravel (construction).
Franklin	(2)	236	Do.
Frontier	(2)	7	Do.
Furnas	(2)	46	Do.
Gage	W	W	Do.
Garden	(2)	30	Do.
Grant	(2)	--	
Hall	(2)	670	Sand and gravel (construction).
Hamilton	(2)	W	Do.
Hayes	(2)	W	Do.
Hitchcock	(2)	W	Do.
Holt	(2)	760	Do.
Howard	(2)	45	Do.
Jefferson	245	W	Sand and gravel (construction), clays.
Kearney	(2)	58	Sand and gravel (construction).
Keith	(2)	246	Do.
Knox	(2)	313	Do.
Lancaster	W	81	Clays.
Lincoln	(2)	72	Sand and gravel (construction).
Loup	(2)	W	Do.
Madison	(2)	413	Do.
Merrick	(2)	550	Do.
Morrill	W	W	Sand and gravel (construction), lime.
Nance	(2)	189	Sand and gravel (construction).
Nemaha	W	W	Do.
Nuckolls	W	W	Cement, sand and gravel (construction).
Pawnee	W	(3)	
Perkins	(2)	22	Sand and gravel (construction).
Phelps	(2)	28	Do.
Pierce	(2)	W	Do.
Platte	(2)	1,164	Do.
Polk	(2)	W	Do.
Red Willow	(2)	758	Do.
Richardson	(2)	--	
Rock	(2)	--	
Saline	--	41	Sand and gravel (construction).
Sarpy	230	W	Sand and gravel (construction), clays.
Saunders	W	2,699	Sand and gravel (construction), sand (industrial).
Scotts Bluff	W	W	Lime, sand and gravel (construction).
Seward	105	(3)	
Sheridan	(2)	68	Sand and gravel (construction).
Stanton	(2)	W	Do.
Thayer	(2)	1,166	Do.
Thomas	(2)	W	Do.
Valley	(2)	--	
Washington	W	(3)	

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Nebraska, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Webster	[2]	W	Sand and gravel (construction).
York	[2]	W	Do.
Undistributed[4]	$50,710	$20,815	
Sand and gravel (construction)	[e]28,310	XX	
Stone (crushed)	XX	[e]14,300	
Total[5]	79,605	75,280	

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Adams, Arthur, Banner, Blaine, Boone, Boyd, Cherry, Dakota, Dawes, Garfield, Gosper, Greeley, Harlan, Hooker, Johnson, Keya Paha, Kimball, Logan, McPherson, Otoe, Sherman, Sioux, Thurston, Wayne, and Wheeler. County distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2]Construction sand and gravel was produced; data not available by county.

[3]Crushed stone was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Nebraska business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	762.0	762.1	
Unemployment	do	57.5	44.6	-22.4
Employment (nonagricultural):				
Mining[1]	do	1.6	1.4	-12.5
Manufacturing	do	82.1	87.7	+6.8
Contract construction	do	18.1	17.3	-4.4
Transportation and public utilities	do	42.6	42.1	-1.2
Wholesale and retail trade	do	152.6	155.4	+1.8
Finance, insurance, real estate	do	41.4	41.9	+1.2
Services	do	122.9	124.4	+1.2
Government	do	130.1	134.4	+3.3
Total nonagricultural employment	do	591.4	604.6	+2.2
Personal income:				
Total	millions	$16,942	$17,474	+3.1
Per capita		$10,641	$10,940	+2.8
Construction activity:				
Number of private and public residential units authorized		3,851	5,555	+44.2
Value of nonresidential construction	millions	$200.6	$199.6	-.5
Value of State road contract awards	do	$110.1	$191.1	+73.6
Shipments of portland and masonry cement to and within the State	thousand short tons	687	726	+5.7
Nonfuel mineral production value:				
Total crude mineral value	millions	$75.3	$87.4	+16.1
Value per capita, resident population		$50	$55	+10.0
Value per square mile		$1,030	$1,130	+9.7

[p]Preliminary.

[1]Includes oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

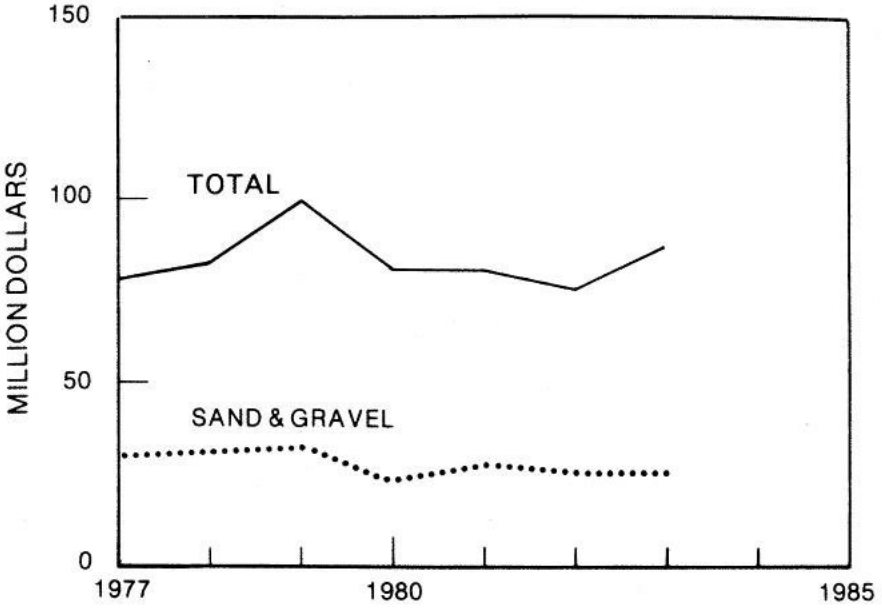

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Nebraska.

Thirty of Nebraska's ninety-three counties reported no nonfuel mineral production in 1982, the latest year for which county data is available. Cass County, the largest individual producer of nonfuel minerals, accounted for more than one-third of the State total. Sand and gravel was the sole nonfuel mineral produced in 51 of the 63 counties reporting nonfuel mineral output. Cement was produced in Cass and Nuckolls Counties, and crushed stone, in 10 counties.

Representing only a fraction of 1% of the labor force, mining employed about 1,400 people in Nebraska in 1983, including oil and gas workers, about 200 less than in 1982. The relatively modest role nonfuel mining played in Nebraska's economy is illustrated by comparing Nebraska's output of about $55 per capita in nonfuel minerals with the national average of $91 per capita.

"The Nebraska Mineral Operations Review, 1983," published by the Nebraska Geological Survey, reported that 3,280 quarries, pits, and mines have been active at various times over approximately the last 80 years in Nebraska. Of this number, 365 were limestone quarries; 2,738, sand, gravel, and silt pits; 24, clay or shale pits; 90, sandstone pits; 11, quartzite pits; 29, volcanic ash pits; 14, coal mines; 1 chalk mine; 3, flint quarries; and 5, peat pits. Of the 39,092 acres these operations have disturbed, approximately 50% have been reclaimed. During 1983, that agency identified 34 limestone quarries; 607 sand, gravel, and silt or siltstone pits; 7 clay or shale pits; and 20 sandstone pits active in Nebraska. These 668 active mining operations disturbed 548 acres and restored 141 acres during the year.

Exploration Activities.—Molycorp Inc. continued drilling in the Elk Creek carbonatite of southeastern Nebraska appraising the potential for rare-earth production. Wyoming Fuels Co., a subsidiary of the Kansas-Nebraska Gas Co., continued evaluating a uranium resource consisting of possibly 25 million pounds of uranium at Crow Butte in the Chadron-Crawford area of northwestern Nebraska. The company developed plans to construct an in situ pilot plant in the area in 1984 and continued preparing environmental work for State and Federal permits.

The Nebraska Geological Survey, coop-

erating with the Geological Surveys of Iowa, Kansas, and Missouri, prepared and published a mineral resource map of the Forest City Basin, which includes parts of southeastern Nebraska, northeast Kansas, northwest Missouri, and southwest Iowa, an area of mineral exploration interest.

Legislation and Government Programs.—Legislative Bill 356, passed on May 25, provided for regulating all exploration drilling in Nebraska. Although intended to protect ground water in areas of uranium occurrence in the northwestern part of the State, the bill was broadened to include all minerals. The Nebraska Department of Environmental Control will administer the new law.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Cement was produced by two companies in Nebraska in 1983, Ash Grove Cement Co. at its plant in Louisville, Cass County, and Ideal Basic Industries Inc. at its plant in Superior, Nuckolls County, both in the southeastern part of the State. Ash Grove's plant was the larger of the two. Output at both plants was primarily types I and II, general use and moderate heat portland cement; a minor amount of masonry cement was also produced at both plants. Two-thirds of the State's total cement output went to ready-mix companies; about one-fifth to highway contractors; and most of the balance to concrete product manufacturers, building material dealers, and other contractors. Nearly all was sold in bulk, and more than 90% was moved to the consumer by truck. Clay, cement rock, gypsum, iron ore, and limestone were the raw materials used in cement manufacture.

Cement production in 1983 was about 10% greater than in 1982.

Clays.—Four companies produced common clay in five counties in Nebraska in 1983. Endicott Clay Products Co. in Jefferson County, with about 50% of total output, was the largest, followed by Ash Grove in Cass County, Yankee Hill Brick Manufacturing Co. in Lancaster County, and Omaha Brick Works near Ralston in Douglas and Sarpy Counties. Cass, Douglas, and Sarpy Counties relate to the Omaha metropolitan area; Lancaster County, to the city of Lincoln; and Jefferson County, to the southwest of Lincoln. All are in Nebraska's more densely populated southeastern corner. Common and face brick were the main products of the three firms manufacturing brick in Nebraska. Benefiting from an upswing in residential construction, clay production in 1983 increased more than 20% over the 1982 level.

Lime.—Great Western Sugar Co. produced quicklime in Scottsbluff and Morrill Counties in Nebraska's western panhandle for use in processing sugar beets into refined sugar at plants in the towns of Bayard, Gering, Mitchell, and Scottsbluff. Production in 1983 was about 34% less than in 1982. Three crushed limestone plants produced agricultural lime exclusively; these plants were located near Garland in Seward County, near Nelson in Nuckolls County, and near Ponca in Dixon County. Most crushed limestone plants, located mainly in the more urbanized southeast, produced some agricultural lime.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel was produced in all but nine of Nebraska's mineral producing counties. Among the largest producers were Central Sand & Gravel Co. in Butler, Madison, Pierce, and Platte Counties; Hartford Sand & Gravel Co. in Douglas and Dodge Counties; Lyman-Richey Sand & Gravel Corp. in Cass, Dodge, Douglas, Morrill, Platte, Sarpy, and Saunders Counties; and Western Sand & Gravel Co. in Cass, Dodge, and Saunders Counties. Estimates for 1983 indicate about a 4% production increase in consonance with an indicated increase in construction and road building.

Nebraska's public and private efforts to use its gravel pits for recreation have been more ambitious than those of most other States. A chain of lakes consisting of over 140 sandpit lakes spread over 223 miles, from Grand Island in the center of the State to Big Springs at the Colorado border, was left from construction of highway I-80. These pits, dug mostly for interchange fill, are no more than one-fourth mile from either I-80 or the Platte River, which parallels I-80. The lakes provide over 700 surface acres of water for esthetic and recreational benefits.

Industrial.—Western Sand & Gravel produced industrial sand in Saunders County. The total amount was used in sandblasting.

Table 4.—Nebraska: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	NA	NA	NA
Gravel	NA	NA	NA	NA	NA	NA
Sand and gravel (unprocessed)	NA	NA	NA	NA	NA	NA
Total or average	r9,713	r$23,851	r$2.46	e10,100	e$25,000	e$2.48
Industrial sand	14	105	7.36	4	W	W
Grand total or average	r9,727	r23,956	r2.46	e10,104	W	W

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone was reported produced by 13 companies at 24 quarries in 10 counties in Nebraska in 1983. A 43% production increase over that of 1982 was reported, reflecting the substantial increase in road building and residential construction. This stone output was the largest ever reported in Nebraska.

Limestone, the only type of stone reported quarried, was all marketed as crushed stone. No dimension stone output was reported, although Nebraska firms cut stone brought in from other States. Cass was the leading county in crushed stone output, followed by Gage, Washington, Pawnee, and Nuckolls. All the counties reporting stone production were in the southeast part of the State near the major urban centers of Omaha and Lincoln. Major producers included Ash Grove, Fort Calhoun Stone Co., Kerford Limestone Co., and Martin Marietta Aggregates. These 4 companies, accounting for 78% of total production, operated 13 of the 24 quarries reported. One quarry yielding between 900,000 and 999,999 tons produced more than 21% of the State's crushed stone; one quarry in the 800,000- to 899,999-ton range accounted for 18% of the total; and eight quarries with 100,000 to 199,999 tons each contributed another 27%. Nearly all crushed stone was transported by truck to the site of consumption. About 38% of crushed stone output was used in unpaved road surfacing and 24% in cement manufacture. Other major uses, in descending order of use, included concrete aggregate, graded road base or subbase, bituminous aggregate, riprap and jetty stone, fill, poultry grit and mineral food, fine-screened aggregate, and agricultural limestone. Minor uses included asphalt fillers or extenders, macadam aggregate, bituminous surface-treatment aggregate, railroad ballast, filter stone, flux stone, terrazzo, roof granules, and other filler.

Table 5.—Nebraska: Crushed limestone sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	34	180
Riprap and jetty stone	187	977
Filter stone	7	35
Coarse aggregate, graded:		
Concrete aggregate, coarse	523	2,832
Railroad ballast	4	W
Fine aggregate (-3/8 inch): Screening, undesignated	118	315
Coarse and fine aggregate:		
Graded road base or subbase	438	2,083
Unpaved road surfacing	1,673	10,285
Terrazzo and exposed aggregate	12	89
Crusher run or fill or waste	174	926
Agricultural: Agricultural limestone	110	598
Chemical and metallurgical: Flux stone	2	12

See footnotes at end of table.

Table 5.—Nebraska: Crushed limestone sold or used by producers in 1983, by use —Continued

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Special:		
Asphalt fillers or extenders	40	W
Other fillers or extenders	23	137
Roofing granules	17	120
Other[1]	2,278	11,458
Total	[2]5,641	30,047

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes poultry grit and mineral food, bituminous aggregate (coarse), bituminous surface-treatment aggregate, cement manufacture, combined coarse and fine aggregate, uses not specified, and uses indicated by symbol W.
[2]Data do not add to total shown because of independent rounding.

Talc.—Cyprus Industrial Minerals Co., a subsidiary of Amoco Minerals Co., ground talc obtained from outside the State at its Grand Island mill in Hall County. The ground talc was sold for use in ceramics, cosmetics, insecticides, paint, paper, plaster, textiles, and toilet articles.

Vermiculite (Exfoliated).—W. R. Grace & Co. produced exfoliated vermiculite at its plant in Douglas County near Omaha. Crude vermiculite was brought in from Grace's mining and beneficiating operations at Libby, MT. The exfoliated product was sold to the construction industry primarily for use as block insulation and loose-fill insulation, but also as concrete aggregate, fireproofing, horticultural use, and plaster aggregates.

METALS

Lead bullion from smelters outside the State was processed at the Omaha refinery of ASARCO Incorporated to produce refined and antimonial lead and refined bismuth. The refinery also recovered antimony, antimony oxide, doré containing silver and gold, copper, and zinc. Total rated annual capacity of the refinery was 180,000 tons of metal.

The Occupational Safety and Health Administration granted temporary relief from the worker-removal provision of the lead-safety standard to four primary lead-producing plants Asarco owned, including the one in Omaha. Scheduled to last from May to November 1983, the relief was conditional on Asarco's complying with all other provisions of the lead standard, as well as special provisions including additional medical surveillance and full-time respirator protection.

[1]State Liaison Officer, Bureau of Mines, Denver, CO.
[2]Geologic program manager, Conservation and Survey Division of the University of Nebraska (Nebraska Geological Survey), Lincoln, NE.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co.[1]	920 Main St. Suite 1000 Kansas City, MO 64105	Plant	Cass.
Ideal Basic Industries Inc., Ideal Cement Co.	Box 8789 Denver, CO 80201	do	Nuckolls.
Clays:			
Endicott Clay Products Co	Box 17 Fairbury, NE 68352	Open pit and plant	Jefferson.
Yankee Hill Brick Manufacturing Co.	Route 1 Lincoln, NE 68502	do	Lancaster.
Sand and gravel (construction):			
Central Sand & Gravel Co	Box 626 Columbus, NE 68601	Pits and plants	Butler, Hall, Madison, Pierce, Platte.
Hartford Sand & Gravel Co	Box Z Valley, NE 68604	Dredges and pits	Dodge, Douglas, Sarpy.
Lyman-Richey Sand & Gravel Corp	4315 Cuming St. Omaha, NE 68131	Pits and plants	Cass, Dodge, Douglas, Morrill, Platte, Sarpy, Saunders.
Stalph Gravel Co	Box 6 West Point, NE 68788	Pit and plant	Cuming.
Western Sand & Gravel Co.[2]	Box 28 Ashland, NE 68003	do	Cass, Dodge, Saunders.
Stone:			
Fort Calhoun Stone Co	1255 South St. Blair, NE 68008	Quarries and plants.	Washington.
Kerford Limestone Co	Box 449 Weeping Water, NE 68463	Quarry and plant	Cass.
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 27622	Quarries and plants.	Cass, Nemaha, Nuckolls, Pawnee, Saunders.

[1]Also produces limestone and clays in Cass County.
[2]Also produces industrial sand and gravel in Saunders County.

The Mineral Industry of Nevada

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Nevada Bureau of Mines and Geology for collecting information on all nonfuel minerals.

By Fred V. Carrillo[1] and John H. Schilling[2]

The value of Nevada's nonfuel mineral production in 1983 was $616 million, an increase of 16% from that recorded in 1982. Nevada ranked 12th nationally in the value of its nonfuel minerals production. Gold was the leading commodity produced in terms of value, accounting for $390 million or 63% of the total nonfuel mineral value produced in the State. Nevada also continued to lead the Nation in the production of barite, magnesite, and mercury.

Table 1.—Nonfuel mineral production in Nevada[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite thousand short tons	1,575	$52,727	663	$21,736
Clays do	103	2,640	58	2,348
Gem stones	NA	1,200	NA	1,200
Gold (recoverable content of ores, etc.) troy ounces	r757,099	r284,601	920,331	390,220
Gypsum thousand short tons	656	4,523	998	7,896
Iron ore thousand long tons	77	1,119	W	W
Lead (recoverable content of ores, etc.) metric tons	W	W	14	7
Mercury 76-pound flasks	25,760	W	25,070	W
Sand and gravel (construction) thousand short tons	6,027	11,724	e7,500	e16,200
Silver (recoverable content of ores, etc.) thousand troy ounces	3,142	24,981	5,164	59,073
Stone (crushed) thousand short tons	e1,300	e4,500	1,269	5,358
Combined value of cement (portland), copper, diatomite, fluorspar, lime, lithium, magnesite, molybdenum, perlite, salt, sand and gravel (industrial), tungsten ore and concentrate (1982), and values indicated by symbol W	XX	r144,448	XX	111,747
Total	XX	r532,463	XX	615,785

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Nevada, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Carson City	$522	$26	Sand and gravel (construction).
Churchill	2,391	1,080	Diatomite, gold, sand and gravel (construction), salt, iron ore, silver, tungsten, lead.
Clark	22,008	27,855	Lime, sand and gravel (construction), sand and gravel (industrial), gypsum, gold, silver.
Douglas	W	669	Sand and gravel (construction), silver, gold, lead.
Elko	42,457	97,748	Gold, barite, sand and gravel (construction), tungsten, copper, silver, lead.
Esmeralda	22,128	27,478	Lithium, silver, gold, diatomite, clays, copper.
Eureka	65,277	59,254	Gold, iron ore, sand and gravel (construction), silver, mercury.
Humboldt	W	33,899	Gold, mercury, clays, sand and gravel (construction), copper, silver.
Lander	W	71,141	Gold, barite, copper, silver, sand and gravel (construction), lead.
Lincoln	W	8,230	Gold, tungsten, silver, perlite, sand and gravel (construction), clays, copper.
Lyon	26,403	20,220	Cement, gypsum, sand and gravel (construction), diatomite, gold, silver.
Mineral	W	26,871	Gold, silver, sand and gravel (construction), tungsten, lead.
Nye	58,903	91,692	Gold, molybdenum, barite, copper, clays, magnesite, silver, sand and gravel (construction), fluorspar, tungsten.
Pershing	22,511	23,096	Diatomite, tungsten, gypsum, silver, iron ore, gold, perlite, sand and gravel (construction), clays.
Storey	W	5,870	Diatomite, gold, silver, tungsten.
Washoe	W	W	Sand and gravel (constructon), clays.
White Pine	W	W	Gold, silver, sand and gravel (construction), tungsten, copper.
Undistributed[2]	228,286	32,833	
Sand and gravel (construction)	e15,770	XX	
Stone (crushed)	XX	e4,500	
Total[3]	506,659	532,463	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]County distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2]Includes some gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[3]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Nevada business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	475.3	487.0	+2.5
Unemployment	do	58.4	44.5	-23.8
Employment (nonagricultural):				
Mining[1]	do	5.2	6.2	+19.2
Manufacturing	do	18.0	19.7	+9.4
Contract construction	do	16.6	20.1	+21.1
Transportation and public utilities	do	24.2	24.8	+2.5
Wholesale and retail trade	do	75.8	82.9	+9.4
Finance, insurance, real estate	do	17.8	19.3	+8.4
Services	do	169.1	181.4	+7.3
Government	do	58.9	57.9	-1.7
Total nonagricultural employment[1]	do	385.6	412.3	+6.9
Personal income:				
Total	millions	$10,548	$11,153	+5.7
Per capita		$12,022	$12,516	+4.1
Construction activity:				
Number of private and public residential units authorized		8,319	16,140	+94.0
Value of nonresidential construction	millions	$257.9	$431.7	+67.4
Value of State road contract awards	do	$77.0	$64.0	-16.9
Shipments of portland and masonry cement to and within the State	thousand short tons	405	459	+13.3
Nonfuel mineral production value:				
Total crude mineral value	millions	$532.5	$615.8	+15.6
Value per capita, resident population		$597	$691	+15.8
Value per square mile		$4,758	$5,570	+17.1

pPreliminary.

[1]Includes oil extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

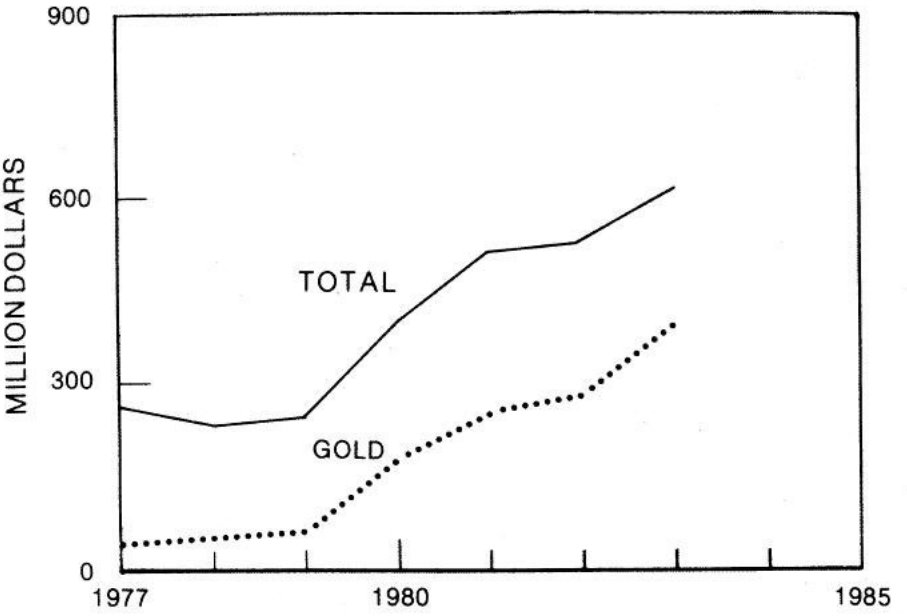

Figure 1.—Value of gold and total value of nonfuel mineral production in Nevada.

Trends and Developments.—With the price of silver and gold holding steady throughout most of the year, a number of the State's largest producers maintained or improved their operations. Exploration activity began a recovery from the severe cuts reported in 1982, which forced layoffs and closures of exploration offices. The U.S. Bureau of Land Management reported that more claims were recorded in Nevada in 1983 than in any other State. Reopenings were reported at several gold and silver operations throughout the State. Heap-leach operations at open pit low-grade disseminated deposits assumed an important role in the production of both silver and gold.

Although Nevada accounted for about 87% of the total U.S. barite output, production continued to decline as a result of decreased domestic drilling for oil and gas with resultant lower barite consumption. The decline in barite production was accompanied by a sharp decrease in the number of barite mines reported to be active within the State.

Employment.—Approximately 6,300 workers were employed in the Nevada mining industry in 1983. The Nevada Employment Security Department reported an annual average of 4,600 employees in metal mining and 1,700 in other mining categories. The annual payroll for the mining industry in the State was approximately $157 million.

Statistics collected by the Nevada Division of Mine Inspection show that 1,672 persons were employed in 155 industrial-mineral mines or mills in 1983. The largest number of employees and operations were in the sand and gravel industry (421 and 80, respectively) followed by the barite industry (274 and 20, respectively).

Legislation and Government Programs.—A bill creating a new Department of Minerals was passed by the Nevada Legislature. The new department will regulate mining, oil, and geothermal activities. Stated objectives are to assist, promote, and protect the interests of the mining, oil and gas, and geothermal industries; to provide for an equitable and balanced use of the

public lands; and to ensure the wise use and management of the State's mineral resources.

The Nevada Bureau of Mines and Geology published eight reports and maps on mineral resources during the year and reprinted seven others. Twenty-nine projects were underway at yearend, including aeromagnetic, gravity, and geologic maps; an index for the Nevada geology and mineral resources bibliography; statewide studies on mercury, tungsten, and zinc; and an inventory of ore deposits in the Winnemucca area.

An amendment to the "Payments in Lieu of Taxes Act" enabled the U.S. Department of the Interior's Bureau of Land Management to distribute $5,202,000 to Nevada counties to partially compensate them for revenues lost because of certain tax-exempt Federal lands within their boundaries.

Two grants were made during 1983 to the Mackay School of Mines, University of Nevada, for research in the treatment of mineral industry waste for the recovery of critical metals and minerals. The U.S. Bureau of Mines allotted $150,000 to the Mineral Research Institute and $442,000 to the Waste Treatment and Recovery Generic Center.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Copper.—In June, Kennecott's Nevada Mines Div. shut down indefinitely its custom copper smelting operations at McGill in White Pine County, laying off 115 workers. Nevada Northern Railway Co., a subsidiary of Kennecott, asked the State Public Service Commission for permission to cease operations for 6 months, starting July 1. Nevada Northern's main business had been hauling copper concentrate to the smelter.

Gold.—With the price of gold holding relatively steady throughout most of 1983, a number of the State's largest producers maintained or enlarged the scale of their operations. Freeport Gold Co.'s Enfield Bell (Jerritt Canyon) Mine set production records and became the State's largest gold operation. Duval Corp. increased production at its Battle Mountain property, refurbished its mill, and stripped overburden from a new ore body early in the year. The Smokey Valley Mining Div. of Copper Range Co. modified plant operations and increased production at its Round Mountain Mine near Tonopah.

Newmont Mining Corp.'s wholly owned Carlin Gold Mining Co. was the State's second largest producer from the Carlin Mine in Eureka County. Carlin shipped ore from the nearby Maggie Creek deposit to the Carlin mill while their Gold Quarry and Rain deposits were being prepared for production.

Placer U.S. Inc., formerly Placer Amex Inc., a wholly owned subsidiary of Placer Development Ltd. of Vancouver, British Columbia, Canada, began limited operations at its 75%-owned Bald Mountain Mine just east of the Alligator Ridge gold mine in northwestern White Pine County. The test project began in May with construction of a $1.3 million processing plant. Placer U.S. also brought into production its Horse Canyon ore body near Cortez.

Tenneco Minerals Co. reopened the Manhattan Mine after completing a $4.5 million expansion and modification at the northern Nye County open pit gold mine. Minex Resources Inc. began heap leaching operations at its Fire Creek gold property in Lander County and poured its first gold bar in October. Cominco American Incorporated began developing a $12 million project at the Buckhorn gold deposit about 55 miles southwest of Carlin.

Dee Gold Mining Co. began stripping overburden and constructing processing facilities late in 1983 at its new Boulder Creek gold deposit in western Elko County. United Mining Corp. processed gold-bearing ore at its Virginia City mill in Storey County.

Gold production of 920,000 troy ounces valued at $390 million was reported from 40 lode mines in the State. Of these, 19 recovered gold with a reported value exceeding $1 million each. Placer gold operations were reported from four small mines in Humboldt, Lander, Pershing, and Washoe Counties.

Exploration for gold continued at a high level throughout the State. FMC Corp. announced the discovery of a large gold-silver deposit 8 miles south of Gabbs in northwest Nye County. Reserves are estimated at more than 1 million ounces of gold and 30 million ounces of silver. Kinetic Minerals Inc. announced that it had found 10 million tons of ore averaging 0.11 ounce of gold per ton on the Bluebird claim in the

Battle Mountain mining district of Lander County. Lacana Mining Inc. continued development of its Relief Canyon gold deposit northeast of Lovelock in Pershing County. Freeport Gold announced that step-out drilling around its Enfield Bell (Jerritt Canyon) gold mine added reserves of more than 1.5 million tons of ore averaging 0.15 ounce of gold per ton. Westley Mines Ltd. drilled a gold deposit in the Santa Fe mining district northeast of Luning in Mineral County. Reserves were estimated at 5 million tons averaging 0.4 ounce of gold and 0.45 ounce of silver per ton. Exploratory drilling programs were conducted by Freeport Minerals Co. on their Mesona property and by Bull Run Gold Mines Ltd. on a property in Elko County. Cordex Exploration Co. conducted exploratory drilling for gold on its claims adjacent to the Bluebird claims in Lander County.

Table 4.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1981, total	49	1	12,834,421	524,802	$241,219,994	3,039,480	$31,970,377
1982, total	45	3	11,541,462	r757,099	r284,601,088	3,142,263	24,980,993
1983:							
Churchill	1	--	109	18	7,632	1,274	14,575
Elko	3	--	W	W	W	W	W
Esmeralda	1	--	540,778	12,099	5,129,976	1,396,303	15,973,707
Eureka	4	--	W	W	W	667	7,630
Humboldt	1	1	W	W	W	--	--
Lander	6	1	W	W	W	W	W
Lincoln	1	--	W	W	W	W	W
Lyon	1	--	W	W	W	W	W
Mineral	6	--	2,417,321	72,944	30,928,256	W	W
Nye	3	--	5,583,579	129,951	55,099,224	W	W
Pershing	3	1	W	W	W	W	W
Storey	2	--	W	W	W	W	W
Washoe	--	1	--	368	156,032	121	1,384
White Pine	2	--	W	W	W	W	W
Total	34	4	3 15,478,628	3 920,331	3 390,220,344	3 5,163,724	3 59,073,002

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1981, total	W	W	W	W	W	W	$283,796,079
1982, total	W	W	W	W	--	--	r320,640,459
1983:							
Churchill	--	--	1	$426	--	--	22,633
Elko	W	W	W	W	--	--	W
Esmeralda	--	--	--	--	--	--	W
Eureka	--	--	--	--	--	--	W
Humboldt	--	--	--	--	--	--	W
Lander	W	W	W	W	--	--	W
Lincoln	--	--	--	--	--	--	W
Lyon	--	--	--	--	--	--	W
Mineral	W	W	W	W	--	--	W
Nye	W	W	--	--	--	--	W
Pershing	W	W	W	W	--	--	W
Storey	--	--	--	--	--	--	W
Washoe	--	--	--	--	--	--	157,416
White Pine	--	--	--	--	--	--	W
Total	W	W	3 14	3 6,576	--	--	W

rRevised. W Withheld to avoid disclosing company proprietary data.

[1]Operations from which gold, silver, copper, lead, and zinc were recovered only from tailings, from precipitates, from cleanup, or an operation from which gold, silver, and copper were recovered as byproducts of molybdenum ore, are not counted as producing mines.

[2]Does not include gravel washed.

[3]Includes items indicated by symbol W.

Table 5.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated[2] (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Dry gold[3]	21	10,958,631	878,059	442,852	W	W	--
Gold-silver	5	W	W	W	W	9	--
Silver[3]	8	2,398,870	27,401	4,045,332	W	W	--
Total	34	W	W	W	W	[4]14	--
Copper	--	W	--	--	W	--	--
Total	34	W	W	W	W	[4]14	--
Other lode material:							
Gold-silver tailings	--	W	W	W	--	--	--
Molybdenum ore	--	W	--	W	W	--	--
Total lode	34	[4]15,478,628	W	W	W	[4]14	--
Placer	4	--	W	W	--	--	--
Grand total	38	[4]15,478,628	[4]920,331	[4]5,163,724	W	[4]14	--

W Withheld to avoid disclosing company proprietary data.
[1]Operations from which gold, silver, and copper are recovered from tailings or as byproducts from molybdenum ore are not counted as producing mines.
[2]Does not include gravel washed.
[3]Includes material that was leached.
[4]Includes items indicated by symbol W.

Table 6.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Cyanidation	[1]918,432	[1]3,970,436	--	--	--
Acid leaching (vat, tank, heap)	--	--	W	--	--
Smelting of concentrates	[1]1,394	[1]1,193,025	W	W	--
Direct smelting of ore	W	W	--	W	--
Total lode material	W	W	W	W	--
Placer	W	W	--	--	--
Grand total	[2]920,331	[2]5,163,724	W	[2]14	--

W Withheld to avoid disclosing company proprietary data.
[1]Includes recovery from retreated tailings.
[2]Includes items indicated by symbol W.

Iron Ore.—Nevada ranked ninth among the 11 States that reported shipments of usable iron ore. Quantity and value declined 55% and 56%, respectively, from that reported in 1982. Three producers shipped iron ore in 1983 from Eureka, Churchill, and Pershing Counties. Nevada Barth Corp.'s Eureka County operation was the State's largest shipper.

Lead.—Small amounts of lead were recovered during the year as byproducts of gold and silver mine production from Churchill, Elko, Lander, Mineral, and Pershing Counties.

Mercury.—Nevada accounted for all of the mercury production reported in the Nation during 1983. The McDermitt Mine in Humboldt County, operated by Placer U.S., was the principal producer. Mercury was also produced as a byproduct at the Carlin and Pinson gold mines. Production remained nearly the same as reported in 1982, with operations running at about 72% of capacity.

Molybdenum.—Nevada ranked sixth in the quantity and value of molybdenum concentrate produced among the six States that reported molybdenum production in 1983.

The Anaconda Minerals Co. resumed milling at its Nevada Moly property in September, after ceasing production in Jan-

uary. Plans were announced to continue operation of the $200 million open pit molybdenum mine and mill complex at 60% of capacity. Exxon Minerals Co. moved ahead with preliminary design work for its Mount Hope molybdenum project, about 20 miles northwest of Eureka.

American Copper and Nickel Co. closed down its molybdenum exploration activities late in the year at Ashdown, south of Denio, in Humboldt County. Some rich molybdenum ore reportedly had been discovered underground earlier in the year.

Silver.—Nevada ranked third among the Nation's silver producers in 1983. Production of more than 5.1 million troy ounces of silver was 64% higher than that of 1982, but value more than doubled, to $59 million, as prices increased during the year.

Nevada's largest producing silver mine, the Candelaria in Mineral County, ranked eighth among the Nation's 25 leading silver producing mines in 1983. NERCO Minerals Co. became sole owner of the Candelaria Mine, the largest open pit silver mine in the United States, and resumed full production at the heap leaching operation.

The Taylor silver mine and mill near Ely was reopened early in September. Asamera Minerals (U.S.) Inc. resumed production in May at the Gooseberry Mine, Storey County. Pacific Silver Corp. began development of the Buckskin property, 16 miles west of Yerington; ground was broken in August for a 300-ton-per-day concentrator.

Silver King Mines Inc. began driving two 12-foot decline tunnels at their Ward Mountain property. Belmont Resources Inc. began leaching ore at their Silver Center Mine. Production of over 900,000 ounces of silver was reported by Sunshine Mining Co. at the 16-to-1 Mine.

Titanium.—Titanium Metals Corp. of America (TMCA) produced titanium metal sponge and ingot from imported rutile concentrate at its Henderson plant. TMCA is the largest U.S. titanium metal producer, with an annual capacity of about 15,000 tons of sponge and 17,000 tons of ingot.

Tungsten.—All Nevada tungsten operations were closed during 1983. These included the Emerson Mine and mill of Union Carbide Corp. at Tempiute in Lincoln County, and General Electric Co.'s Springer Mine, mill, and ammonium paratungstate plant in Pershing County.

NONMETALS

Barite.—Nevada remained the Nation's leading producer of primary barite despite output declining 58% from that reported in 1982 and value reportedly down 59%. Declines in both exploration and production were attributed to the decreased drilling for oil and gas during the year and the resultant lower barite consumption. Increased imports of cheaper barite from China, Chile, and Morocco, and higher railroad freight rates from Nevada to the gulf coast area compared with ocean freight rates were other factors.

The decline in barite production was accompanied by a sharp decrease in the number of mines reported to be active by the Nevada Division of Mine Inspection—12 in 1983, compared with 26 in 1982. Barite production was reported from 11 operations in Elko, Eureka, Lander, and Nye Counties. NL Baroid's Queen Lode and Sagehen properties in Elko County were the State's largest producers. Milchem Inc.'s Argenta jig plant and Dresser Minerals Div.'s Greystone Mine and mill, both in Lander County, were also important producers.

Closures were reported during the year at The Standard Slag Co.'s flotation milling operation near Fallon in Nye County, Porter and Meissner Inc.'s operation in Humboldt County, A. W. Arnold and Associates Inc.'s milling operation at Rimrock, Geo West Services' Stormy Creek Mine and plant in Elko County, and Geo Drilling Fluids' Jumbo Mine in Nye County. Imco Services laid off employees at their Mountain Springs drying plant and at the Battle Mountain grinding plant.

Consumption of crushed and ground barite continued a second consecutive year of decline, decreasing 42% from the record high reported in 1981, to 2.7 million short tons. The decline reflected a significant decrease in barite required for well drilling, which accounted for over 96% of total sales.

Cement.—The Fernley plant of Centex Corp.'s Nevada Cement Co. in Lyon County furnished the entire output of Nevada's reported 1983 cement production. Finished portland cement was used principally by building material dealers, concrete products manufacturers, ready-mix companies, and highway contractors. The 31% increase in production from that reported in 1982 was

attributed to improvements in the construction industry during the latter part of the year.

Clays.—Industrial Mineral Ventures Inc. was the principal producer of Nevada clays, mining and processing bentonite and sepiolite in southern Nye County. Bentonite was also produced by Vanderbilt Minerals Corp. at the Blanco Mine in Esmeralda County and by K. W. Snyder & Co. at the Hi Hopes Mine in Humboldt County. Fuller's earth from Nye County and kaolin from Washoe County were also recovered.

Diatomite.—Eagle-Picher Industries Inc. was the State's largest producer from properties in Lyon, Pershing, and Storey Counties. Three companies produced diatomite from Miocene-Pliocene freshwater lake deposits, making Nevada the second largest diatomite producer in the United States.

Fluorspar.—The Daisy Mine in Nye County was Nevada's only fluorspar producer during 1983. Metallurgical-grade fluorspar was shipped to steel plants in California.

Gem Stones.—An estimated $1.2 million value of gem stones was produced. Turquoise and opals were the most sought after gems.

Gypsum.—Output and value of both crude and calcined gypsum reversed a 4-year trend. Both the quantity and value of gypsum production in 1983 exceeded that of 1982 owing to improvements in building and construction activities in the West.

Lime.—Genstar Lime Co. accounted for all of the State's lime production from its Apex and Henderson properties in Clark County.

Lithium Compounds.—Foote Mineral Co., a subsidiary of Newmont Mining, was the State's sole producer of lithium compounds from brines in Esmeralda County. Lithium carbonate was produced by solar evaporation and chemical processing of lithium-rich brines pumped from beneath the Silver Peak dry lake.

Magnesite.—Basic Inc.'s magnesite operation at Gabbs in northwestern Nye County continued to operate well below capacity. It remained the only magnesite producer in the United States, with output and value similar to that reported in 1982.

Perlite.—Crude perlite production in 1983 was reported from Delamar Perlite Co.'s Mackie claims in Lincoln County and from the United States Gypsum Co. Pearl Hill Mine in Pershing County. U.S. Gypsum sold expanded perlite from its Empire plant in Washoe County.

Salt.—The Huck Salt Co. operation in Churchill County, owned by Leslie Salt Co., was the only reported 1983 salt producer in the State.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Simplot Industries Inc.'s Silica Products Div. plant in Clark County was the only silica sand operation reported in the State during 1983.

Table 7.—Nevada: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	1,525	$4,006	$2.63	NA	NA	NA
Gravel	3,335	6,331	1.90	NA	NA	NA
Sand and gravel (unprocessed)	1,167	1,388	1.19	NA	NA	NA
Total or average	6,027	[1]11,724	1.95	[e]7,500	[e]$16,200	[e]$2.16
Industrial:						
Sand	410	5,117	12.49	W	W	12.39
Gravel	W	W	2.53	--	--	--
Total or average	W	W	7.14	W	W	12.39
Grand total or average	W	W	2.61	W	W	2.76

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone was produced from nine quarries throughout the State, only one of which produced more than 500,000 short tons. Genstar Lime and Centex's Nevada Cement were the State's major producers. Production was reported from Clark, Eureka, Humboldt, Lyon, Nye, and Storey Counties.

The principal use of crushed stone was in the manufacture of lime and cement. It was also used as concrete aggregate, poultry grit, and terrazzo.

---

[1]State Liaison Officer, Bureau of Mines, Spokane, WA.
[2]Director and State geologist, Nevada Bureau of Mines and Geology, Reno, NV.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
Dresser Industries Inc., Minerals Div.	Box 375 Battle Mountain, NV 89820	Surface mine and mill	Lander.
Milchem Inc	Box 272 Battle Mountain, NV 89820	do	Do.
NL Baroid/NL Industries Inc	Box 414 Battle Mountain, NV 89820	do	Elko and Eureka.
Cement:			
Centex Corp., Nevada Cement Co	Box 895 Fernley, NV 89408	Plant	Lyon.
Clays:			
Industrial Mineral Ventures Inc	1800 East Sahara Ave. Suite 107 Las Vegas, NV 89104	Surface mine and mill	Nye.
Copper:			
The Anaconda Minerals Co	Box 1268 Tonopah, NV 89049	do	Do.
Duval Corp	Box 451 Battle Mountain, NV 89820	do	Lander.
Diatomite:			
Eagle-Picher Industries Inc., Minerals Div.	Box 12130 Reno, NV 89510	Surface mine and plants.	Lyon, Pershing, Storey.
Grefco Inc	Box 288 Mina, NV 89422	Surface mine and plant	Esmeralda.
Fluorspar:			
J. Irving Crowell, Jr., & Son	Box 96 Beatty, NV 89003	Underground mine	Nye.
Gold:			
Carlin Gold Mining Co	Box 979 Carlin, NV 89822	Surface mine, mill, refinery.	Eureka.
Copper Range Co., Smokey Valley Mining Div.	Box 480 Round Mountain, NV 89045	do	Nye.
Duval Corp	Box 451 Battle Mountain, NV 89820	do	Lander.
Freeport Gold Co., Joint Venture	Mountain City Star Route Elko, NV 89801	Surface mine and mill	Elko.
Iron ore:			
Cooney Mining Co	Box 568 Lovelock, NV 89419	do	Pershing.
Iron Mine	Box 1160 Carson City, NV 89701	do	Churchill.
Lime:			
Genstar Lime Co	215 Market St., Suite 1000 San Francisco, CA 94105	Surface mine and plant	Clark.
Lithium compounds:			
Foote Mineral Co	Route 100 Exton, PA 19341	Dry lake brines and plant.	Esmeralda.
Magnesite:			
Basic Inc	845 Hanna Bldg. Cleveland, OH 44115	Surface mine and mill	Nye.
Mercury:			
Placer U.S. Inc., McDermitt JV	Box 497 McDermitt, NV 89421	do	Humboldt.
Molybdenum:			
The Anaconda Minerals Co	Box 1268 Tonopah, NV 89049	do	Nye.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Perlite:			
Delamar Perlite Co	Box 217 Pioche, NV 89043	Underground mine	Lincoln.
Salt:			
Leslie Salt Co., Huck Salt Co	895 Harringan Rd. Fallon, NV 89406	Solar evaporation plant.	Churchill.
Sand and gravel (industrial):			
Simplot Industries Inc., Silica Products Div.	Box 308 Overton, NV 89040	Surface mine and plant.	Clark.
Silver:			
Nerco Minerals Co	111 SW. Columbia Suite 800 Portland, OR 97201	----do----	Mineral.
Silver King Mines Inc	322 First Security Bank Bldg. Salt Lake City, UT 84111	----do----	White Pine.
Sunshine Mining Co	Box 97 Silver Peak, NV 89047	Underground mine	Esmeralda.
Stone:			
Centex Corp., Nevada Cement Co	Box 895 Fernley, NV 89408	Quarry	Lyon.
Genstar Lime Co	901 Mariner's Blvd. Suite 425 San Mateo, CA 94404	Quarries	Clark.
Glass Mountain Block Inc	355 Gregg St. Sparks, NV 89431	Quarry	Storey.

The Mineral Industry of New Hampshire

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the New Hampshire Department of Resources and Economic Development for collecting information on all nonfuel minerals.

By L. J. Prosser[1] and Lincoln R. Page[2]

The value of nonfuel mineral production in New Hampshire in 1983 was $19.1 million, a decline of $4.2 million compared with that of 1982. The State ranked fifth among the New England States in value of output accounting for 7% of the region's total.

Construction sand and gravel, crushed and dimension stone, and clays were produced at about 50 mining operations. Sand and gravel mining accounted for approximately 80% of the State's mineral production, 63% of the value, and 80% of the mining operations.

Table 1.—Nonfuel mineral production in New Hampshire[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel (construction) thousand short tons	4,332	$12,593	e$4,000	e$12,100
Stone:				
Crushed do.	e600	e3,100	946	2,853
Dimension do.	e107	e7,500	58	4,032
Combined value of other nonmetals	XX	101	XX	101
Total	XX	23,294	XX	19,086

eEstimated. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in New Hampshire, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Belknap	[2]	W	Sand and gravel (construction).
Carroll	[2]	$2,924	Do.
Cheshire	W	W	Do.
Coos	[2]	566	Do.
Grafton	W	460	Do.
Hillsborough	W	2,486	Do.
Merrimack	W	2,327	Do.
Rockingham	W	928	Do.
Strafford	W	W	Sand and gravel (construction), clays.
Sullivan	[2]	701	Sand and gravel (construction).
Undistributed[3]	$9,609	2,302	
Sand and gravel (construction)	[e]12,990	XX	
Stone:			
Crushed	XX	[e]3,100	
Dimension	XX	[e]7,500	
Total	[4]22,600	23,294	

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of New Hampshire business activity

	1982	1983[p]	Change, percent
Employment and labor force, annual average:			
Total civilian labor force thousands	482.9	498.4	+3.2
Unemployment do.	39.5	26.1	-33.9
Employment (nonagricultural):			
Mining do.	.3	.3	--
Manufacturing do.	108.3	116.4	+7.5
Contract construction do.	19.7	22.1	+12.2
Transportation and public utilities do.	14.6	15.3	+4.8
Wholesale and retail trade do.	86.0	95.1	+10.6
Finance, insurance, real estate do.	20.8	21.9	+5.3
Services do.	79.1	86.1	+8.8
Government do.	56.6	54.9	-3.0
Total nonagricultural employment do.	385.4	412.1	+6.9
Personal income:			
Total millions	$10,179	$11,141	+9.5
Per capita	$10,721	$11,620	+8.4
Construction activity:			
Number of private and public residential units authorized	4,508	7,602	+68.6
Value of nonresidential construction millions	$142.3	$304.1	+113.7
Value of State road contract awards do.	$51.4	$68.0	+32.3
Shipments of portland and masonry cement to and within the State thousand short tons	297	268	-9.8
Nonfuel mineral production value:			
Total crude mineral value millions	$23.3	$19.1	-18.0
Value per capita, resident population	$24	$20	-16.7
Value per square mile	$2,504	$2,060	-17.7

[p]Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Legislation and Government Programs.—Late in the year, the U.S. Congress began considering legislation that would add 77,000 acres of designated wilderness to the White Mountain National Forest (WMNF). The 77,000 acres include three areas: one near the Pemigewasset River north of Loon Mountain (45,000 acres), the Sandwich Range (25,000 acres), and the Dry River Extension (7,000 acres). With these lands, a total of 102,000 acres of the 751,000-acre WMNF would be considered wilderness.

Also during the year, work continued on the Draft Forest Plan, which will establish guidelines and procedures for management of the WMNF. The forest plan was developed at public meetings and with a cross section of people with environmental and commercial concerns. Through this process, 16 issues were identified and ranked according to importance. The top five issues were (1) minerals management—to what extent should mineral exploration and development be allowed; (2) dispersed recreation—what opportunities should be provided for off-road vehicles and what dispersed recreation activities should be featured; (3) developed recreation—what shall be the extent of developed recreation program; (4) timber management—what shall be the extent and nature of timber management; and (5) wilderness areas—how much area and how managed. The final forest plan was expected to be completed in the fall of 1984.[3]

New Hampshire continued cooperative agreements, through the Office of the State Geologist, with three U.S. Department of the Interior agencies, the Bureau of Mines, Minerals Management Service, and the Geological Survey. Through these agreements, information on the minerals and geology of the State was collected and published. Among other activities, the Office of the State Geologist served as a source of information for mining companies considering exploration programs and for State agencies involved in ground water studies, waste disposal, land use planning, and resource management.

During the year, a project to systematically map and study the surficial geology of the State began in the southern part of the Merrimack Valley. Fieldwork funded by the U.S. Department of Energy for revising the 1955 edition of the Geologic Map of New Hampshire was completed. Further progress on the map is contingent upon the availability of additional funding. Also in 1983, work was completed in the Lewiston and Sherbrooke Quadrangles and initiated in the Glenn Falls Quadrangle in connection with the U.S. Geological Survey's Conterminous United States Mineral Appraisal Program. A lack of funding prevented publication of any State reports or maps in 1983.

Under a new regulation, all water well drillers were required to register with the State and to provide data on geological information. This information will be used in evaluating the surficial geology and ground water supplies of the State. The State Geologist was appointed a permanent member of the board, which was established to regulate drilling activity.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—Kane-Gonic Brick Corp., the State's only producer, mined common clay for brick manufacture in Strafford County. New Hampshire was one of four New England States that mined clays in 1983, and Kane-Gonic was one of eight clay operations in the region.

Gem Stones.—Mineral collectors and hobbyists recovered semiprecious gem stones and other mineral specimens from various sites in New Hampshire. Two areas of particular interest are the pegmatite districts of Grafton and Keene.

Gypsum.—National Gypsum Co. operated a manufacturing plant for gypsum wallboard products at Portsmouth, Rockingham County. The plant is 1 of 18 operated by National Gypsum in the United States.

Crude gypsum was imported from National Gypsum's mines in Nova Scotia through the Port of Portsmouth. The company was one of two gypsum calciners in New England; United States Gypsum Co. operates a facility in Massachusetts.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel remained the State's leading mineral commodity in terms of value and production. Output dropped for the fifth consecutive year, with the reported production declining from 7.9 million short tons in 1978 to 4 million tons in 1983.

Table 4.—New Hampshire: Construction sand and gravel sold or used by producers

	1982			1983[e]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	1,869	$5,404	$2.89	NA	NA	NA
Gravel	2,158	6,686	3.10	NA	NA	NA
Sand and gravel (unprocessed)	305	503	1.65	NA	NA	NA
Total or average	4,332	12,593	2.91	4,000	$12,100	$3.03

[e]Estimated. NA Not available.

Housing starts, which somewhat reflect the demand for sand and gravel, also declined each year since 1978 until 1983. Sand and gravel output and housing starts data for the past 6 years are listed below:

Year	Quantity (thousand short tons)	Housing starts[1]
1978	7,859	7,162
1979	7,086	6,769
1980	6,334	5,278
1981	4,528	4,443
1982	4,332	4,508
1983	4,000	7,602

[1]U.S. Department of Commerce. Construction Rev., Mar.-Apr. 1984, p. 35.

Also, the number of active sand and gravel pits declined about 30% from 1978 to 1982, and county production totals dropped for each county with the exception of Sullivan County during that same period.

Data for sand and gravel sold or used in the counties of New Hampshire in 1978 and 1982 (the last year in which a complete sand and gravel canvass was made) are given below:

County	1978		1982	
	Number of deposits	Quantity (thousand short tons)	Number of deposits	Quantity (thousand short tons)
Belknap	3	785	2	W
Carroll	5	1,094	3	959
Cheshire	3	558	2	W
Coos	4	540	6	275
Grafton	3	355	4	282
Hillsborough	9	1,667	5	785
Merrimack	7	1,106	5	898
Rockingham	7	847	5	272
Strafford	7	628	2	W
Sullivan	3	212	4	244
Various	2	67	--	616
Total	53	7,859	38	[1]4,332

W Withheld to avoid disclosing company proprietary data; included with "Various."
[1]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Output of crushed stone increased from 600,000 short tons in 1982 to 946,000 tons in 1983. The 1983 production total was the highest in New Hampshire since 1975 when 1.4 million tons of crushed stone was produced.

Table 5.—New Hampshire: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	8	W
Filter stone	3	11
Coarse and fine aggregate:		
Graded road base or subbase	35	W
Crusher run or fill or waste	5	11
Special:		
Other[2]	896	2,831
Total	[3]946	2,853

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes granite and traprock.
[2]Includes concrete aggregate (coarse), bituminous aggregate (coarse), stone sand (concrete), and uses not specified.
[3]Data do not add to total shown because of independent rounding.

All of the stone mined was traprock except for a small quantity of granite extracted in Grafton County. Traprock was quarried at one site in each of Cheshire, Grafton, Merrimack, and Rockingham Counties. Traprock was sold primarily for use as concrete aggregate, bituminous aggregate, and stone sand.

Dimension.—Granite was the only type of dimension stone quarried in New Hampshire. The State again ranked fourth nationally in dimension granite output, producing 57,512 tons (695,630 cubic feet). The granite was mined by four companies with each operating one quarry. Leading uses for

the granite were for rough blocks, curbing, and irregular-shaped stone.

J. Swenson Granite Co., Concord, one of the State's four dimension granite producers in partnership with a group of investors, signed a letter of intent to purchase Rock of Ages Corp., a subsidiary of Nortek Inc. of Providence, RI. Rock of Ages, one of the Nation's leading dimension granite producers, operated three granite quarries in Vermont and one in New Hampshire in 1983. Final agreement on the sale, reportedly for $20 million, was expected in 1984.

---

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.
[2]State geologist, New Hampshire Department of Resources and Economic Development, Durham, NH.
[3]Lakes Region Trader (Laconia). Mar. 7, 1984, p. 7.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Kane-Gonic Brick Corp	Gonic, NH 03867	Pit	Strafford.
Gypsum (calcined):			
National Gypsum Co	4100 First International Bldg. Dallas, TX 75270	Plant	Rockingham.
Sand and gravel:			
Granite State Concrete Co. Inc	Box 185 Milford, NH 03055	Pit	Hillsborough.
Manchester Sand & Gravel	Box 415 Hooksett, NH 03106	Pit	Merrimack.
Ossipee Aggregate Corp	Route 16 Ossipee, NH 03864	Pit	Carroll.
F. W. Whitcomb Construction Corp	Box 429 Bellows Falls, VT 05101	Pit	Cheshire.
Stone:			
Crushed:			
Boston S&G Cook Concrete Co	Hooksett, NH 03106	Quarry	Merrimack.
Iafolla Industries Inc	Peverly Hill Rd. Portsmouth, NH 03801	do	Rockingham.
Lebanon Crushed Stone Inc	Plainfield Rd. West Lebanon, NH 03784	do	Grafton.
Dimension:			
Kitledge Granite Corp	Armory Rd. Milford, NH 03055	do	Hillsborough.
Maine-New Hampshire Granite Corp	Box 135, Groton Rd. West Chelmsford, MA 01863	do	Do.
J. Swenson Granite Co	North State St. Concord, NH 03301	do	Merrimack.

The Mineral Industry of New Jersey

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey, Division of Water Resources, New Jersey Department of Environmental Protection, for collecting information on all nonfuel minerals.

By Donald K. Harrison[1]

The value of New Jersey's nonfuel mineral production in 1983 was $154.6 million, a $22.2 million increase over that of 1982. Crushed stone was the leading mineral commodity produced, accounting for nearly 46% of the total value. New Jersey was the only State in the Nation that produced greensand, which is used mainly as a water purifier, and was one of three States that produced selenium, a byproduct of copper refining operations. The State ranked third in output of industrial sand, fifth in exfoliated vermiculite, and sixth in zinc and magnesium compounds. Other minerals produced included construction sand and gravel, clays (common and fire), dimension stone, and peat.

Table 1.—Nonfuel mineral production in New Jersey[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	63	$566	62	$596
Gem stones	NA	1	NA	1
Sand and gravel:				
Construction thousand short tons	7,940	25,722	e10,800	e34,300
Industrial do.	2,140	28,151	2,386	31,819
Stone (crushed) do.	e10,700	e57,800	12,301	70,421
Zinc (recoverable content of ores, etc.) metric tons	16,800	14,248	16,475	15,033
Combined value of magnesium compounds, marl (greensand), peat, stone (dimension), and titanium concentrate (ilmenite, 1982)	XX	5,922	XX	2,445
Total	XX	132,410	XX	154,615

eEstimated. NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in New Jersey, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Atlantic	W	W	Sand and gravel (industrial), sand and gravel (construction).
Bergen	(2)	$1,263	Sand and gravel (construction).
Burlington	(2)	W	Do.
Camden	W	2,652	Do.
Cape May	$3,009	W	Sand and gravel (construction), magnesium compounds.
Cumberland	W	W	Sand and gravel (industrial), sand and gravel (construction), clays.
Essex	W	(3)	Sand and gravel (construction).
Gloucester	W	W	Greensand marl, sand and gravel (construction), sand and gravel (industrial).
Hudson	158	(3)	
Hunterdon	W	(3)	
Mercer	W	(3)	
Middlesex	W	W	Sand and gravel (construction), sand and gravel (industrial), clays.
Monmouth	(2)	1,648	Sand and gravel (construction).
Morris	W	4,736	Do.
Ocean	W	W	Sand and gravel (construction), ilmenite.
Passaic	7,050	1,787	Sand and gravel (construction).
Salem	--	W	Do.
Somerset	24,829	W	Clays.
Sussex	W	17,178	Zinc, sand and gravel (construction), peat.
Warren	W	W	Sand and gravel (construction), peat.
Undistributed[4]	87,566	45,345	
Sand and gravel (construction)	e26,050	XX	
Stone:			
Crushed	XX	e57,800	
Dimension	XX	W	
Total	148,662	5132,410	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Union County is not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State value shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Trends and Developments.—The New Jersey economy continued to rebound in 1983. Continued hiring in manufacturing, construction, trade, and other service activities raised most nonfarm wage and salary employment to a record-high level. Based on the strong pace of construction contracts during the year, the job outlook also remained favorable for building activity. During the first 10 months of the year, contract awards in the State were up 50% over that during the same period of 1982, an increase almost twice as great as that for the Nation as a whole (26.5%). Better than national gains were recorded for homebuilding, nonresidential construction, and State road contract awards. As a result of these increases, output of most construction mineral commodities was higher in 1983. Increases in quantity were reported for construction sand and gravel (36%), crushed stone (15%), and shipments of portland and masonry cement to the State (8%). Employment in the mining sector remained unchanged in 1983 with 1,800 persons on the payroll.

Legislation and Government Programs.—Near yearend, the New Jersey Assembly voted to table a container deposit bill that would have required a 5-cent deposit on most beverage can and bottle containers. According to published reports, many legislators who voted against the bill were from the southern part of the State, where the glass manufacturing industry is located. The State's glass industry, which has sustained losses recently because of substitutes and weak demand, opposes deposit law legislation. Proponents of the deposit law said they would introduce the bill at the next session of the assembly. Nine States currently have laws that mandate deposits on beverage containers.

By February, New Jersey had purchased nearly 23,000 acres of the Pinelands National Reserve at a total cost of $14.1 million.

Table 3.—Indicators of New Jersey business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	3,564.7	3,750.2	+5.2
Unemployment	do	325.2	286.6	-11.9
Employment (nonagricultural):				
Mining	do	1.8	1.8	--
Manufacturing	do	697.8	718.7	+3.0
Contract construction	do	92.0	111.7	+21.4
Transportation and public utilities	do	197.0	205.1	+4.1
Wholesale and retail trade	do	686.4	739.0	+7.7
Finance, insurance, real estate	do	167.8	173.8	+3.6
Services	do	660.7	687.3	+4.0
Government	do	527.1	531.4	+.8
Total nonagricultural employment	do	[1]3,030.5	3,168.8	+4.6
Personal income:				
Total	millions	$97,599	$104,968	+7.6
Per capita		$13,169	$14,057	+6.7
Construction activity:				
Number of private and public residential units authorized		21,327	37,521	+75.9
Value of nonresidential construction	millions	$1,422.8	$1,313.2	-7.7
Value of State road contract awards	do	$188.0	$208.0	+10.6
Shipments of portland and masonry cement to and within the State	thousand short tons	1,288	1,393	+8.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$132.4	$154.6	+16.8
Value per capita, resident population		$18	$21	+16.7
Value per square mile		$16,898	$19,856	+17.5

[p]Preliminary.
[1]Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

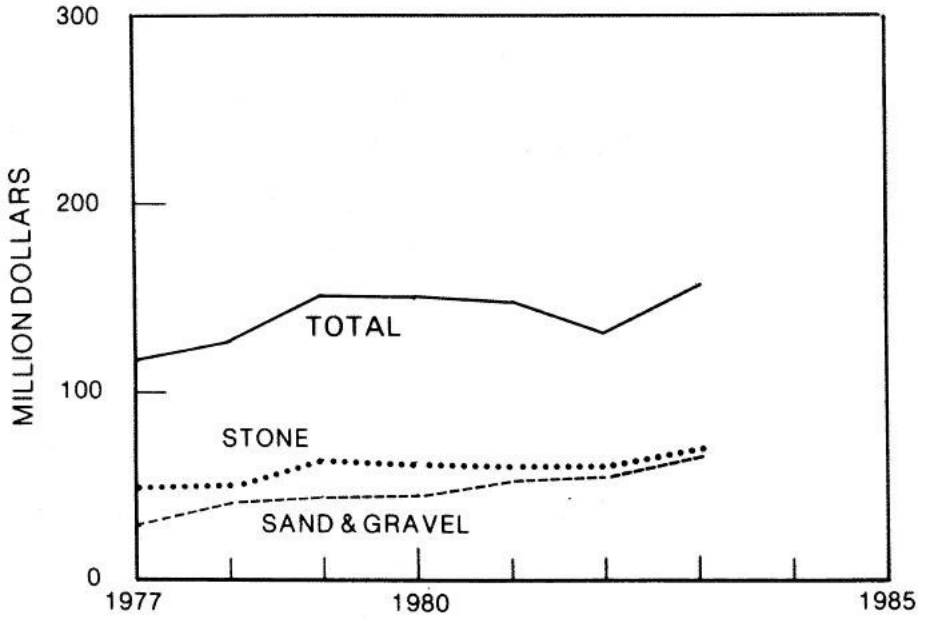

Figure 1.—Value of sand and gravel and stone, and total value of nonfuel mineral production in New Jersey.

The Federal Omnibus Parks and Recreation Act of 1978 authorized $26 million for the State's acquisition of "critical and threatened" lands in the Pinelands, a seven-county region, which encompasses more than 924,000 acres under the jurisdiction of the New Jersey Pinelands Commission. Under the plan's Resource Extraction Program, municipalities shall incorporate within their ordinances provisions for registration, operation, reclamation, and safety of resource extraction sites. The Pinelands include portions of Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, and Ocean Counties.

During the year, the Governor signed a bill approving the State's entry into the Northeast Interstate Low-Level Radioactive Waste Management Compact. New Jersey became the fourth State, joining Delaware, Connecticut, and Maryland, in the formation of a single organization that will determine where a disposal facility for low-level radioactive waste should be built in the Northeast.

In December, the Readington Township Committee, Hunterdon County, voted unanimously for a 3-year moratorium on the exploration, drilling, and extraction of oil, gas, minerals, and fissionable materials in the township. Supporters of the moratorium were primarily concerned with the potential contamination of the fresh water supplies of the township should an accident occur during drilling.

As a result of a merger in 1982 with the Bureau of Ground Water Management, approximately 75% of the New Jersey Geological Survey's (NJGS) work involves ground water. The NJGS was reorganized and elevated to an element within the Division of Water Resources with four bureaus: Geology and Topography; Ground Water Pollution Analysis; Ground Water Resources Evaluation; and Technical Support (geophysics and drilling).

Three ground water projects were funded for the Atlantic City, Camden, and South River areas. These projects are part of a cooperative agreement with the U.S. Geological Survey Water Resources Division, which began work in April 1983. The NJGS also continued assessing ground water pollution throughout the State. During the year, there were more than 300 active cases and about 50 backlogged. A Ground Water Pollution Priority System was also developed to prioritize the cases. The system was expected to be published in February 1984.

Another NJGS project was an assessment of the Pleistocene buried valley aquifer in the northern part of the State. The project, which began during the 1980-81 drought, has been submitted for publication. Work on this project continued during 1983, utilizing an Underground Injection Control Grant from the U.S. Environmental Protection Agency. Since the State is under an exploration and moratorium for fissionable materials, the law requires that the NJGS assess the impact of such work upon the population and environment. The NJGS was to begin assessing the geology and mineralogy of four sites late in 1984. A report was scheduled to be completed in 1986 for use by a contractor, which was to assess the probable health effects if the site is mined for uranium.

During fiscal year 1983, the U.S. Bureau of Mines had 11 active contracts valued at $290,664. These were awarded to various private firms for mineral-related studies.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—In 1983, there were only two clay mining operations in the State, compared with three in 1982. New Jersey Shale Brick & Tile Corp. produced common clay and shale at one operation in Somerset County, and Jessie S. Morie & Son Inc. produced fire clay in Cumberland County. Almasi Clay Co., which produced both common and fire clay in 1982 in Middlesex County, did not report in 1983. Total clay production in 1983 (includes both common and fire clay) was 62,018 short tons valued at $596,000. This represents a decrease of only 1% compared with that of 1982, although total value rose slightly over 5%. Common clay was used primarily for the manufacture of common brick and fire clay primarily for foundry uses.

B & J Warren & Sons Inc.'s temporary suspension of a clay mining operation in Monroe Township, Middlesex County, in late 1982 was overturned by the Monroe Township Council early in the year. The company was able to resume excavation of clay to cap the township's landfill. The landfill was closed by State officials in 1978 because of the contamination of the Englishtown aquifer, a major source of potable water in the area.

Gem Stones.—Value of gem stones and

mineral specimens collected by mineral dealers and amateur collectors in New Jersey was estimated at $1,000 in 1983. The State is well known for its variety of mineral specimens, especially those associated with the zinc ores of the Franklin area in the northern part of the State. Near Franklin is the Gerstmann private museum, which has one of the finest Franklin mineral collections in the country. Other mineral collecting localities are near Paterson in the basaltic rocks of the Watchung Mountains and at Cape May, which is a favorite collecting area for glaciated and reworked quartz pebbles.

Greensand.—Inversand Co., a subsidiary of Hungerford & Terry Inc., near Clayton, Gloucester County, was the only producer of greensand in the United States in 1983. Deposits of greensand, also known as the mineral glauconite, occur from Sandy Hook south to the Delaware Bay near Salem. Greensand is processed and sold for use mainly as a filtration medium to remove soluble iron and manganese from well waters. A secondary use of the unprocessed material is as a conditioner for organic soils. Glauconite is a hydrous iron potassium silicate containing various amounts of aluminum, magnesium, sodium, and trace elements.

Gypsum (Calcined).—Two companies calcined crude gypsum imported from Nova Scotia during the year—National Gypsum Co., Burlington County, and Genstar Building Materials Co., Camden County. Production and value increased 6% and 13%, respectively, compared with that of 1982. The calcined gypsum was used primarily in the manufacture of wallboard and industrial and building plasters.

Iodine.—Crude iodine was shipped into New Jersey and utilized by eight companies at nine plants to manufacture various iodine-containing compounds. Iodine compounds were used for laboratory reagents, in pharmaceuticals, specialty organic and inorganic chemicals, and sanitary purposes. The companies that produced iodine-containing compounds were (1) Allied Chemical Co., Morristown, (2) Cooper Chemical Co., Long Valley, (3) Fisher Scientific Co., Fair Lawn, (4) GAF Corp., Linden, (5) Ganes Chemicals Inc., Carlstadt, (6) J. T. Baker Chemical Co., Phillipsburg, (7) Troy Chemical Corp., Newark, and (8) White Chemical Corp., Newark.

Magnesium Compounds.—New Jersey was one of seven States that produced magnesium compounds in 1983. Harbison-Walker Refractories Co., the State's only producer, extracted magnesium compounds from seawater in Cape May County at the southernmost part of the State. Production and value declined in 1983 because the company closed its 100,000-short-ton-per-year plant in October. At yearend, the plant remained closed. Main uses for the product were for refractories, fertilizers, and pharmaceuticals.

Peat.—In 1983, peat was produced by five companies at five operations in two counties. Sussex County accounted for most of the production (four operations), and Warren County, the remainder (one operation). Both reed-sedge and humus were produced and were either shipped packaged (42%) or sold in bulk (58%). The peat was used mainly for soil improvement and as an ingredient in potting soil.

Perlite (Expanded).—Crude perlite, shipped in from out of State, was expanded by The Schundler Co. in Edison, Middlesex County. Production and value dropped substantially compared with 1982 levels, the result of Grefco Inc.'s closure of its Jamesburg plant in Middlesex County. During the year, the company also sold its insulation board plant to International Permalite Inc., Ontario, Canada.

Quartz Crystal.—James M. Ronan Associates Inc., Wayside, Monmouth County, used cultured quartz crystal during 1983 for the manufacture of electronic products.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Output totaled 10.8 million short tons valued at $34.3 million in 1983. This represents an increase of 36% in tonnage and 33% in value compared with that of 1982. In 1982, there were more than 50 companies that mined construction sand and gravel at 58 operations. Leading counties in order of output were Ocean, Morris, Camden, and Middlesex. Construction sand and gravel was used primarily for construction aggregate, concrete products, and snow and ice control.

Industrial.—The State ranked third in industrial sand production in 1983, up from fifth place in 1982. In 1983, production amounted to 2.4 million short tons valued at $31.8 million. This represents an increase in output and value of 11% and 13%, respec-

tively, compared with that of 1982. Cumberland County led in production accounting for 97% of the State's total. Other producing counties were Middlesex, Ocean, and Gloucester. Principal uses were for the manufacture of glass products, mold and core, and in sandblasting.

During the year, Jessie S. Morie & Son shipped more than 300 tons of industrial sand from its Cumberland County plant to Jeddah, Saudi Arabia, for use in water filtration. Over the past 5 years, the State's high-silica sand has been shipped to approximately 30 foreign countries. Near yearend, Durand Glass Manufacturing Co., a French-owned firm, planned to expand its glass-making operations in Millville. Employees at the Wheaton Glass Co., Millvale, remained off the job at yearend because of stalled contract negotiations, which began May 1.

Table 4.—New Jersey: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	4,931	$15,647	$3.17	NA	NA	NA
Gravel	1,927	7,052	3.66	NA	NA	NA
Sand and gravel (unprocessed)	1,081	3,023	2.80	NA	NA	NA
Total or average	[1]7,940	25,722	3.24	[e]10,800	[e]$34,300	[e]$3.18
Industrial:						
Sand	W	W	13.08	W	W	13.17
Gravel	W	W	14.44	W	W	21.71
Total or average	2,140	28,151	13.15	2,386	31,819	13.34
Grand total or average	10,080	[1]53,874	5.34	[e]13,186	[e]66,119	[e]5.01

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Crushed stone was the leading mineral produced and accounted for more than 46% of the State's total value in 1983. Crushed stone has also accounted for more than one-third of the total value of minerals produced in the last 10 years. In 1983, production amounted to 12.3 million short tons value at $70.4 million. This represents an increase of 15% and 22% in output and value, respectively, compared with that of 1982. Leading counties in order of output were Somerset, Passaic, Sussex, and Mercer. Other counties that produced crushed stone were Essex, Hunterdon, and Morris. Types of stone included traprock (basalt), granite, and limestone, with traprock accounting for the majority of production. Major uses of the stone were for road base and concrete and bituminous aggregate.

Near yearend, controversy continued over a proposed quarrying operation in West Amwell Township, Hunterdon County. Residents and environmental groups were attempting to block the sale of 150 acres of property to the Silvi Concrete Co., Morrisville, PA, that had agreed to buy part of the Boy Scout reservation property for more than $600,000.

Table 5.—New Jersey: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	220	1,180
Riprap and jetty stone	124	611
Filter stone	47	204

See footnotes at end of table.

Table 5.—New Jersey: Crushed stone[1] sold or used by producers in 1983, by use —Continued

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,799	8,908
Bituminous aggregate, coarse	1,139	5,845
Bituminous surface treatment aggregate	243	1,429
Railroad ballast	29	156
Fine aggregate (-3/8 inch):		
Stone sand, concrete	251	746
Screening, undesignated	455	2,357
Other fine aggregate	979	5,658
Coarse and fine aggregate:		
Graded road base or subbase	1,797	9,770
Unpaved road surfacing	346	1,938
Crusher run or fill or waste	43	199
Other coarse and fine aggregate	833	4,083
Other[2]	3,996	27,338
Total	12,301	[3]70,421

[1]Includes limestone, granite, and traprock.
[2]Includes stone used for agricultural limestone, poultry grit and mineral food, terrazzo and exposed aggregate, abrasives, mine dusting or acid water treatment, asphalt fillers or extenders, other fillers or extenders, stone sand (bituminous mix or seal), coarse aggregate (graded), and uses not specified.
[3]Data do not add to total shown because of independent rounding.

Dimension.—Only one company quarried dimension stone in 1983. Delaware Quarries produced dimension sandstone in Hunterdon County for use as cut stone.

Sulfur (Recovered).—Sulfur was recovered as a byproduct of oil refining at four plants. Both Mobil Oil Corp. and Texaco Inc. operated plants in Gloucester County. Chevron USA Inc. operated a refinery in Middlesex County, and Exxon Co. USA operated the Bayway refinery in Union County. Shipments in 1983 amounted to 73,000 metric tons valued at $8 million. This represents a decrease in quantity and value of 29% and 33%, respectively, compared with that of 1982. Sulfur was used in the manufacture of sulfuric acid, fertilizers, plastics, and other products.

Talc.—Talc, mined in other States, was purchased and processed by Amoco Minerals Co. at a plant in South Plainfield, Middlesex County. The talc was used primarily in the manufacture of paper, cosmetics, and paint.

Vermiculite (Exfoliated).—Crude vermiculite was shipped into the State and exfoliated by W. R. Grace & Co., Trenton, Mercer County, and by The Schundler Co., Edison, Middlesex County. Although output increased nearly 11% in 1983 compared with that of 1982, value remained essentially the same. Principal uses were for fireproofing, loose fill and block insulation, and as a horticultural agent.

METALS

Aluminum.—There is no primary or secondary aluminum produced in New Jersey, but the State contributes substantially to the recycling of aluminum. During its first year of operation, the Aluminum Co. of America's Fairview recycling center, Bergen County, recycled more than 300 million aluminum beverage cans, an equivalent of 7.5 million pounds of aluminum. Used cans were purchased from recycling centers throughout the Northeast, pressed into 800-pound bales, and shipped to a plant in Tennessee for can sheet.

Copper.—United States Metals Refining Co., a subsidiary of AMAX Inc., operated a custom copper and precious metals smelter and toll refinery in Carteret, Middlesex County. The plant treated material purchased for AMAX's own use or refined on toll for other companies. A large volume of the material is industrial copper scrap. The company also treated copper refinery slimes at the plant. Major products from the smelter and refinery include electrolytic copper and oxygen-free copper. Production of refined copper in 1983 was 92,322 tons.[2]

Near yearend, U.S. Metals announced that it was permanently reducing its secondary copper production at the Carteret facility because of depressed conditions in the copper market. Approximately 375 workers were expected to be laid off. In mid-1982, the company eliminated 400 jobs at the facility because of the copper industry's poor performance. The plant's two other divisions at Carteret, which refine precious metals and produce specialty copper alloys, were not expected to be affected by the layoffs.

Copper sulfate was produced by two com-

panies in the State in 1983. CP Chemical Inc. operated a plant in Sewaren, and Madison Industries Inc. operated a plant in Old Bridge.

Ferroalloys.—New Jersey was 1 of 17 States that produced ferroalloys in 1983. Although shipments rebounded 34% in 1983 compared with 1982 levels, value was nearly 12% lower in the same period, the result of the continued weak demand by the iron and steel industries. The only producer in the State was Shieldalloy Corp., a subsidiary of Metallurg Inc. The company operated a metallothermic furnace in Newfield, Gloucester County, and produced ferroalloys of aluminum, boron, columbium, titanium, and vanadium.

Iron Oxide Pigments.—Shipments and value of finished iron oxide pigments continued to decline in 1983. Three companies produced finished pigments during the year. Columbian Chemicals Co. operated a plant at Monmouth Junction, Middlesex County; Combustion Engineering Inc., CE Minerals Div., Camden County; and E. I. du Pont de Nemours & Co. Inc. at Newark in Essex County.

During the year, Columbian Chemicals was sold by Cities Service Co. to Consolidated Mining and Industries Co., a privately owned international company involved in mining, industry, and natural resource trading. Columbian Chemicals was to continue operating under the previous management. Also during the year, Du Pont announced that it was planning to sell its color pigment businesses to various companies in 1984. Included in the sales was the company's iron oxide facility in Newark, which was to be sold to Heubach Inc., a producer of inorganic pigments. Heubach is a newly formed U.S. branch of Dr. Hans Heubach GmbH & Co. KG, Langelsheim, Federal Republic of Germany.

Selenium and Tellurium.—U.S. Metals was one of three companies in the United States that produced primary selenium in 1983. The company recovered the selenium from anode slimes generated in the electrolytic refining of copper at its Carteret plant. Near yearend, however, selenium production at the facility was sharply curtailed when most of the copper refinery closed. Future selenium production at the facility is expected to be minimal. Tellurium production was discontinued in 1982.

Steel.—In November, workers at the Pilgrim Steel Co. in Glassboro ended a 14-week strike with the ratification of a 2-year contract, which included an initial 10% pay cut. In addition to the pay cut, the union also agreed to give up several of its paid holidays. Although the company remained open during the strike, it operated at a substantially reduced capacity.

In less than 3 years of operation, the Raritan River Steel Co. has captured about 20% of the wire rod market in the United States. In 1983, the company produced nearly 500,000 tons of wire rod. The minimill is also the largest consumer of scrap in the New York-New Jersey-New England area and one of the largest in the Northeast. While steel mills nationwide were operating at an average of about 40% of capacity, Raritan was operating at about 85%.

Near yearend, New Jersey Steel Corp. began trial rollings of merchant squares and rounds in an effort to expand the company's product line beyond the concrete reinforcing bars, which dominated the minimill's product mix. Earlier in the year, the company had spent nearly $500,000 to completely modify one of two electric arc furnaces at the Sayreville plant. Modifications included a new furnace shell, water-cooled sidewall panels, water-cooled fume elbows for conversion from a side draft smoke extraction system, oxygen-fuel burners, and a water-cooled roof.

Titanium.—In March 1982, ASARCO Incorporated closed its ilmenite mineral sand facility in Lakehurst, Ocean County, because of escalating costs, a worldwide oversupply of ilmenite, and poor market conditions. Also, in September, NL Industries Inc. shut down its titanium dioxide (TiO_2) pigment plant in Sayreville, Middlesex County. No production was reported from either plant in 1983. In November 1983, TiO_2 production in New Jersey ceased when Gulf + Western Industries Inc. (G + W) shut down its 44,000-ton-per-year plant at Gloucester City. G + W has reportedly withdrawn from the TiO_2 industry. Titanium metal fabricated products for nonaerospace industrial applications were produced by Titanium Industries Inc. in Fairfield.

Zinc.—New Jersey ranked sixth among the nine States producing zinc in 1983. The New Jersey Zinc Co. Inc., the State's only producer, operated the Sterling Mine in Sussex, Sussex County. In terms of output, the Sterling Mine was the Nation's fifth leading producer. In 1983, production amounted to 16,475 metric tons valued at $15 million. This represents a decrease of 2% in output but nearly a 6% increase in value compared with that of 1982.

---

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.
[2]AMAX Inc. 1983 Form 10-K Report. P. 11.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Jessie S. Morie & Son Inc.[1]	1201 North High St. Millville, NJ 08322	Pit	Cumberland.
New Jersey Shale Brick & Tile Corp	Box 490 Somerville, NJ 08876	Pit	Somerset.
Greensand:			
Inversand Co., a subsidiary of Hungerford & Terry Inc.	Box 45 Clayton, NJ 08312	Pit	Gloucester.
Gypsum (calcined):			
Genstar Building Materials Co	1101 South Front St. Camden, NJ 08103	Plant	Camden.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	do	Burlington.
Iron oxide pigments:			
Columbian Chemicals Co	Box 37 Tulsa, OK 74102	do	Middlesex.
Combustion Engineering Inc., CE Minerals Div.	901 East 8th Ave. King of Prussia, PA 19406	do	Camden.
E. I. du Pont de Nemours & Co. Inc	Pigments Dept. Wilmington, DE 19898	do	Essex.
Peat:			
Hyponex Corp	Newton, NJ, plant 2013 South Anthony Blvd. Fort Wayne, IN 46803	Bog	Sussex.
Kelsey Humus Co	Kelsey Park Great Meadows, NJ 07838	Bog	Warren.
Mount Bethel Humus Co	315 West 57th St. New York, NY 10019	Bog	Sussex.
Netcong Natural Products	R.D. 3, Box 573AA Flemington, NJ 08822	Bog	Do.
Stan's Soils	R.D. 2, Box 129 Sussex, NJ 07461	Bog	Do.
Perlite (expanded):			
The Schundler Co.[2]	Box 251 Metuchen, NJ 08840	Plant	Middlesex.
Sand and gravel:			
Construction (1982):			
Dallenbach Sand Co. Inc	Box 333 Dayton, NJ 08810	Dredge	Do.
Ralph Clayton & Sons	Box 928 Lakewood, NJ 08701	Pit	Ocean.
Stavola Sand & Gravel Inc	Box 482 Red Bank, NJ 07701	Pit	Do.
Industrial:			
New Jersey Silica Sand Co	Box 636 Millville, NJ 08332	Dredge	Cumberland.
Pennsylvania Glass Sand Corp	Berkeley Springs, WV 25411	Pit	Do.
Unimin Corp., Dividing Creek Plant	Box 187 50 Locust Ave. New Canaan, CT 06840	Pit	Do.
Stone:			
Granite (crushed and broken):			
Riverdale Quarry Co	125 Hamburgh Turnpike Riverdale, NJ 07457	Quarry	Morris.
Tri-County Asphalt Corp	Route 15 Hopatcong, NJ 07843	do	Sussex.
Traprock (basalt), crushed and broken:			
Little Ferry Asphalt Corp	650 Valley Rd. 1111 Clifton Ave. Clifton, NJ 07013	do	Passaic.
Stavola Construction Materials Inc	Box 482 Red Bank, NJ 07701	do	Somerset.
Trap Rock Industries Inc	Box 419 Kingston, NJ 08528	Quarries	Hunterdon, Mercer, Somerset.
Sulfur (recovered):			
Chevron USA Inc	1200 State St. Perth Amboy, NJ 08861	Refinery	Middlesex.
Exxon Co. USA	Box 23 Linden, NJ 07036	do	Union.
Mobil Oil Corp	Paulsboro, NJ 08066	do	Gloucester.
Texaco Inc	Eagle Point, Box 52332 Houston, TX 77052	do	Do.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Mercer.

[1]Also industrial sand and gravel.
[2]Also exfoliated vermiculite.

The Mineral Industry of New Mexico

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the New Mexico Bureau of Mines and Mineral Resources for collecting information on all nonfuel minerals.

By Jane P. Ohl[1] and Robert W. Eveleth[2]

Total value of nonfuel minerals increased to $517 million in 1983 from $429 million in 1982, and New Mexico ranked 13th in the Nation. The increased value failed, however, to meet the $696 million value of nonfuel mineral production of 1981. Copper and potash continued to be the leading mineral commodities, representing more than three-quarters of the State's nonfuel mineral value, followed by noteworthy values of gold, cement, sand and gravel, stone, silver, and perlite.

Table 1.—Nonfuel mineral production in New Mexico[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	[2]60	[2]$112	50	$115
Gem stones		NA	200	NA	200
Gypsum	thousand short tons	198	887	169	1,016
Lead (recoverable content of ores, etc.)	metric tons	W	W	258	123
Lime	thousand short tons	W	W	17	W
Perlite	do.	408	13,355	394	13,297
Potassium salts	thousand metric tons	1,497	204,600	1,278	174,700
Pumice	thousand short tons	97	809	110	1,070
Sand and gravel (construction)	do.	5,616	17,670	e7,000	e20,000
Silver (recoverable content of ores, etc.)	thousand troy ounces	805	6,397	W	W
Stone:					
Crushed	thousand short tons	e2,800	e13,700	4,720	15,121
Dimension	do.	e18	e138	18	141
Combined value of carbon dioxide (1982), cement, clays (fire clay, 1982), copper, gold, helium (Grade-A), mica (scrap), molybdenum, salt, sand and gravel (industrial), 1982), and values indicated by symbol W		XX	r171,432	XX	291,411
Total		XX	r429,300	XX	517,194

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes fire clay; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in New Mexico, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Bernalillo	W	$28,148	Cement, sand and gravel (construction), sand (industrial), clays.
Catron	(2)	(3)	
Chaves	--	1,281	Sand and gravel (construction).
Cibola	--	W	Do.
Curry	W	W	Do.
De Baca	(2)	W	Do.
Dona Ana	W	1,004	Sand and gravel (construction), clays.
Eddy	W	W	Potassium salts, salt, sand and gravel (construction).
Grant	$320,466	119,652	Copper, silver, lime, gold, lead.
Harding	W	W	Carbon dioxide.
Hidalgo	889	164	Silver, gold, clays, copper.
Lea	W	W	Potassium salts, sand and gravel (construction), salt.
Lincoln	(2)	241	Sand and gravel (construction).
Luna	W	W	Sand and gravel (construction), clays.
McKinley	W	W	Sand and gravel (construction).
Otero	(2)	354	Do.
Quay	(2)	--	
Rio Arriba	W	W	Sand and gravel (construction), pumice.
Sandoval	W	W	Gold, gypsum, sand and gravel (construction), pumice.
San Juan	W	W	Sand and gravel (construction), helium, clays.
San Miguel	(2)	W	Sand and gravel (construction).
Santa Fe	20,648	21,740	Gold, sand and gravel (construction), pumice, silver, gypsum, copper, lead.
Sierra	(2)	10,765	Copper, silver, gold, lead.
Socorro	2,171	W	Perlite, sand and gravel (construction).
Taos	W	11,934	Perlite, sand and gravel (construction), molybdenum, mica.
Torrance	W	90	Sand and gravel (construction).
Union	W	W	Do.
Valencia	W	W	Perlite, sand and gravel (construction).
Undistributed[4]	332,450	220,085	
Sand and gravel (construction)	e19,780	XX	
Stone:			
Crushed	XX	e13,700	
Dimension	XX	e138	
Total[5]	696,407	429,300	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Colfax, Guadalupe, Los Alamos, Mora, and Roosevelt Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Includes some gem stones and vanadium (1981) that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of New Mexico business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	595.5	599.7	+0.7
Unemployment	do	68.4	54.8	-19.9
Employment (nonagricultural):				
Mining[1]	do	21.5	21.1	-1.9
Manufacturing	do	33.4	34.3	+2.7
Contract construction	do	28.9	31.2	+8.0
Transportation and public utilities	do	29.4	28.6	-2.7
Wholesale and retail trade	do	105.2	112.7	+7.1
Finance, insurance, real estate	do	22.3	23.6	+5.8
Services	do	95.6	99.8	+4.4
Government	do	128.8	128.1	-.5
Total nonagricultural employment[1]	do	465.1	479.4	+3.1

See footnotes at end of table.

Table 3.—Indicators of New Mexico business activity —Continued

	1982	1983[p]	Change, percent
Personal income:			
Total ---- millions	$12,483	$13,377	+7.2
Per capita	$9,135	$9,560	+4.7
Construction activity:			
Number of private and public residential units authorized	8,600	10,469	+21.7
Value of nonresidential construction ---- millions	$382.1	$385.4	+.9
Value of State road contract awards ---- do	$150.3	$164.0	+9.1
Shipments of portland and masonry cement to and within the State thousand short tons	553	610	+10.3
Nonfuel mineral production value:			
Total crude mineral value ---- millions	$429.3	$517.2	+20.5
Value per capita, resident population	$318	$370	+16.4
Value per square mile	$3,549	$4,254	+19.9

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

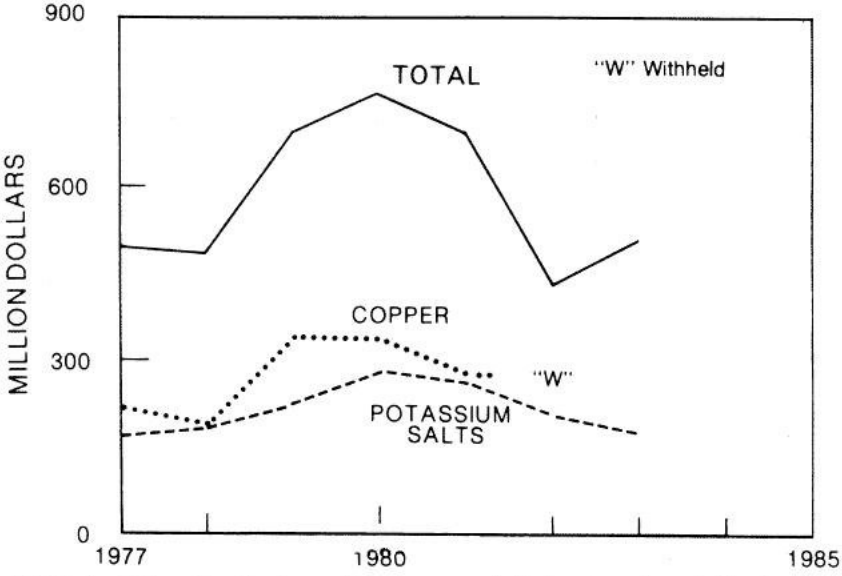

Figure 1.—Value of potassium salts, copper, and total value of nonfuel mineral production in New Mexico.

Trends and Developments.—Although improving slightly, the mining industry was still in the doldrums at yearend. Industrial leaders cited several problems leading to the shrinking domestic mining industry; foreign competition, large inventories, a strong dollar hurting U.S. exports, and relatively high interest rates were the main factors in depressing most metals prices. Although prices of precious metals, such as gold, rose slightly in 1983, those of base metals such as copper, lead, and molybdenum remained depressed at yearend.

More than 40% of the Western World's copper mine capacity in 1983 was owned or effectively controlled by the governments of

less-developed countries and did not respond to ordinary market conditions. Some foreign producers were subsidized by their governments and could continue to mine copper and other mineral commodities below cost, resulting in pressure on U.S. mines, which were paying higher wages and other related production costs.

The economic recovery envisioned by many market analysts for the domestic copper industry did not materialize during 1983. With the market at rock bottom, New Mexico's copper producers finished the year with just two of four mines still operating.

Employees of the Chino Mines Co., a Kennecott (2/3) and Mitsubishi Metal Corp. (1/3) partnership, and the Tyrone Branch of Phelps Dodge Corp. were asked to sign a petition opposing a $268 million loan from the Inter-American Development Bank to the Corporación Nacional del Cobre de Chile to increase copper production in Chile. The petition in Grant County was intended to demonstrate that copper mine employees opposed supporting foreign copper companies when the domestic copper industry was operating at low production levels and at sinking copper prices, partly attributable to high production levels in Third World countries.

For chemical raw materials such as lime and sulfur (Frasch and elemental), the nationwide economic recovery in 1983 reversed the 1981-82 production downtrend; in New Mexico, however, lime, salt, and sulfur all declined from 1982 levels.

Construction materials such as cement, sand and gravel, and crushed stone benefited from declining mortgage and commercial interest rates, which stimulated stronger construction activity in 1983. The value of construction contracts sharply increased in residential (54.6%) and nonresidential (39.6%) building.[3]

Union contracts that ended on September 30 in the copper industry were handled differently in this year of declining inflation. Kennecott, a subsidiary of Standard Oil Co. of Ohio (Sohio), offered a continuation of the cost-of-living-adjustment (COLA), which had been in copper company contracts since the 1960's, but Phelps Dodge and other companies refused to grant COLA and were struck.

New Mexico topped the 50-State list of members lost by organized labor unions during the 18 months preceding February 1983, according to the U.S. Department of Labor. High-paid copper miners, and, to a lesser extent, potash and construction workers, made up 35% of this union membership loss. Increasingly, the efforts of State and business leaders were directed toward diversifying the economy by attracting more service and high-tech industries to the State. Well-paying jobs in construction and copper, potash, and uranium mining helped boost New Mexico's per capita personal income to 38th among the 50 States in 1980, up from 44th place in 1970.[4]

According to the Congressional Research Service of the Library of Congress, potash imports rose from 1 million metric tons in 1965 to an estimated 4.8 million tons in 1982. The United States exported 34% of its production in 1973-80, but only 20% in 1982. Imports were up because easily mined, low-cost domestic potash deposits have been nearly depleted; whereas higher grade ore bodies that can be mined at a lower cost have been developed in Canada. Canada supplied 88% of all U.S. potash imports in 1983.

The State Land Commissioner decided that potash mining companies in New Mexico, paying royalities to the State on the basis of a formula used without reevaluation since 1931, were underassessed. The underassessments were estimated to amount to $6.2 million for the 4-1/2-year period ending in 1980. Potash value in 1931 was $17.65 per ton; the price of marketable potassium salts (K_2O equivalent) in 1983 was $136.70 per ton.

Potash royalties are used to provide funds for the public education budget, and thus the issue is a sensitive one.

Employment.—Estimated employment figures for metal mining, bituminous coal, quarrying, and nonmetallic mining for December 1983 totaled 8,600 persons, compared with 9,300 in December 1982. In metal mining, employees decreased by 100, or 2.2%; in the combined category of bituminous coal, quarrying, and nonmetallic mining, employees decreased by 600, or 12.8%, from December 1982 to December 1983.[5]

In the period 1974-83, the average number of salaried and wage earning copper mine and mill workers in New Mexico was highest (2,682 workers) in 1981, but the average tumbled to 1,053 in 1983.

By yearend 1983, however, recovery was indicated in the form of rehirings and mine openings in the coal, oil, and potash industries. Average hourly earnings in the mining sector in New Mexico rose 13.2% (in constant 1983 dollars), from $9.97 in 1973 to

$11.29 (preliminary estimate) in 1983.[6]

In August 1983, five operating potash mines in New Mexico, some open on a limited basis, employed only 1,376 persons. These figures compared unfavorably with those of 1967 when 3,913 persons were employed in seven potash mines near Carlsbad.

Hiring of workers for the modernization project at Chino Mines' Hurley smelter began in January. Employment was expected to top out at 400 during the 2-year project. Chino Mines recalled about 20 more workers in late July 1983 at the company's open pit copper mine at Santa Rita, bringing the total payroll up to slightly more than 1,000. Chino Mines' employment was approximately 1,500 before layoffs began early in 1982.[7] But by late November 1983, Chino Mines announced a reduction in force, involving at least 20 employees.

Phelps Dodge terminated 49 salaried and 2 wage employees in December 1983 at its Tyrone operation. Yearend employment at Tyrone was 112, down from about 800 early in 1982. Quintana Minerals Corp. cut an additional 28 employees December 31 at its Copper Flat copper mine near Hillsboro. Employment totaled 20 at yearend, down from a peak of 227 at midyear following the February-March startup of mining and milling operations.

Environment.—Molycorp Inc., Questa Div., experimented with an electrical ion-exchange unit to cut discharges of molybdenum waste into the Red River from 75 pounds per day to less than 25 pounds. The company negotiated with the U.S. Bureau of Land Management (BLM) about the need to prepare an environmental statement for a new tailings pond it planned to install. The opening of the new underground Questa molybdenum mine October 1 necessitated the second pond, which must be completed by 1986.

Carlsbad's five operating potash facilities completed installing antipollution equipment to meet Federal air quality environmental standards. Mississippi Chemical Co., which was shut down in January 1983, also met the standards; however, National Potash Co., which closed in January 1982, did not. International Minerals & Chemical Corp. spent the largest amount—$2.7 million—to meet standards, owing to its particular potash refining technique. The average cost of compliance probably surpassed $1 million.

Residents of Lincoln and Socorro Counties, concerned over the proposed location of a steel minimill in their areas, demanded that the steel mill owners provide proof of financial responsibility, that there be safeguards against possible pollutants, and that the owners guarantee proof of water supply conservation. A town council refused to support a $10 million industrial revenue bond to help Zia Steel Co. of Dallas, TX, finance moving a $35 million inactive copper-processing mill from Arizona to Lincoln County.

Announced in the summer of 1983, the Federal Government's decision to store transuranic wastes at the Waste Isolation Pilot Plant (WIPP) between Hobbs and Carlsbad, was one reason the State began pursuing a more stringent agreement on environmental issues. A New Mexico Environmental Evaluation Group recommended that the State get the U.S. Department of Energy to agree that no potash mining be allowed within the first three zones of the WIPP site and that oil and gas drilling be allowed only if such drilling goes deeper than 6,000 feet. The Environmental Evaluation Group is an independent group of scientists charged with investigating the scientific issues surrounding the controversial project. Work began in the summer of 1983 on excavating the shafts and underground chambers at the WIPP site.

On December 20, the New Mexico State Government began a yearlong $93,000 survey of 31 potential pollution sites and 1 documented pollution source to determine whether Federal Superfund money should be used for cleanup. The U.S. Environmental Protection Agency is financing the survey. Nearly all sites are industry related. Each site has the potential for polluting the air, ground, or water with hazardous wastes, according to the New Mexico State Environmental Improvement Division. The 32 sites were chosen from among 140 in-state sites, using two criteria: The sites were to represent a general class of industry that handles pollutants, and the facilities at the sites were to be fairly large. The Superfund money was applied to—among other problem areas—cleaning up cyanide leaked onto the ground at the defunct Argent Inc. silver recovery operation in Rio Rancho. Other sites to be surveyed include American Smelting and Refining Co.'s mill and mine at Deming and Vanadium, respectively; Gulf Minerals Resources Co.'s San Mateo Mine; Kennecott's Chino Mine near Hurley; and Sierra Blanca Milling and

Processing Co.'s Carrizozo Mine. The remaining 20 or more sites were not mining related.

Exploration Activities.—Mineral exploration in the State was restricted in 1983 owing to the slow recovery from the economic recession and generally low prices for base metals and industrial minerals. Santa Fe Mining Co. continued to explore and develop existing mines and to drill in the old Pecos Mine area in the Sangre de Cristo Mountains. Santa Fe Mining was closely determining the extent of massive sulfide mineralization. Westar Resources Inc. signed contracts with Federal Resources Corp. to supply base and precious metal flux from the Lordsburg area.

Boliden Minerals Inc. continued to explore its 1,100 patented and unpatented claims in the Pinos Altos area north of Silver City, Grant County. The area is said to contain small lens-shaped, high-grade deposits of copper, silver, and zinc. In 1983, underground work consisted of a decline and an 800-meter-long drift that dropped 100 meters vertically and penetrated two ore zones. The zinc deposits and the copper-silver deposits, generally occurring separately, would be mined together and blended for treatment at a proposed concentrator. The mine would produce a copper-silver concentrate and a separate zinc concentrate for shipment to custom smelters. Depending on the economy, the earliest predicted production may be in the first quarter of 1985.

In the Black Range, Sierra County, First Mississippi Corp. (FRM Minerals Inc.) explored an alunite deposit associated with precious metals, 6 miles north of Chloride, and Tenneco Inc. continued exploring for fluorite near Truth or Consequences. Zeotech Co. analyzed samples from its zeolite deposit near Buckhorn in the southwest part of the State.

Exploration in the potash district of southeastern New Mexico was limited to one hole by Duval Corp., a subsidiary of Pennzoil Co., to satisfy lease requirements.[8]

Amselco Exploration Inc., a Phoenix-based subsidiary of British Petroleum Ltd., stated its intention to explore for precious minerals in the foothills of the Ortiz Mountains, about 20 miles southwest of Santa Fe, using trenching as its exploration method. Amselco has encountered opposition from the owner of the surface rights who grazes cattle on the land, called the Jarrott Ranch; from operators of the J. W. Eaves Movie Ranch, 3 miles away; from the project manager for a proposed $20 million luxury hotel complex to be built on former Eaves Ranch land; and from reviewers of the reclamation plan.

Legislation and Government Programs.—On April 6, 1983, the New Mexico Legislature reduced the severance tax on uranium.[9]

The New Mexico Land Commission was preparing legislation in November to increase the royalty that must be paid on potash mined from State lands. The Commission proposed following the BLM's rates and sliding scale policy, hoping to collect retroactively to January 1, 1984, once the legislation is approved. The Commission reportedly asked the State's attorney general for a ruling on whether additional royalties at the new rate can be collected retroactively to 1976 or earlier.

Eddy County, which contains most of the Carlsbad-area potash mines, raised its property tax rate from 5.5 mils per $1,000 to 7.5 mils per $1,000. The State considered collecting taxes on product sales retroactive to 1976. It had been collecting taxes on an arbitrary valuation of ore produced.

Santa Fe Railroad officials reportedly stated that they will continue working closely with potash companies in New Mexico in an effort to ensure a recovery of the industry in southeast New Mexico. The railroad reported that it already had taken steps to give the potash companies a break on their transportation costs.

The total amount of federally owned land in New Mexico, fiscal year 1982, was 25.9 million acres. Of that total, the BLM owned 12.7 million acres, or 16.4% of the acreage of the State. Between the enactment of section 314 of Public Law 94-579, commonly called the Federal Land Policy and Management Act of October 21, 1976, and fiscal year 1983, 395 patented mining claims (39 during fiscal year 1983) and 79,765 unpatented claims to hard-rock minerals in New Mexico were recorded by the BLM; also in fiscal year 1983, operators filed 14 notices and plans of mining operations with the BLM.

BLM royalties from potash and sodium mineral leases and permits in the State of New Mexico amounted to $6.1 million during fiscal year 1983. More than 99.6% was from potash production; by law, 50%, or $3.05 million, was returned to the State.[10]

The BLM's Roswell District Office contracted with an independent geologist to update the Potash Enclave Map of 1979, for

southeastern New Mexico. Over the years, conflicts have arisen over mining potash and drilling for oil and gas, owing to the vertical geologic integration of those resources in the area. Potash mining takes place at depths of 800 to 2,200 feet; oil and gas resources are found in the Morrow Formation at depths as great as 12,000 feet. The updated map will provide the most current resource information available. Moreover, it will ensure that the Secretary of the Interior's directive of March 2, 1983 (the latest in a series of revisions since the first ban on oil and gas leasing in the Potash Area, signed by the Secretary on February 6, 1939), will provide multiple mineral development within the 491,916-acre Potash Area while protecting the rights of both oil and gas and potash lessees.

The updated map was to become available to the public in July 1984. All suspended oil and gas leases within the Potash Area were to be reviewed by the BLM to determine which leases will remain in suspension and which leases can be drilled from an island or barren area. Drilling islands will be established pursuant to the procedures set forth in the Secretarial Order. The BLM will require potash mining operators to submit 3-year mine plans annually to assist in the establishment of drilling islands.

The Mining and Mineral Resources and Research Institute established under title III of the Surface Mining Control and Reclamation Act of 1977 (Public Law 95-87) at the New Mexico Institute of Mining and Technology in Socorro was affiliated in 1982 with a Comminution Generic Center and with a Mineral Industry Waste Treatment and Recovery Generic Center. Funding under the above law by the U.S. Bureau of Mines amounted to $252,000 in 1983. These organizations produced reports in 1983 on radionuclide and heavy metal distribution in recent sediments of major streams in the Grants mineral belt and on radionuclide extraction from low-grade ores and mill tailings.[11]

The Surface Transportation Assistance Act (Public Law 97-424), passed by Congress on January 6, 1983, initiated a 5-cent-per-gallon user fee and other highway users fees, effective April 1, 1983. States were expected to provide matching funds for interstate highway work, and some projects were started in the first half of 1983. Public Law 97-424 extended the Federal Highway Trust Fund to September 30, 1988. The funding levels the act established are the highest ever for highways and mass transportation, and the highest in constant dollars since the early 1970's. Proponents of the bill considered it a factor in promoting general economic recovery, as well as a factor in strengthening local economies. The use of crushed stone and other industrial minerals in a general highway development and repair program, as well as in other construction programs, supports local economies because such materials are quarried very short distances from where they are used.

On June 6, 1983, the U.S. Supreme Court ruled that sand and gravel were minerals and that sand and gravel deposits on 33 million acres of land in at least 19 States, largely encompassing New Mexico and three other Western States, were, in fact, owned by the United States. The lands had been owned originally by the Federal Government, but surface rights were conveyed to private persons in parcels as large as 160 acres under provisions of the 1916 Stock Raising Homestead Act. Guidelines to implement the June 6, 1983, decision were to be issued by the BLM in early 1984.

On October 26, legislation was introduced to the U.S. Senate to impose duties on cement produced in Mexico on the basis of the difference between the cost or price of subsidized fuel and the true value of such fuel. The Mexican Government sells heavy fuel oil to its cement producers at $1.23 per barrel, thereby allowing Mexican cement to be produced more cheaply. Imported Mexican cement purportedly has prevented the establishment of a cement plant between Las Cruces and Deming, NM.

On November 17, the U.S. House of Representatives, Interior Subcommittee on Public Lands and National Parks, approved for full committee action H.R. 2983, providing for the addition of about 20 acres to the Sandia Mountain Wilderness, and H.R. 3766, the San Juan Basin Wilderness Protection Act of 1983. Both of these wilderness areas are in New Mexico. The full committee was to consider the wilderness measures sometime after Congress reconvened on January 23, 1984.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Copper.—Contrary to the Nation's generally weak response to the brief copper price recovery in 1983, New Mexico's copper production far exceeded the recessionary levels of 1982. The price averaged 76.53 cents per pound. The Chino and Tyrone Mines, both in Grant County, ranked fourth and eighth, respectively, among the 25 leading copper-producing mines in the United States.

Kennecott (a wholly owned subsidiary of Sohio) and its new Japanese partner, Mitsubishi Metal Corp., began and completed the first phase of expanding its Chino Mines' concentrating and smelting complex during 1983 at a cost of $350 million. About $100 million was spent on the new smelter and $250 million was spent on a new conveyor system, blending shed, concentrator, and other facilities. The partnership planned to begin the second phase of the mine's expansion and smelter modernization in 1984.

Chino Mines had completed the copper concentrator and conveyor system at the Santa Rita copper mine in 1982, replacing a more costly truck and rail haulage system. The firm was stockpiling excess copper concentrate in its new $5 million blending shed and in covered piles outside the new concentrator in readiness for the completion of the new flash furnace smelter in late 1984. The new concentrator and conveyor system resulted in reducing operating costs by about 31 cents per pound, according to the Sohio 1983 annual report.

Chino Mines' old smelter at Hurley, which treated 30,000 tons per month of copper concentrates in 1983, was not able to process output from the newly expanded concentrator because the blending shed was filled completely with copper concentrates and more piles of concentrate were stacked outside; the company sought permission from the State Environmental Improvement Division to store an additional 75,000 tons of concentrates outside. Sometime in late 1984, smelting will cease entirely for a brief period to tie in the new INCO furnace with the existing facility. The rated capacity was to increase from approximately 65,000 to approximately 110,000 short tons of copper metal per year, according to the Sohio 1983 annual report. Sustained operation of the smelter was to begin in 1985.

Chino Mines planned to buy oxygen from the Linde Div. of Union Carbide Corp., which was building a new plant nearby to supply more than 400 tons of oxygen per day to the smelter.

Phelps Dodge's facilities at Tyrone, Grant County, included an open pit copper mine and concentrator, leaching and precipitation plants, a new solvent extraction-electrowinning plant (SX-EW) with a design output of 15,000 metric tons of copper per year, and a new computerized truck dispatching system. The two new capital projects at Tyrone were to produce additional unit cost savings. Begun and nearing completion in 1983 was the $35 million SX-EW plant, designed to produce low-cost, electrolytic-grade copper cathode without further smelting or refining. Copper extracted by electrowinning from leach solutions was projected to be among the cheapest (possibly 28 cents per pound) produced by Phelps Dodge. The annual plant production of 15,000 metric tons of copper was expected to cost only about one-half as much as copper produced by traditional processes and would increase the Tyrone Branch capacity by about 16%.

The SX-EW plant, to be owned and operated by the Burro Chief Copper Co. (a consolidated subsidiary of Phelps Dodge), was scheduled to begin operating by mid-1984. It is to consist of two 4,000-gallon-per-minute plants operating in tandem, supplementing the concentrator at the mine and the precipitate plant. Feed was low-grade (0.2% to 0.4%) copper sulfide that had been stripped as overburden to get at mill-grade ore and dumped in the 1970's to backfill abandoned benches of the West Racket extension of the mine.

Miles of pipeline were laid over the West Racket area to sprinkle water over the mine rock. The resulting solutions drained into a lagoon at the base of the West Racket leach dump, where they were pumped through a 24-inch-diameter plastic pipeline to the SX-EW plant. The barren solution was pumped back to the leach dump to repeat the cycle. Life expectancy of the plant was expected to exceed 20 years.

The second project was to provide additional tailings disposal capacity for the Tyrone concentrator at a cost of approximately $8 million. New Mexico State authorities must first approve the project. The

new tailings disposal project would permit continuous operation of the Tyrone Mine, which now operates on the equivalent of a 5-day week, and would, therefore, improve unit production costs at the mine.[12]

The firm also had a smelter at Playas in Hidalgo County and was a leading domestic producer of copper rod, the basic feed for the electrical wire and cable industry. Coincident with the 1982 closure of the Tyrone Mine, the Hidalgo smelter had remained open to handle toll commitments and the firm's precipitate production when other smelter operations were suspended.

Mining and concentrating, which had been suspended at Tyrone on April 17, 1982, to reduce cash losses, restarted on May 2, 1983, and operated on a schedule of 10 days on, 4 days off, or at about 70% of capacity. The firm recalled about 450 workers, about 55% of the 800 to 900 employees on the payroll before the April 1982 shutdown.

According to the Phelps Dodge annual report, 8,625,000 tons of ore containing 0.78% copper was mined from the Tyrone Mine in 1983, compared with 3,744,000 tons containing 0.70% copper in 1982. Output in 1982 and 1983 was 75% and 42%, respectively, below that of 1981. At yearend 1983, reserves at the Tyrone Mine amounted to 209.6 million tons of ore, averaging 0.79% copper, according to the company's 1983 annual report.

Phelps Dodge recently entered the fluxing (silica) ore market formerly occupied only by ASARCO Incorporated. Phelps Dodge determined that it was unprofitable to feed barren flux through its furnaces and, after a wide search for new sources of flux, signed one contract with Capitan Resources to obtain flux from its Great Republic Mine at the northeast end of the Black Range. Contracts were signed for as little as 500 short tons bimonthly; additionally, Phelps Dodge offered to pay for shipments 30 days after the date of exchange of assays with the shipper. Both features were expected to have a beneficial effect on base- and precious-metal mining, particularly on smaller scale operations.

To hold down labor costs, Phelps Dodge proposed lower wages in the 1983 contract it offered the 13 unions in Arizona and New Mexico. The company estimated it would save more than $50 million if unions forgo a COLA for the next 3 years. The company also asked that new workers' starting pay be as much as $2 an hour less; still, unskilled workers would earn $20,000 per year.

The 13 unions composing the nonferrous coordinated bargaining committee refused to give up COLA and went on strike in Arizona and Texas on July 1. Phelps Dodge continued operating its Arizona facilities with salaried personnel, but neither New Mexico property—the Tyrone Mine nor the Hidalgo smelter, the latter of which is nonunion—was directly affected by the strikes.

According to the Phelps Dodge 1983 annual report, in the years 1972-82, wage rates increased an average of 12% per year, whereas copper prices increased an average of 3.5% per year.

The Copper Flat open pit mine at Gold Dust, 4 miles northeast of Hillsboro, Sierra County—opened in mid-March and closed June 30, 1982—was put on the market in 1983 by Quintana Minerals of Tucson and its partner, Phibro Mineral Enterprises Inc., of New York. As an alternative, the owners sought a third partner who could pay off a loan and eliminate the need for the sale. The $98 million facility produced about 7 million pounds of copper and small amounts of gold, silver, and molybdenum in its 2-1/2-month operating period. The 15,000-ton-per-day operation, with a 12- to 15-year expected life, came on-stream in the midst of a prolonged period of weak copper prices.

Table 4.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing	Material sold or treated (metric tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
1981, total	12	23,375,862	65,749	$30,220,871	1,632,346	$17,169,618
1982, total	15	10,341,336	W	W	804,594	6,396,523
1983:						
Grant	6	W	W	W	W	W
Hidalgo	2	W	W	W	W	W
Sandoval	1	W	W	W	W	W
Santa Fe	1	W	W	W	--	--
Sierra	1	79,042	946	401,104	608,849	6,965,233
Total	11	W	W	W	W	W

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1981, total	154,114	$289,203,720	W	W	W	W	[1]$336,815,343
1982, total	W	W	W	W	--	--	[1]150,797,306
1983:							
Grant	W	W	W	W	--	--	W
Hidalgo	W	W	W	W	--	--	W
Sandoval	W	W	W	W	--	--	W
Santa Fe	--	--	--	--	--	--	W
Sierra	1,109	1,871,918	254	$121,324	--	--	9,359,579
Total	W	W	[1]258	[1]123,406	--	--	W

W Withheld to avoid disclosing company proprietary data.
[1]Includes items indicated by symbol W.

Table 5.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Gold	2	W	W	W	--	--	--
Gold-silver	4	12,060	888	W	13	W	--
Silver	3	W	985	W	1,110	W	--
Copper	2	W	W	W	W	--	--
Total	11	W	W	W	W	258	--
Other lode material:							
Copper precipitates	1	W	--	--	W	--	--
Grand total	11	W	W	W	W	258	--

W Withheld to avoid disclosing company proprietary data.
[1]Detail will not add to totals shown because some mines produce more than one class of material.

Table 6.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Cyanidation	W	W	--	--	--
Smelting of concentrates	W	W	W	172	--
Direct smelting of:					
Ore	W	W	515	87	--
Precipitates	--	--	W	--	--
Total	W	W	W	[1]258	--

W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Gold.—The average gold price in 1983 was $424 per troy ounce. Although the output in New Mexico was slightly lower than in 1982, the total value rose more than 9%. Gold was recovered in five counties: (1) in Grant County by Phelps Dodge at Tyrone, by Kennecott at Santa Rita Mine near Hurley, by Summit Minerals Co. of Duncan, AZ, at Summit Mountain Mine, by Sierra Corp. of El Paso, TX, at Old Georgetown Mine, and by Queenstake Oakcreek Mining of Duncan, AZ, at Gold King Imperial Mine; (2) in Hidalgo County by Volcano Mining Co. of Duncan, AZ, at Campbell Mine, and by Leroy Jones of Hidalgo at Lucina Mine; (3) in Sandoval County by Bland Mining Co. of Domingo at Wash Claim Mine; (4) in Santa Fe County by Gold Fields Mining Corp. at Ortiz Mine near Madrid; and (5) in Sierra County by The Goldfield Corp., a Melbourne, FL, firm, at its St. Cloud Mine.

Despite a sophisticated security system, the Ortiz Mine, south of Santa Fe, was robbed June 30 of about $500,000 (about 1,200 ounces) in bullion. Gold Fields, owner of the open pit mine and milling operation, recovered gold using a cyanide process in which the metal was deposited on stainless steel plates. The resulting bullion, sold to other firms for further refining, contained 70% to 78% gold, 10% to 15% silver, and 7% to 20% trace metals.

Iron and Steel.—UV Industries Inc. processed byproduct iron ore from uranium-vanadium ores in Grant County. Sharon Steel Corp. shipped some magnetite, a byproduct of earlier copper mining activities, from its Continental Mine.

Zia Steel moved its search for a steel minimill site from Raton to the Rio Grande Valley south of Socorro, 7 miles from the Bosque de Apache Wildlife (fowl) Refuge. The company owned a nearby iron ore deposit, east of San Antonio at Jones Camp, Socorro County. Zia Steel planned to move a sponge iron ore processing plant, formerly used at a copper mine near Casa Grande, AZ, to the Socorro area to produce direct-reduced iron. It would use local coal to produce the finished iron. Environmentalists opposed the company, and the Socorro City Council considered withdrawing approval of bonds to finance the plant.

Lead.—The average price of lead in 1983 was 21.68 cents per pound. New Mexico was sixth of 12 States that produced lead in 1983. The State's gold-silver and silver ores have been a major source of byproduct lead for decades. Summit Minerals, Volcano Mining, Bland Mining, and St. Cloud Mining Co. recovered lead from mines in Grant, Hidalgo, Sandoval, and Sierra Counties, respectively.

Molybdenum.—New Mexico ranked fifth of six States producing molybdenum concentrate in 1983. Ore came from the Quivira Mining Co.'s uranium and byproduct molybdenum mine at Ambrosia Lake in McKinley County, and from Molycorp's Questa Mine, north of the Red River in Taos County. Molycorp is a subsidiary of Union Oil Co. of California, a wholly owned subsidiary of Unocal Corp.

When fully operational in 1986, the $250 million Questa underground mine was expected to be one of the world's lowest cost producers. Underground reserves amounted to 124 million tons grading 0.294% molybdenum disulfide (MoS_2). Surface mine reserves totaled 119 million tons grading 0.169% and were expected to contribute to overall production through 1986; however, full recovery of surface resources would require considerable stripping.

On August 5, Molycorp began producing molybdenum ore from the Goat Hill area using the gravity block caving method.[13]

The new Questa Mine was the result of almost 10 years of exploration, analysis, engineering, and design. Physical develop-

ment of the new underground mine began in late 1978, and mining began in July 1983. Molycorp miners, once active in the nearby surface mine, were retrained for underground work. The first shipment of 40,000 pounds of molybdenum concentrate left the mill October 28. The ore travels from underground to the surface through a conveyor incline, thence by belt conveyor through two transfer towers to the crushing facility. Cylindrical storage bins for crushed ore allow continuous milling operations.

Molybdenum mining, begun at Questa with small underground operations in 1929, converted to open pit mining in 1965. Surface ore reserves were exhausted in 1982. The existing surface mine and mill were shut down in mid-1981 while the underground mine was being constructed.

The Questa mill was restarted on October 1 at its expanded capacity of 18,000 tons of ore per day, 20 million pounds of molybdenum per year. Before closing for modifications in August 1981, the plant had been processing from 15,000 to 17,000 tons of ore per day mined from the surface. Renovations in the mill represented an expenditure of $30 million; the principal change was installation of new flotation cells, including 24 roughers (1,000-cubic-foot volume) and 27 cleaners (300-cubic-foot volume). Capacity operation of the 900-employee facility was predicted for late 1984. The work force, nearly double that used at the old surface mine 4 years ago, accounted for about 10% of the employment in Taos County; the monthly payroll was more than $2 million.[14]

Molycorp had been using a tailings site on private land 1/2 mile east of Guadalupe Mountain; this site has capacity for several more years use. The location of the existing pond has been a problem for Molycorp, because the tailings impoundment is virtually within the village of Questa. The proposed pond is to be built west of Questa on Federal land. Environmentalists were concerned because the proposed site is surrounded by two Federal wilderness areas and a third proposed wilderness in the Guadalupe Mountains.

The BLM in Taos was to release in mid-February 1984 an environmental analysis on Molycorp's proposed Guadalupe Mountains tailings project. Environmentalists had threatened legal action to force the BLM into a full-scale formal investigation of the site and issue an Environmental Impact Statement. The BLM believed that the scope of the tailings project and the means to mitigate the project's effects on the land had been adequately addressed in the environmental analysis report and thus did not merit a study over and above that already reported, especially as the problem is one requiring nondiscretionary action; under the 1872 General Mining Laws (CFR 43, Group 3800), the owner of a mining claim has the legal right to use Federal land in the manner proposed.

The Environmental Improvement Division, however, demanded that the results of a drilling program to determine ground water discharge data be provided before it would approve the plan and issue a ground water discharge permit. The company continued to object to this requirement as being unnecessary.

Silver.—The average price for silver in 1983 was $11.44 per troy ounce. New Mexico's silver production was given a boost when Phelps Dodge reopened the Tyrone Mine in May 1983, and although silver production increased in New Mexico over that of 1982, industrial silver consumers used less silver than in 1982. The Tyrone Mine in Grant County and the St. Cloud Mine in Sierra County ranked 16th and 19th, nationally, among 25 leading silver-producing mines. Other silver production came from Summit Mine, Old Georgetown, and Gold King Imperial, all in Grant County; from Campbell and Lucina Mines in Hidalgo County; and from Wash Claim in Sandoval County.

Goldfield announced that sales from its St. Cloud silver mine in the Black Range, Sierra County, increased from $1,548,000 to $1,913,000 in the third quarter of 1983, nearly 84% of the firm's reported sales. Although profitable in the third quarter, the St. Cloud was adversely affected by silver price declines in the fall of 1983 and by a decrease in ore grade.[15]

In mid-September, Goldfield brought online its new St. Cloud flotation mill in the Winston-Chloride area. Rated at about 460 short tons of ore per day capacity, the new mill was operating at 320 short tons per day. Both the St. Cloud and the new U.S. Treasury Mine, on-stream in October, provided feed to the mill. St. Cloud Mine furnished about 75% of the feed, which was scheduled to be reduced to 50% as U.S. Treasury reaches capacity. The mill was designed to produce about 1 million ounces of silver per year. Between March 1982 when the St. Cloud Mine opened and the fall of 1983 when the new mill opened, ores

had to be trucked 240 miles to the company's San Pedro mill north of Albuquerque. The company expected to save at least $1 million per year in haulage costs alone because of the proximity of the new mill at Winston. Revenues also were expected to increase because of the greater efficiency of the new St. Cloud mill and simplified blending of ore from the two mines. Concentrates were shipped to Asarco's El Paso, TX, smelter for treatment.

The St. Cloud property had demonstrated ore reserves (as of October 1, 1982) of nearly 375,000 tons over an average width of 10.31 feet. Grade was 8.9 ounces of silver and 0.039 ounce of gold per ton, and 1.4% copper, 1.0% lead, and 1.32% zinc. From project inception in 1968 through March 1982 when production started, Goldfield invested $3.7 million in the St. Cloud project. In 1982, the St. Cloud Mine sold 408,471 ounces of silver, 1,418,000 pounds of copper, and 632 ounces of gold.[16] Although lead and zinc were not recovered as primary concentrates, the company attempted to recover these materials as flotation concentrates during the year. In addition to producing copper, gold, and silver concentrates, St. Cloud sold precious metal-bearing flux to Asarco and Phelps Dodge.

In December, Challenge Mining Co. of Mogollon reported that it was to finish constructing a permanent cyanidation plant for its low-grade silver-gold ore. Challenge operated under a batch-type system, 24 hours per day, 6 days per week. An earlier cyanidation plant was portable because of the firm's need to solve metallurgical problems and to establish sufficient reserves. Challenge had 24 employees, 150 claims, probable reserves in excess of 6 million tons of low-grade ore, a 170-ton-per-day flotation plant, and the hydrometallurgical cyanide plant. The firm marketed its products through the London Metals Exchange and Handy and Harman, without dealing first with a smelter.

NONMETALS

Cement.—In 1983, portland and masonry cement production increased 3% and 22%, respectively, reflecting increased activity in construction. On December 30, 1983, Ideal Basic Industries Inc. first sold and then released its Tijeras cement plant in Bernalillo County from General Electric Credit Corp. of Stamford, CT. Ideal Basic received $53 million for the transaction and planned to use the proceeds to retire debt. The sale and leaseback, transacted to strengthen Ideal Basic's balance sheet, will not alter plant operations.

Clays.—More than 95% of New Mexico's clay output was from three common clay and shale operations; the remainder was from two fire clay pits. Common clay output decreased 20% and value decreased 16%, compared with those of 1982. El Paso Brick Co. Inc., Kinney Brick Co. Inc., and Phelps Dodge produced clays in Dona Ana, Bernalillo, and Hidalgo Counties, respectively.

Gem Stones.—The senior U.S. Senator from New Mexico asked the U.S. Trade Representative to investigate allegations by the French Government's Directorate for Consumer Affairs and Repression of Fraud that most (90%) of the turquoise imported from the United States is fake. The New Mexico export industry sells approximately $50 million worth of turquoise and Indian jewelry annually to Europe.[17]

Gypsum.—Crude gypsum mined in New Mexico increased 14.5% in value from that of 1982; however, quantity declined 14.6%. In Sandoval County, Pomeroy Inc., at White Mesa, and Ernest Teeter, at San Felipe, were the producers; in Santa Fe County, Western Gypsum Co. mined gypsum at Rosario. Western Gypsum also was one of two companies in New Mexico to calcine gypsum; for gypsum wallboard manufacture, Allied American Gypsum Co. calcined the White Mesa output of Pomeroy. The quantity of calcined gypsum declined 14.4%—similar to the decline in mined gypsum—but the total value rose 149.5% (from an average price of $5.25 in 1982 to $15.41 per short ton in 1983).

Lime.—The quantity of lime produced in New Mexico declined, compared with that of 1982. Mathis Mining & Exploration Co., however, reported a large increase in its quicklime production at its plant in Grant County in 1983. Chino Mines' lime kiln south of Hurley was dormant in 1983 and depended upon purchased high-quality lime from Douglas, AZ.

Mica.—Both value and output of scrap mica fell about 6.3% from those of 1982; price per ton of scrap and flake mica remained the same as that of 1982. Mineral Industrial Commodities of America Inc. (M.I.C.A.), of Santa Fe, ranked second nationally in order of scrap and flake mica output, and third as a ground mica producer from scrap and flake mica, although M.I.C.A.'s production decreased more than 5% from that of 1982. The major end uses of

ground mica were joint cement, paint, oil well-drilling muds, roofing, and rubber.

Perlite (Processed).—Perlite mines in New Mexico accounted for 86% of the U.S. total crude ore mined. Producers were Grefco Inc., in Socorro and Taos Counties; Manville Products Corp. and Silbrico Corp., in Taos County; and United States Gypsum Co., in Valencia County. Average value per short ton of crude ore rose $1.06 to $33.78, but sales and consumption decreased 3.4% from that of 1982.

Potash.—The New Mexico potash industry, which accounted for about 85% of domestic potash mine production, declined 20.7%, from 15,691,000 metric tons of crude salts (sylvinite and langbeinite) in 1982 to 12,440,000 metric tons in 1983, the second year of significant decline. The value of K_2O equivalent sold or used, f.o.b. mine, declined from $204.6 million in 1982 to $174.7 million in 1983.

Partly because of the U.S. Department of Agriculture's 1983 nationwide acreage-reduction program (Payment in Kind, or PIK) and partly because of increasing foreign imports and decreasing exports, fertilizer use dropped and with it the demand for potash, a basic ingredient of fertilizer. U.S. farmers withheld 54 million acres from the production of five major crops—corn, cotton, sorghum, soybeans, and wheat. These five crops account for 60% of all potash fertilizers used in the United States, and the crop acreage reductions severely impacted the potash mining and processing industries.

Owing to the increasingly weak demand for potash, National Potash had shut down its operation in February 1982, Mississippi Chemical closed its facility, oldest in the Carlsbad area, January 19, 1983, and the other five Carlsbad operations laid off workers, reduced output, or shut down for maintenance longer than usual in 1983 to work off excess potash inventories. As most potash inventories were near record-high levels, the PIK program seemed likely to have a negative impact on the already depressed New Mexico potash industry for the next year or two.

At the beginning of 1983, six companies produced potash in New Mexico from underground, bedded sylvinite and langbeinite deposits east of Carlsbad: AMAX Chemical Corp. of AMAX Inc.; Duval, a wholly owned subsidiary of Pennzoil; International Minerals & Chemical; Kerr-McGee Chemical Corp. of Kerr-McGee Corp., which began granular muriate of potash production at the otherwise defunct National Potash plant; Mississippi Chemical; and Potash Co. of America (PCA) of Ideal Basic. One company reacted muriate of potash and potassium magnesium sulfate to produce sulfate of potash.

AMAX's maintenance shutdown on June 6 was extended through July and most of August, owing to large potash inventories, low prices, and poor sales. AMAX recalled 305 workers to its plant at Carlsbad on August 29, when the mine, mill, and refinery were restarted at 80% of productive capacity.

Variations in ore grade at the AMAX potash mine resulted from the production ratio of the two separate ore zones that were about 28 feet apart vertically. The lower ore zone averaged 20.4% potassium oxide and the upper ore zone averaged 12.3%. The principal product was muriate of potash, a chemical fertilizer that contains approximately 60% potassium oxide. Reserves were estimated to be 53 million tons, averaging 13.7% potassium oxide, according to the AMAX 10K Annual Report to the Securities and Exchange Commission.

Duval's principal potash reserve was potassium magnesium sulfate (langbeinite). Washed langbeinite was used to fertilize crops such as citrus fruits, tobacco, and other row crops. Proven reserves at yearend 1983 amounted to 31.7 million tons of ore, averaging 8.4% K_2O, an amount estimated to be sufficient to produce 10.9 million tons of washed langbeinite, 22% K_2O. Production in 1983 was 232,000 tons, 57,000 and 180,000 tons less, respectively, than in 1982 and 1981, according to the Pennzoil 10K Annual Report.

Kerr-McGee Chemical leased the closed National Potash granulation, storage, and shipping facilities in Carlsbad. During the 12-month lease period (1983), Kerr-McGee Chemical stated its hope to exercise an option to purchase National Potash's New Mexico potash leases on a near-term basis. National Potash had closed its operation in February 1982, eliminating 275 jobs. From June 12 to July 18, owing to failure of the hoisting works at the main production shaft, Kerr-McGee Chemical shut down its mine; about 300 workers were laid off. The company continued shipments from inventories during the mine closure.

Mississippi Chemical mothballed its Carlsbad potash mine and refinery on January 21, 1983. About 200 workers were laid

off and 20 were retained to sell off a 3-month potash inventory and to maintain the plant. The company was a farmer-owned organization headquartered in Yazoo City, MS. Its main storage and shipping facility was in Pascagoula, MS, and total yearend inventory exceeded 1 year's needs. Mississippi Chemical had operated the mine and refinery since its purchase from Teledyne Corp. in 1974. The oldest mine in the basin, it was previously worked by United States Borax & Chemical Corp.'s United States Potash Div.

PCA reduced its work force by 70 on March 20, 1983. The firm had laid off 60 people in early December 1982, and cut another 20 employees at yearend by not filling vacancies created by retirement and resignations. Again shut down in the summer because of large inventories and poor sales, PCA recalled 250 workers in mid-September, increasing production and bringing the work force up to 400 working a 10-day-on, 4-day-off schedule.

The drought that ruined most of the midwestern corn crop in the summer of 1983 resulted in one of the smallest harvests in history, and may result in farmers planting more corn and other crops that will require more potash fertilizer in 1984.

Table 7.—Production and sales of potash in New Mexico

(Thousand metric tons and thousand dollars)

Period	Crude salts[1] (mine production)		Marketable potassium salts				
			Production		Sold or used		
	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Value[2]
1982:							
January-June	7,732	1,013	1,434	758	1,471	751	110,600
July-December	7,960	1,026	1,464	766	1,401	745	94,000
Total[3]	15,691	2,039	2,898	1,524	2,872	1,497	204,600
1983:							
January-June	6,562	851	1,251	653	1,395	717	96,900
July-December	5,878	748	1,129	561	1,129	560	77,800
Total[3]	12,440	1,600	2,380	1,214	2,525	1,278	174,700

[1]Sylvinite and langbeinite.
[2]F.o.b. mine.
[3]Data may not add to totals shown because of independent rounding.

Pumice and Pumicite.—Four firms mined pumice and pumicite from four operations in Rio Arriba, Sandoval, and Santa Fe Counties during 1983. New Mexico ranked second of eight pumice-producing States. General Pumice Corp. and Copar Pumice Co. Inc. were among the top 8 of 21 producing companies in the Nation. Those eight companies accounted for 90% of the tonnage and 67% of the value of total U.S. pumice and pumicite production. Pumice was used in abrasives, concrete aggregate, and building, decorative, and roofing tiles. The average value of pumice was $9.70 per short ton in 1983, compared with $8.33 per short ton in 1982.

Salt.—New Mexico was 1 of several small producers among 12 evaporated salt-producing States. The number of producing companies in Eddy and Lea Counties fell from five to four in 1983; the four remaining were the major producers. Total value and quantities produced, used, and sold declined significantly from 1982 figures; nevertheless, the largest of the four producers, United Salt Corp., increased its output and product value. Salt was sold for an average of $13.95 per short ton.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Table 8.—New Mexico: Sand and gravel sold or used by producers

	1982			1983[e]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	1,688	$5,608	$3.32	NA	NA	NA
Gravel	3,003	10,372	3.45	NA	NA	NA
Sand and gravel (unprocessed)	925	1,690	1.83	NA	NA	NA
Total or average	5,616	17,670	3.15	7,000	$20,000	$2.86
Industrial sand	W	W	7.50	--	--	--

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Thirty-five firms and government agencies produced crushed stone from 60 quarries in 22 counties during 1983. The individual annual output at all but two quarries was less than 300,000 short tons. Bee Bee Contractors, Rock Products Inc., the largest producer of crushed stone in the State in 1983, produced granite from its quarry in Torrance County, southeast of Albuquerque. Ideal Basic, the second largest producer, took limestone from its quarry in Bernalillo County.

Crushed stone prices per short ton were limestone, $2.78; granite, $4.29; quartzite, $4.09; traprock, $3.20; and volcanic cinder $3.80. Crushed volcanic cinder used to make terrazzo and exposed aggregate was priced at an average of $17 per short ton.

More than 65% of crushed and broken limestone was used for construction and maintenance including, in decreasing order of use, dense-graded road base stone, coarse concrete aggregate, bituminous aggregate, filter stone, and other uses. A significant portion of crushed limestone also was used to manufacture cement and lime. More than 99% of crushed granite was used as railroad ballast.

Dimension.—Quantity and value of dimension stone New Mexico producers sold or used changed little compared with 1982 figures.

Limestone accounted for the largest dimension stone output. Guillen Construction Co. and Rocky Mountain Stone Co. quarried limestone from Dona Ana and Valencia Counties, and Apache Springs Co. operated a marble quarry in Dona Ana County. Rocky Mountain Stone also produced dimension stone from a quarry in Socorro County. Most of the quarries produced less than 25,000 short tons each.

Cut in thin slabs or panels and used as building facades, dimension stone made a comeback and replaced glass in some new constructions. Stone veneer deflects heat rays better than glass does and requires less air conditioning, thereby reducing energy costs.

Table 9.—New Mexico: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Other coarse aggregate	32	186
Coarse aggregate, graded:		
Concrete aggregate, coarse	535	1,434
Bituminous aggregate, coarse	499	1,801
Bituminous surface treatment aggregate	227	581
Railroad ballast	995	4,040
Other graded coarse aggregate	6	34
Fine aggregate (-3/8 inch): Other fine aggregate	4	W
Coarse and fine aggregate:		
Graded road base or subbase	1,133	2,949
Unpaved road surfacing	33	W
Crusher run or fill or waste	49	108
Chemical and metallurgical: Lime manufacture	17	W
Special:		
Lightweight aggregate	85	W
Roofing granules	8	21
Other[2]	1,108	3,969
Total[3]	4,730	15,121

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."

[1]Includes limestone, granite, quartzite, traprock, and volcanic cinder and scoria.

[2]Includes stone used for riprap and jetty stone, filter stone, stone sand (concrete), terrazzo and exposed aggregate, cement manufacture, flux stone, stone sand (bituminous mix or seal), screening (undesignated), fine aggregate, uses not specified, and uses indicated by symbol W.

[3]Data do not add to totals shown because of independent rounding.

Sulfur (Recovered).—Elemental sulfur was recovered from natural gas and petroleum refinery operations in Eddy, Lea, Roosevelt, and San Juan Counties. The largest production came from Lea County where El Paso Natural Gas, Northern Natural Gas Co., Phillips Petroleum Co., and Warren Petroleum Co. had plants. Total production in the State was down about 4.7% from that of 1982.

[1]State Liaison Officer, Bureau of Mines, Denver, CO.

[2]Mining engineer, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM.

[3]New Mexico Business. Current Economic Report. The New Mexico Economy, 1983. V. 5, No. 1, Jan.-Feb. 1984, p. 1.

[4]The New Mexico Sun. Jan. 26, 1983.

[5]Sunwest Financial Services Inc. Estimated Non-Agricultural Wage and Salary Employment. Monthly Business & Economic Report. NM Prog., Feb. 1984, p. 3.

[6]Pages 1, 5, and 10 of work cited in footnote 3.

[7]New Mexico Labor Market Review. V. 12, No. 7, Aug. 31, 1983, 9 pp.

[8]Austin, G. S., and staff. New Mexico. Min. Eng., v. 36, No. 5, May 1984, p. 453.

[9]Bill S-32, Uranium Mining and Exploration—category in ref.: NCR Inf. Rep. on New Mexico State Leg., v. 9, No. 8, Dec. 15, 1983.

[10]U.S. Bureau of Land Management. Public Land Statistics, 1983. Apr. 1984, 231 pp.

[11]U.S. Bureau of Mines staff. Bureau of Mines Research 1983. A Summary of Significant Results in Mineral Technology and Economics, compiled and edited by J. R. Pederson. BuMines SP 3-83, 173 pp.; GPO Stock No. 024-004-02123-3.

[12]Phelps Dodge Corp. 10K Annual Report, 1983. P. 4.

———. Annual Report, 1983. P. 3.

[13]Skillings' Mining Review. V. 72, No. 43, Oct. 22, 1983, pp. 4-7.

[14]The Mining Record. Molybdenum Mine Dedicated. V. 95, No. 41, Oct. 12, 1983, p. 6.

[15]The Goldfield Corp. News. Nov. 15, 1983.

[16]New Mexico Pay Dirt. Goldfield's St. Cloud To Produce 1 Million Ounces of Silver a Year. No. 77, Oct. 1983, p. 8A.

[17]The Denver Post. Turquoise Probe Sought. Sept. 9, 1983.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Carbon dioxide (natural):			
Amerigas Corp., a subsidiary of UGI Corp.	4455 LBJ Freeway Suite 1100 Dallas, TX 75234	Wells and liquefaction and solidification extraction plant.	Harding.
Cement:			
Ideal Basic Industries Inc., Ideal Cement Co.[1]	950 17th St. Denver, CO 80201	Dry process, 2 rotary-kiln plants.	Bernalillo.
Clays:			
El Paso Brick Co. Inc	Box 12336 El Paso, TX 79912	Open pit mine	Dona Ana.
New Mexico Brick Co. Inc., doing business as Kinney Brick Co. Inc.	100 Prosperity Ave. SE. Box 1804 Albuquerque, NM 87102	do	Bernalillo.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Copper:			
Chino Mines Co., a Kennecott-Mitsubishi Metal Corp. partnership[2]	Hurley, NM 88043	Open pit mine, flotation mill, precipitation plant, smelter.	Grant.
Phelps Dodge Corp., Tyrone Branch[3]	Drawer B Tyrone, NM 88065	Open pit mine and mill	Do.
The Goldfield Corp.[4]	65 East Nasa Blvd. Suite 101 Melbourne, FL 32901	Underground mine, flotation mill.	Sierra.
Gypsum:			
Allied American Gypsum Co	Box 6345 Albuquerque, NM 87197	Processing and wallboard plant.	Bernalillo.
Pomeroy Inc	10147 2d St. Albuquerque, NM 87114	Open pit	Sandoval.
Western Gypsum Co., a subsidiary of Drywall Supply Inc.	Box 2636 Sante Fe, NM 87501	Open pit and plant	Sante Fe.
Lime:			
Mathis Mining & Exploration Co	1101 Santa Rita Box 2577 Silver City, NM 88062	Quarry and open pit mine.	Grant.
Mica:			
Mineral Industrial Commodities of America Inc.	Box 2403 Santa Fe, NM 87501	Open pit mine	Taos.
Molybdenum:			
Molycorp Inc., a division of Unocal Corp.	Box 760 Los Angeles, CA 90051	Open pit mine and flotation mill.	Do.
Quivira Mining Co	Box 218 Grants, NM 87020	Underground mine and mill.	McKinley.
Perlite:			
Grefco Inc., a subsidiary of General Refractories Co.	Box 308 Antonito, CO 81120	Open pit mines; crushing, screening, air separation.	Socorro and Taos.
Manville Sales Corp., a division of Manville Products Corp.	Box 338 Antonito, CO 81120	do	Taos.
Silbrico Corp	Box 367 Antonito, CO 81120	Open pit	Do.
United States Gypsum Co	Box 216 Grants, NM 87020	Open pit mine and crushing plant.	Cibola.
Potash:			
AMAX Chemical Corp	Box 279 Carlsbad, NM 88220	Underground mine and plant.	Eddy.
Duval Corp., a subsidiary of Pennzoil Co.[5]	Box 511 Carlsbad, NM 88220	do	Do.
International Minerals & Chemical Corp.	Box 71 Carlsbad, NM 88220	do	Do.
Kerr-McGee Chemical Corp., a subsidiary of Kerr-McGee Corp.	Kerr-McGee Bldg. Oklahoma City, OK 73102	do	Do.
Potash Co. of America, a subsidiary of Ideal Basic Industries Inc.[5]	Box 31 Carlsbad, NM 88220	do	Do.
Pumice:			
American Pumice Co., a division of Beatrice Foods Co.	Box 4305 Santa Fe, NM 87502	Processing plant	Santa Fe.
Copar Pumice Co. Inc	Box 38 Espanola, NM 87532	Open pit	Do.
General Pumice Corp	Box 449 Santa Fe, NM 87501	Open pit mine and crushing and screening plant.	Rio Arriba.
Salt:			
United Salt Corp	Box SS Carlsbad, NM 88220	Salt lake	Eddy.
Sand and gravel:			
Albuquerque Gravel Products	Box 829 Albuquerque, NM 87103	Dredge and plant	Bernalillo.
Springer Building Materials Corp.	Drawer S Albuquerque, NM 87103	Pit and stationary crushing and screening plant.	Do.
Stone:			
Peter Kiewit Sons Co	Box 521 Littleton, CO 80120	Quarries	Colfax and Union.

[1]Also stone.
[2]Also silver and lime.
[3]Also silver, gold, and sandstone.
[4]Also silver.
[5]Also salt.

The Mineral Industry of New York

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the New York State Education Department, New York Geological Survey, for collecting information on all nonfuel minerals.

By Donald K. Harrison[1]

The value of nonfuel mineral production in New York was $506.6 million, an increase of $4.4 million over that of 1982. The State ranked 14th in value of nonfuel minerals produced in 1983. Crushed stone was the leading mineral commodity produced, accounting for more than 27% of the State's total mineral production value. Other principal commodities produced included portland cement, lime, salt, construction sand and gravel, talc, and zinc.

Table 1.—Nonfuel mineral production in New York[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] thousand short tons	352	$897	371	$869
Gem stones	NA	30	NA	30
Lead (recoverable content of ores, etc.) metric tons	r1,065	r600	1,299	621
Peat thousand short tons	W	W	18	W
Salt do.	6,205	117,718	4,859	100,119
Sand and gravel:				
Construction do.	r17,338	r46,871	e18,700	e54,200
Industrial do.	45	512	W	W
Silver (recoverable content of ores, etc.) thousand troy ounces	27	r216	33	379
Stone:				
Crushed thousand short tons	e28,700	e132,800	32,331	137,982
Dimension do.	e22	e2,293	24	4,310
Zinc (recoverable content of ores, etc.) metric tons	r52,237	r44,303	56,748	51,783
Combined value of cement, clays (ball clay), emery, garnet (abrasive), gypsum, iron ore (1982), lime, talc, titanium concentrate (ilmenite), wollastonite, and values indicated by symbol W	XX	r155,959	XX	156,351
Total	XX	r502,199	XX	506,644

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes ball clay; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in New York, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Albany	W	W	Cement, clays, sand and gravel (construction).
Allegany	(2)	$1,338	Sand and gravel (construction).
Broome	W	W	Sand and gravel (construction), clays, peat.
Cattaraugus	$175	6,582	Sand and gravel (construction), peat.
Cayuga	(2)	401	Do.
Chautauqua	(2)	572	Do.
Chemung	(2)	552	Do.
Chenango	(2)	643	Do.
Clinton	W	338	Do.
Columbia	W	647	Do.
Cortland	(2)	1,009	Do.
Delaware	W	39	Do.
Dutchess	W	W	Do.
Erie	W	W	Sand and gravel (construction), clays.
Essex	16,586	13,234	Wollastonite, iron ore, titanium, sand and gravel (construction), garnet.
Franklin	100	148	Sand and gravel (construction).
Fulton	(2)	378	Do.
Genesee	W	W	Gypsum, sand and gravel (construction).
Greene	W	W	Cement, sand and gravel (construction).
Herkimer	W	852	Sand and gravel (construction).
Jefferson	1,784	705	Do.
Lewis	W	W	Wollastonite, sand and gravel (construction).
Livingston	W	W	Salt, sand and gravel (construction).
Madison	1,340	99	Sand and gravel (construction).
Monroe	W	1,121	Do.
Montgomery	2,263	W	Do.
Nassau	(2)	W	Do.
Niagara	W	(3)	
Oneida	W	940	Sand and gravel (construction), sand (industrial).
Onondaga	48,664	34,184	Lime, salt, sand and gravel (construction), cement, clays.
Ontario	W	674	Sand and gravel (construction).
Orange	W	W	Sand and gravel (construction), clays.
Orleans	914	W	Sand and gravel (construction).
Oswego	(2)	830	Do.
Otsego	(2)	284	Do.
Putnam	W	(3)	
Rensselaer	880	2,212	Sand and gravel (construction).
Rockland	17,639	(3)	
St. Lawrence	W	W	Zinc, talc, lead, sand and gravel (construction), silver.
Saratoga	W	245	Sand (industrial), sand and gravel (construction).
Schenectady	(2)	W	Sand and gravel (construction).
Schoharie	W	W	Cement, sand and gravel (construction).
Schuyler	W	W	Salt, sand and gravel (construction).
Seneca	W	W	Peat, sand and gravel (construction).
Steuben	W	1,432	Sand and gravel (construction).
Suffolk	(2)	3,998	Do.
Sullivan	W	362	Do.
Tioga	(2)	952	Do.
Tompkins	W	W	Salt, sand and gravel (construction).
Ulster	W	W	Clays, sand and gravel (construction).
Warren	W	W	Cement, garnet, sand and gravel (construction).
Washington	W	158	Sand and gravel (construction).
Wayne	W	737	Do.
Westchester	W	W	Emery, peat, sand and gravel (construction).
Wyoming	W	W	Salt, sand and gravel (construction).
Yates	(2)	89	Sand and gravel (construction).
Undistributed[4]	345,327	291,351	
Sand and gravel (construction)	e45,560	XX	
Stone:			
Crushed	XX	e132,800	
Dimension	XX	e2,293	
Total	[5]481,231	502,199	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Bronx, Hamilton, Kings, New York, Queens, and Richmond Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Includes gem stones and some sand and gravel (industrial, 1981) that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of New York business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	7,895.5	7,888.4	-0.1
Unemployment	do.	751.5	637.0	-15.2
Employment (nonagricultural):				
Mining[1]	do.	6.0	6.5	+8.3
Manufacturing	do.	1,282.2	1,289.6	+.6
Contract construction	do.	192.2	208.3	+8.4
Transportation and public utilities	do.	410.2	410.1	--
Wholesale and retail trade	do.	1,432.8	1,496.2	+4.4
Finance, insurance, real estate	do.	673.2	692.3	+2.8
Services	do.	1,821.1	1,874.0	+2.9
Government	do.	1,294.9	1,291.6	-.2
Total nonagricultural employment[1]	do.	7,112.6	[2]7,268.7	+2.2
Personal income:				
Total	millions	$217,230	$232,251	+6.9
Per capita		$12,389	$13,146	+6.1
Construction activity:				
Number of private and public residential units authorized		25,369	36,916	+45.5
Value of nonresidential construction	millions	$2,151.5	$1,639.4	-23.8
Value of State road contract awards	do.	$561.0	$570.0	+1.6
Shipments of portland and masonry cement to and within the State	thousand short tons	2,362	2,533	+7.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$502.2	$506.6	+.9
Value per capita, resident population		$28	$29	+3.6
Value per square mile		$10,093	$10,317	+2.2

[p]Preliminary.
[1]Includes oil and gas extraction.
[2]Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

New York was the only State in which emery was produced and accounted for virtually all of the Nation's wollastonite production. The State ranked second in primary aluminum shipments; third in salt, zinc, and garnet output; and fourth in lead and talc production. Other mineral commodities produced included clays, gypsum, ilmenite, peat, industrial sand, byproduct silver, and dimension stone. Mineral commodities processed or manufactured included abrasives, alumina, synthetic calcium chloride, ferroalloys, synthetic graphite, iodine, iron and steel, synthetic mullite, expanded perlite, iron slag, synthetic sodium carbonate, and exfoliated vermiculite.

Trends and Developments.—The State's steel and metal industries continued to experience declines in their capacity to produce and process minerals. Production continued to remain at far less than capacity because demand for steel decreased or those companies utilizing the steel had excess inventories. As a result of unprofitability, several steel and metal-related industries were forced to close or make cutbacks at several plants.

In late December, officials of Bethlehem Steel Corp. announced the closure of all facilities except the galvanizing line and 13-inch bar mill at the Lackawanna steel plant near Buffalo. Only 1,300 of 8,600 workers will be employed at the plant after the cutback. Also during the year, United States Steel Corp. announced that it was closing its fabrication plant in Elmira, and General Motors Corp. officials indicated that it would totally shut down the 2,130-worker foundry near Tonawanda, north of Buffalo, by mid-1984. The company announced that it had eight other foundries throughout the Nation with sufficient capacity to meet the automobile maker's needs. Another company, Chemung Foundry Co., proposed to close its plant in Elmira, citing poor economic conditions. As part of a planned phasedown of operations, Phelps Dodge Corp. announced its intention to close its outdated Laurel Hill electrolytic copper refinery on Long Island in 1984. Material that was formerly sent to Laurel Hill will be refined at the company's El Paso, TX, plant. The Laurel Hill facility has an annual capacity of 75,000 short tons of refined copper, with a large part of it in the form of wirebars.

On a positive note, however, several plants announced the modernization of existing manufacturing facilities. Al Tech Specialty Steel Corp., a subsidiary of GATX Corp., announced plans to install a $7 million curved mold caster, eliminating one

step in the steelmaking process. Hot metal will be cast directly into billets, thus reducing operating costs. In May, the Aluminum Co. of America (Alcoa) announced plans to install a $10 million continuous caster and rolling mill to produce aluminum rod. The new equipment will utilize both U.S. and foreign technology. In another expansion announcement, Anaconda American Brass Co., a division of Atlantic Richfield Co., is investing $80 million to expand its copper and copper alloy products division.

Legislation and Government Programs.—In November, voters approved a $1.25 billion "Rebuild New York" bond issue. The Rebuild New York program is expected to accelerate the State Department of Transportation's shift in emphasis from new construction to reconstruction and repair. Overall program categories, with Federal and State funding combined, will primarily concentrate on interstate and State highway construction and/or reconstruction and on reconditioning and preservation of the State's roads and bridges. The additional moneys should help to revitalize the State's construction mineral industry, primarily the stone, sand and gravel, and cement producers.

A bottle bill requiring that deposits be charged on all beverage cans and bottles sold in New York became effective on October 1, 1983. The bill, which was signed into law in 1982, is expected to generate approximately 85 million pounds of recycled aluminum cans during its first year. New York is the ninth State to enact such a deposit law covering all beverage containers.

In an effort to combat "acid rain" damage, the New York State Department of Environmental Conservation (DEC) began using lime and soda ash to improve water quality conditions in the Adirondack Lakes. Lime was being used at Nick's Pond near Star Lake, and soda ash, donated by Allied Chemical Corp., was being tested at Bone Pond, 15 miles west of Lake Placid. The Bone Pond project is expected to continue for 8 years before final conclusions are made.

A recent concern of New York cement and steel producers has been the use of imported cement and steel in State construction projects. The Federal Surface Transportation Assistance Act of 1982 requires that domestic cement and steel be used in construction projects undertaken with funds from a 5-cent-per-gallon Federal gasoline tax increase. However, the "Buy America" clause was contested by the Empire State Concrete & Aggregate Producers, who requested that the State Department of Transportation waive the restriction. However, after reviewing testimony, the department refused to waive the restriction.

The New York Geological Survey, which has been functioning continuously for 149 years, continued working on major projects primarily concerned with either environmental, engineering, or regional geologic studies. Projects underway in the environmental and engineering studies include (1) production of county bedrock maps for engineering purposes, (2) study of landslides in the Hudson River Valley, (3) statewide evaluation for potential siting of low-level radioactive waste disposal, (4) statewide appraisal of data relevant to the siting of a high-level radioactive waste disposal in crystalline rock funded by the U.S. Department of Energy, (5) geochemistry of glacial soils, and (6) study of Outer Continental Shelf petroleum development funded by the Department.

Regional geologic studies include (1) subsurface stratigraphy of the Devonian Age rocks of central and western New York, (2) quadrangle mapping of the Adirondack Mountains at 1:62,000, (3) Cambro-Ordovician biostratigraphy, (4) geology of the Shelving Rock Quadrangle at 1:24,000, (5) regional structures of the Adirondack Mountains, and (6) Quaternary geologic mapping of New York at 1:250,000.

During fiscal year 1983, the U.S. Bureau of Mines had 15 active contracts or grants in New York valued at $116,430. These were awarded to New York University and various private firms for mineral-related studies.

Recently, the U.S. Bureau of Mines developed a water elutriator system that separates metals from shredded scrap automobiles based on differences in specific gravities. Near yearend, the new system was installed and tested at an Eastman Kodak Co., Rochester site. The intended use was to separate the metals from a waste-containing paper, plastic film, hard plastics, and lightweight metals. The metal-free combustibles were dried and used as a supplemental boiler fuel, eliminating a disposal and storage problem. A marketable metal product was also obtained. Preliminary results of elutriating the wastes were highly successful, producing a 99%-plus combustible product and a 98% light-metal product.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives (Manufactured).—High-purity aluminum oxide was produced by Carborundum Electro Minerals Co., a division of Standard Oil Co. (Ohio) (SOHIO), and by General Abrasives Div. of Dresser Industries Inc., both located in Niagara Falls. A small quantity of regular aluminum oxide was also produced by General Abrasives. In spite of the continuing depressed state of the manufactured abrasive industry, total State production rose nearly 17% in 1983 compared with 1982 levels.

In March, SOHIO announced plans to close The Carborundum Co.'s worldwide bonded abrasive operations and sell or close its coated abrasive operations. As a result, the company closed the bonded and superabrasives plant in Niagara Falls. Approximately 650 people were employed at the facility. Other company-owned operations are to continue at the Niagara Falls facility. During the year, Carborundum Resistant Materials Co.'s Advanced Materials Div. began construction of a $27 million plant in Niagara Falls for the manufacture of sintered alpha silicon carbide. The ceramic material will be used as a replacement for tungsten carbide wear parts. Also, The Carborundum Co. and Hitachi Chemical Co. Ltd., Japan, agreed to produce and market Carborundum's sintered alpha silicon carbide in Japan. The new company, Hitachi-Carborundum Co., will be equally owned by its parents.

In Erie County, Pellets Inc. produced cut wire shot for abrasive purposes. Although production dropped nearly 55% in 1983 compared with 1982 levels, value of the cut wire shot rose more than 200%.

Calcium Chloride (Synthetic).—New York continued to rank first of three States in the production of synthetic calcium chloride in 1983. Allied Chemical recovered synthetic calcium chloride as a byproduct of soda ash production at its Solvay plant in Onondaga County. Both quantity and value declined 23% and 18%, respectively, in 1983 compared with 1982 figures. Calcium chloride was used for ice and snow removal and as a dust suppressant.

Cement.—Both portland and masonry cement were produced in the State in 1983. Four companies operated five cement plants. All five produced portland cement and three produced masonry cement. In 1983, shipments of portland cement decreased slightly (less than 2%), while shipments of masonry cement increased nearly 30%. Main users of the cement were ready-mixed concrete companies, concrete product manufacturers, highway contractors, and building material dealers.

Two developments during the year have helped to stabilize the State's cement industry. In the fall, voters passed the State's transportation bond issue, which will provide roughly $1.25 billion for new construction in the State. This new construction should provide new revenue to the State's ailing cement industry. A second factor was New York State's Buy America policy, as a result of a provision included under the Federal Surface Transportation Assistance Act of 1982. The 1982 act required that domestic cement and steel be used in construction projects undertaken with funds from the 5-cent-per-gallon Federal gasoline tax imposed under the act.

In June, however, this provision was contested. Even though local cement producers supported this part of the act, the Empire State Concrete & Aggregate Producers requested that the State Department of Transportation waive the restriction because they contended that local cement supplies were unavailable. Canadian cement suppliers also supported the exemption from the domestic clause. However, after deliberation, the department refused to waive the restriction, and the Buy America clause stood firm.

At yearend, Independent Cement Corp., Albany, announced that it had agreed in principle to purchase the Catskill cement plant operated by Lone Star Industries Inc. Also involved in the sale are four distribution terminals in Boston, Providence, Hartford, and New York City. The $30 million plus transaction is subject to approval by the Federal Trade Commission. Because Independent Cement distributes cement produced in Canada, it has been barred from supplying Federal and State highway projects because they are covered by the Buy America restrictions of the Federal Surface Transportation Assistance Act of 1982. However, acquisition of the Catskill plant will allow Independent Cement to bid on State and Federal highway projects.

Citing severe 1982 financial losses at its plant in Ravena, Atlantic Cement Co. Inc. officials in May requested a reduction in the company's local tax assessment. In July, the

town board of Coeymans approved property tax reductions totaling $975,000 for the company over the next 2 years. Atlantic Cement would receive a $600,000 assessment reduction in 1983 and a $375,000 reduction in 1984 as part of a 4-year package. The company's tax assessments will be frozen in 1985 and 1986. Atlantic Cement is the largest taxpayer in Coeymans and the largest employer in southern Albany County.

Clays.—In 1983, both common and ball clay were produced in the State. Common clay was produced by eight companies in six counties. Leading counties in order of output were Albany, Ulster, Broome, Onondaga, Orange, and Erie. Ball clay (slip clay) was produced by one company, Industrial Mineral Products Inc., in Albany County. In 1983, production of common clay increased 5%, while value dropped 3%, compared with 1982 production levels. Common clay was used principally in the manufacture of portland cement, face brick, concrete block, and structural concrete. Main uses of ball clay were for ceramic glazes and bonding.

In 1983, the Northeast Solite Corp.'s Saugerties plant in Mount Marion was awarded the top safety prize for the most accident-free worker-hours in 1982. The award was presented by the Expanded Shale Clay & Slate Institute.

Emery.—New York continued to be the only State in the Nation that produced emery. Two companies, De Luca Emery Mine Inc. and John Leardi Emery Mine, both operated open pit mines near Peekskill, northern Westchester County, approximately 35 miles north of New York City. Production of emery decreased nearly 22% in quantity and 20% in value. The emery occurs in a narrow replacement body in the Precambrian Manhattan quartz-mica schist, where this rock has been metamorphosed by the adjacent Cortlandt Complex, a basic intrusive of post-Ordovician Age.[2] The crude material was processed by two companies, Washington Mills Abrasive Co., North Grafton, MA, and Emeri-Crete Inc., New Castle, NH. Emery was used mainly as a nonslip additive for floors, pavements, and stair treads. Minor uses were for coated abrasives and as a tumbling and deburring media.

Garnet.—New York was one of three States in the Nation that produced garnet; Idaho and Maine were the other two States. The State ranked third in production but second in value. Garnet was produced by two companies. Barton Mines Corp., Warren County, mined garnet from a surface mine near North Creek and sold the product for use in coated abrasives, glass grinding and polishing, and metal lapping. The NYCO Div. of Processed Minerals Inc. operated a mine in Essex County and sold the garnet for use in sandblasting and in bonded abrasives. The recovered garnet at the NYCO operation is a byproduct of wollastonite mining and processing at the site.

Gem Stones.—New York contains a myriad of gem stones and mineral specimens primarily collected by amateurs. Value of gem stones collected in 1983 was estimated to be about $30,000.

Graphite (Synthetic).—New York continued to lead the Nation in the production of synthetic graphite, accounting for one-third of the U.S. output. In 1983, both output and value increased compared with that of 1982. Output in 1983 amounted to 72,876 short tons, a 6% increase. Four companies, all located in Niagara County, produced the synthetic graphite. The four companies were Airco Carbon, a division of Airco Inc.; The Carborundum Co., Graphite Products Div.; Great Lakes Carbon Corp.; and Union Carbide Corp., Carbon Products Div. Principal uses of the synthetic graphite were for electrodes, cathodes, anodes, crucibles and vessels, lubricants, and unmachined graphite shapes.

Early in the year, American Cyanamid Co. purchased the manufacturing assets of Electro-Metalloid Corp. in Irvington. Electro-Metalloid produces metal-coated graphite fibers. The graphite fibers, which are coated with nickel, silver, gold, or other metals, were developed jointly by American Cyanamid and Electro-Metalloid. The markets for these materials were for applications in aerospace, electronic equipment, adhesives, and injection molding compounds.

Gypsum.—The only producer of crude gypsum in New York was United States Gypsum Co., which operated an underground mine at Oakfield in the western part of the State. The gypsum bed, which averages 3 to 4 feet in thickness, is part of the rocks of the Salina Group, Upper Silurian Age. Although output in 1983 decreased only 4%, value decreased 13% compared with that of 1982. The crude gypsum from this mine and gypsum imported from Canada was calcined at two company-owned plants in Oakfield, Genesee County, and at Stony Point, Rockland County. In addition to the two calcining plants of U.S. Gypsum, two other companies calcined gypsum in the

State. National Gypsum Co., Rensselaer County, and Georgia-Pacific Corp., Westchester County, calcined imported gypsum for use in wallboard and plaster. Both output and value increased 13% and 30%, respectively, compared with that of 1982.

Iodine.—Crude iodine was shipped into the State by RSA Corp., Westchester County, and Sterling Organics U.S., a division of Sterling Drug Inc., Rensselaer County. RSA, the largest producer in New York, produced specialty organic chemicals. Sterling used the iodine for the manufacture of pharmaceuticals, catalysts, and sanitation products.

Lime.—One company, Allied Chemical, produced lime in 1983 at its plant in Onondaga County. The Syracuse plant is the Nation's third leading individual lime plant in terms of total output. The company mines two veins of chemical-grade limestone rock to a depth of approximately 100 feet at its Jamesville Quarry, Onondaga County. The mined rock is then loaded onto trucks for further processing in the quarry's crushing plant or for disposal at the waste dumps. The material is then shipped by truck to its soda ash production plant near the village of Solvay. The soda ash was used by the glass, chemical, paper, leather tanning, and water-treatment industries. Some calcium chloride, a byproduct from the manufacture of soda ash, is returned to the quarry. Recently, the company began applying calcium chloride on its quarry roads to control fugitive dust generated by the trucks hauling the limestone and for road stabilization. The liquid calcium chloride is applied using a 3,200-gallon tank truck. Results of the spraying have dramatically reduced the dust generated at and near the quarry site.[3]

Mullite (Synthetic).—The Carborundum Co., Niagara Falls, was the only producer of electric-furnace-fused mullite in New York. Consumption of mullite, a heat-resistant material used in furnace linings and refractories, continued to be soft because of the Nation's ailing steel industry.

Peat.—New York ranked ninth of 22 States in peat sales in 1983. Six companies produced peat from five counties in the State. Leading counties, in order of output, were Dutchess, Cattaraugus, Seneca, Westchester, and Broome. Even though there were two more companies producing peat in 1983 than in 1982, both quantity and value of sales were lower in 1983. Both reed-sedge and humus were produced. Most of the peat was packaged, but a small amount was also sold in bulk. Primary uses for the material was for soil improvement and potting soil.

The New York State Energy Research and Development Authority (NYSERDA) identified 272 sites comprising 149,910 acres in New York as potentially suitable for future peat mining. Most of the peat deposits are located in the northern part of the State, along the coast of Lake Ontario and northeast along the St. Lawrence River. NYSERDA estimates that the mined peat could produce the equivalent of 450 million barrels of oil. A demonstration project to mine and burn the peat in a Fort Drum Military Reservation boiler is expected to take 3 years to complete. Included in the project would be a demonstration to show that the bogland could be returned to an agricultural or silvacultural state or converted to a wildlife refuge.

Near yearend, DEC continued reviewing comments on a proposed peat harvesting operation near the Warren County Airport. In 1982, Adirondack Sod & Peat Farm Inc. applied for a permit to mine a 328-acre site near the town of Queensbury. Because the proposed site is a freshwater wetland, an Environmental Impact Statement was required in accordance with DEC regulations. DEC will review the application with its water-quality and wildlife departments and then notify the town of Queensbury if any significant problems might arise as the result of the mining.

Perlite (Expanded).—Crude perlite, mined in other States, was shipped into New York and expanded by the Buffalo Perlite Div. of Pine Hill Concrete Mix Corp., Erie County, and by Scolite International Corp., Rensselaer County. The U.S. Gypsum plant at Oakfield in Genessee County was inactive during the year. Both quantity and sales dropped substantially in 1983 compared with 1982 figures. Expanded perlite was used in lightweight acoustical building plaster, loose-fill insulation, soil conditioning, and filtration.

Salt.—New York continued to rank third, behind Louisiana and Texas, in quantity of salt sold and used and second in value behind Louisiana. The State produced 14% of the Nation's total. Sales amounted to 4.9 million short tons valued at $100.1 million, a decrease of 22% in quantity and a 15% drop in value. Both rock salt and brine were produced by five companies with several operations in five counties. Rock salt was produced by Cargill Inc., which operated an underground mine in Tompkins County and by International Salt Co. at its Retsof un-

derground mine in Livingston County. Brine and evaporated salt were also produced by Allied Chemical in Onondaga County, Cargill and International Salt in Schuyler County, and Morton Thiokol Inc. and Hooker Chemical Corp. in Wyoming County. Rock salt was used mainly for snow and ice removal; the evaporites and brine were used in the manufacture of soda ash, chlorine, and other chemicals.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Based on these estimates, output and value of construction sand and gravel increased nearly 8% and 16%, respectively. In 1982, more than 300 companies or townships mined construction sand and gravel at 357 operations. Leading counties, in order of output, were Cattaraugus, Suffolk, Dutchess, Rensselaer, and Erie. Construction sand and gravel was sold mainly for road base and coverings, concrete aggregate, and fill.

Industrial.—Whitehead Bros. Co. was the only industrial sand producer in New York. The company operated two pits, one in Oneida County and the other in Saratoga County. Production and value increased in 1983. All of the material produced at the Oneida operation was shipped by truck; the majority of the industrial sand produced in Saratoga County was shipped by rail. Major uses were for moldings and foundry use.

Table 4.—New York: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	NA	NA	NA
Gravel	NA	NA	NA	NA	NA	NA
Sand and gravel (unprocessed)	NA	NA	NA	NA	NA	NA
Total or average	r17,338	r$46,871	r$2.70	e18,700	e$54,200	e$2.90
Industrial sand	45	512	11.45	W	W	11.45
Grand total or average	r17,383	r47,383	r2.73	W	W	W

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data.

Slag, Iron.—Only one company, Buffalo Crushed Stone Corp., processed air-cooled iron (blast furnace) slag in 1983. Although output decreased nearly 6% compared with that of 1982, value of slag sales rose more than 6%. The slag was utilized mainly by the construction industry as substitutes for natural aggregates and other construction materials. Main uses were for road base, asphaltic concrete aggregate, fill, and railroad ballast.

Sodium Carbonate (Synthetic).—New York continued to be the only State that produced synthetic sodium carbonate. Allied Chemical operated a 700,000-short-ton-per-year-capacity plant at Syracuse. Chemical-grade limestone was mined south of Syracuse and chemically treated at the plant to produce the synthetic material. Primary uses were for the manufacture of glass, chemicals, and paper, and for leather tanning and water treatment purposes.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Crushed stone accounted for 27% of the State's total value of nonfuel mineral production. In 1983, both quantity and value increased nearly 13% and 4%, respectively, compared with that of 1982. Limestone was the leading type of crushed stone produced, accounting for nearly 89% of the State's production. Other types of crushed stone included traprock, sandstone, granite, and dolomite. A total of 48 companies operated 78 operations in 36 counties. Leading counties, in order of output, were Onondaga, Rockland, Dutchess, Erie, and Niagara. Main uses for crushed stone were for road base, bituminous aggregate, cement manufacture, and fill.

Table 5.—New York: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	171	974
Riprap and jetty stone	500	2,414
Filter stone	81	291
Coarse aggregate, graded:		
Concrete aggregate, coarse	2,087	7,954
Bituminous aggregate, coarse	4,453	26,397
Bituminous surface-treatment aggregate	845	6,403
Railroad ballast	223	951
Fine aggregate (-3/8 inch):		
Stone sand, concrete	281	1,252
Stone sand, bituminous mix or seal	637	2,738
Screening, undesignated	41	179
Coarse and fine aggregate:		
Graded road base or subbase	4,578	17,837
Unpaved road surfacing	1,311	6,105
Crusher run or fill or waste	2,870	10,206
Other coarse and fine aggregate	W	8
Agricultural: Agricultural limestone	206	1,765
Special: Roofing granules	W	3
Other[2]	14,046	52,507
Total[3]	32,331	137,982

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1]Includes limestone, dolomite, granite, sandstone, traprock, and miscellaneous stone.

[2]Includes stone used for other agricultural uses, cement manufacture, flux stone, chemical stone for alkali works, drain fields, uses not specified, and uses indicated by symbol W.

[3]Data do not add to totals shown because of independent rounding.

Dimension.—Dimension stone production in 1983 amounted to 23,552 short tons (292,000 cubic feet) valued at $4.3 million. This represents an increase of 9% in output and 88% in value. In 1983, 14 companies operated 19 quarries in the State. Washington County had the most quarries (8) followed by Albany (3), and Delaware (3). Essex, Franklin, Orleans, Tompkins, and Westchester Counties each had one operating quarry. Leading producers, in terms of tonnage, were Medina Sandstone Quarry Inc., Orleans County; Lake Placid Granite Co., Essex County; Stone Culture Inc., Albany County; Ritchie Bros. Slate Co. Inc., Washington County; and Johnston & Rhodes Bluestone Co., Delaware County. Types of stone quarried were sandstone, granite, and slate.

Table 6.—New York: Dimension stone[1] sold or used by producers in 1983, by use

Use	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Rough stone: Irregular-shaped stone	11,586	149	$228
Dressed stone:			
Ashlars and partially squared pieces	4,401	54	1,071
Flagging	3,242	39	1,318
Roofing slate	1,620	18	643
Flooring slate	1,086	12	412
Other[2]	1,617	20	638
Total	23,552	292	4,310

[1]Includes granite, sandstone, and slate.

[2]Includes rough blocks for building and construction, dressed slabs and blocks for building and construction, structural and sanitary dressed stone, and uses not specified.

Talc.—New York continued to rank fourth of 11 States that produced talc in 1983. The Gouverneur Talc Co. Inc., a subsidiary of R. T. Vanderbilt Co. Inc., was the sole producer in the State, operating two mines near Fowler, St. Lawrence County. Three main types of ore were produced—"hard" and "ceramic" for use in the ceramics industry and "medium" for use in paint.[4] A second company, Clark Minerals Inc., Jefferson County, milled purchased talc for use mainly in cosmetics and in the manufacture of rubber and plastics.

Vermiculite (Exfoliated).—W. R. Grace & Co., Construction Products Div., shipped vermiculite into the State for exfoliation at

its plant in Weedsport, Cayuga County. In 1983, both output and value increased 10% and 3%, respectively, compared with those of 1982. The product was primarily used for loose-fill insulation, block insulation, horticulture, agriculture, lightweight concrete aggregate, and soil conditioning.

Wollastonite.—New York was one of only two States that produced wollastonite and accounted for virtually all of the Nation's output. A small amount was also produced in California. Wollastonite ($CaSiO_3$), a white to yellowish-brown mineral, has a theoretical composition of 48.3% CaO and 51.7% SiO_2, but iron, magnesium, or manganese may substitute for part of the calcium.[5]

The State's production was centered on the northeastern flank of the Adirondack Mountains. Two companies produced wollastonite in the State. The largest producer, NYCO, a division of Processed Minerals, operated the underground Willsboro Mine and the Lewis surface operation, both in Essex County. R. T. Vanderbilt, the State's other producer, operated the Valentine underground mine in Lewis County. Wollastonite was used as a filler in ceramics, plastics, paint, resins, and other materials.

METALS

Aluminum.—New York continued to rank second behind Washington in the output and value of primary aluminum. In 1983, both output and value remained essentially the same as that of 1982. Two companies produced primary aluminum in the State. Alcoa and Reynolds Metals Co. both operated plants in Massena. Alcoa's capacity was rated at 226,000 short tons per year, while Reynolds' capacity was 126,000 tons annually. At yearend, both plants were operating at full capacity.

In May, Alcoa announced that it would spend more than $10 million in the next 2 years to install modern technology to make its Massena installation more competitive. The company will install a state-of-the-art continuous casting and rolling mill to produce aluminum rod, which is sold to the makers of such goods as rivets and window screens. The new machinery, a combination of U.S. and foreign technology, was ordered and should be installed and operational by early 1985. Alcoa spent $174 million in Massena for improvements during the mid-1970's.

Also in May, Kaiser Aluminum & Chemical Corp. sold its Woodbury extrusion plant, which supplied the construction and transportation markets, to Davidson Aluminum & Metals Corp., Long Island. Davidson Aluminum is a distributor of Kaiser mill products.

Ferroalloys.—New York ranked eighth of 17 States that shipped ferroalloys in 1983. Shipments rebounded somewhat in 1983, increasing 36% in output and 35% in value over those of 1982. However, this was far below the prerecessionary levels and before the iron and steel industries recorded their worst years. The State's three producers were Elkem Metals Co., SKW Alloys Inc., and Union Carbide Corp., all located in Niagara Falls.

Iron Ore.—At yearend, Star Lake Minerals Corp., a subsidiary of Exore Corp., Buffalo, announced plans to reopen the former Jones & Laughlin Steel Corp. (J&L) Benson iron ore mine at Star Lake. Exore planned to reopen the mine in 1984 with 150 people on its payroll by 1985. The first stages of the operation in 1984 will utilize ore left over from the J&L operation. About 30 persons will be employed as Star Lake Minerals begins filling its first order, which will be shipped to a coal cleaning plant. At its startup, the company plans to set up a plant capable of processing 20 long tons per hour. Future plans also call for the building of a briquetting plant at the site and a full-scale mining operation with an annual output of 1.2 million tons of ore by 1987.

Williams Strategic Metals Inc., a subsidiary of Williams Resources Inc. of Tulsa, OK, purchased the Mineville iron ore mine and concentrating facility from Republic Steel Corp. of Cleveland, OH. The Mineville complex had been closed since 1971. Williams Resources, a producer of specialty metals, has begun laboratory tests on the feasibility of recovering yttrium and other rare earths and magnetite from iron ore tailings accumulated during Republic Steel's former mining and processing activities.

Iron and Steel.—In 1983, both pig iron shipments and raw steel production declined in New York. Raw steel production declined from 1.4 million short tons in 1982 to 1.3 million tons in 1983.

Year	Raw steel production (million short tons)	
	New York	U.S.
1979	4.0	136.3
1980	2.7	111.8
1981	3.1	120.8
1982	1.4	74.6
1983	1.3	84.6

Source: American Iron and Steel Institute (AISI).

Production continued to remain at far less than capacity because demand for steel decreased or those companies utilizing the steel had excess inventories. Also, much of the steel industry was unprofitable, which necessitated that some of the older plants either close or cut back operations.

Republic Steel, which temporarily shut down the Buffalo steel mill in 1982, except for a few maintenance workers, permanently closed the inactive plant in 1983. Also in October, steelmaking operations ceased at Bethlehem Steel's Lackawanna plant near Buffalo. The massive plant at one time produced 13 million tons of raw steel annually and employed nearly 21,000 workers. At yearend, only the 13-inch bar mill and galvanizing mill, which employs 1,300 people, remained open. Bethlehem Steel plans to produce steel at more modern plants located in other States. The closing of the steel plant also resulted in closure of the company's lime-producing facility located nearby. In December, U.S. Steel announced massive cutbacks at most of its plants in the United States. Among the cutbacks and closures, the company announced that it was closing its fabrication plant in Elmira.

Lead and Silver.—St. Joe Resources Co., a unit of Fluor Corp., recovered both lead and silver as a byproduct of zinc mining operations in the Balmat area in the northern part of the State. Lead production increased nearly 22% in 1983 to 1,299 metric tons, while value increased nearly 4%. Output of silver recovered during the lead processing increased from 27,000 to 33,000 troy ounces. Value also increased from $216,000 in 1982 to $379,000 in 1983.

Titanium Concentrate.—Ilmenite concentrate was produced by NL Industries Inc. at its Tahawus facility in Essex County. Production decreased drastically, down 85%, in 1983 following the 1982 closure of the company's titanium dioxide pigment plant in Sayreville, NJ, which had utilized the Tahawus concentrate.

Zinc.—New York continued to rank third, behind Tennessee and Missouri, in zinc production in 1983. St. Joe Resources operated the Balmat, Hyatt, and Pierrepont Mines in St. Lawrence County. The Balmat and Pierrepont Mines were the Nation's second and eighth leading zinc-producing mines, respectively. Production increased from 52,237 metric tons in 1982 to 56,748 tons in 1983. This increase was due to a full year's production in 1983 compared with a production of only 7 or 8 months in 1982. All of the ore was milled at the company's Balmat mill. The concentrates were either shipped to St. Joe Resources' Monaca, PA, zinc smelter or exported to Canada and Europe.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.
[2]Harben, P. W., and R. L. Bates. Geology of the Nonmetallics. Metal Bulletin Inc., 1984, p. 365.
[3]Pit and Quarry. Calcium Chloride Puts Damper on Dust at Allied Quarry. V. 75, Apr. 1983, p. 81.
[4]Page 339 of work cited in footnote 2.
[5]Pages 368-369 of work cited in footnote 2.

Table 7.—New York: Mine production (recoverable) of silver, lead, and zinc

		1982	1983
Mines producing: Lode		3	3
Material sold or treated: Zinc ore	thousand metric tons	647	683
Production:			
Quantity:			
Silver	troy ounces	27,212	33,137
Lead	metric tons	1,065	1,299
Zinc	do.	52,237	56,748
Value:			
Silver	thousands	$216	$379
Lead	do.	$600	$621
Zinc	do.	$44,303	$51,783
Total	do.	$45,119	$52,783

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives (manufactured):			
The Carborundum Co.[1]	Box 423 Niagara Falls, NY 14302	Plant	Niagara.
General Abrasives Div. of Dresser Industries Inc.	2000 College Ave. Niagara Falls, NY 14305	do	Do.
Pellets Inc	531 South Niagara St. Tonawanda, NY 14150	do	Erie.
Aluminum:			
Aluminum Co. of America	1210 Alcoa Bldg. Pittsburgh, PA 15222	do	St. Lawrence.
Reynolds Metals Co	Box 27003-2A Richmond, VA 23215	do	Do.
Cement:			
Atlantic Cement Co. Inc., a subsidiary of Newmont Mining Corp.[2]	Box 30 Stamford, CT 06904	Quarry and plant.	Albany.
The Glens Falls Portland Cement Co. Inc., a subsidiary of Moore McCormack Resources Inc.[2]	Box 440 Glens Falls, NY 12801	Quarries and plants.	Schoharie and Warren.
Lehigh Portland Cement Co.[2]	718 Hamilton Mall Allentown, PA 18105	Quarry and plant.	Greene.
Lone Star Industries Inc.[3]	1 Paragon Dr., Box 432 Montvale, NJ 07645	do	Do.
Clays:			
Northeast Solite Corp., a subsidiary of Solite Corp.	Box 27211 Richmond, VA 23261	Pit	Ulster.
Powell & Minnock Inc., General Dynamics Corp.	Coeymans, NY 12045	Pits	Albany.
Emery:			
De Luca Emery Mine Inc	929 Constant Ave. Peekskill, NY 10566	Pit	Westchester.
John Leardi Emery Mine	Gillman Lane Peekskill, NY 10566	Pit	Do.
Garnet:			
Barton Mines Corp	North Creek, NY 12853	Pit	Warren.
Gypsum:			
Georgia-Pacific Corp	Box 311 133 Peachtree St., NE. Atlanta, GA 30303	Plant	Westchester.
National Gypsum Co.[4]	4100 1st International Bldg. Dallas, TX 75270	do	Rensselaer.
United States Gypsum Co.[4]	101 South Wacker Dr. Chicago, IL 60606	Underground mines and plants.	Genesee and Rockland.
Iron ore:			
NL Industries Inc.[5]	Tahawus, NY 12879	Pit	Essex.
Lime:			
Allied Chemical Corp.[3 6]	Box 70 Morristown, NJ 07960	Quarry and plant.	Onondaga.
Peat:			
Good Earth Organics Corp	5960 Broadway Lancaster, NY 14086	Bog	Cattaraugus.
Hyponex Corp	20135 Anthony Blvd. Fort Wayne, IN 46803	Bog	Dutchess.
Perlite (expanded):			
Buffalo Perlite Div. of Pine Hill Concrete Mix Corp.	100 Sugg Rd. Cheektowaga, NY 14225	Plant	Erie.
Salt:			
Cargill Inc	Box 9300 Minneapolis, MN 55402	Underground mine.	Tompkins.
International Salt Co	Clarks Summit, PA 18411	do	Livingston.
Morton Thiokol Inc	110 North Wacker Dr. Chicago, IL 60606	Well	Wyoming.
Sand and gravel:			
Roanoke Marbro Sand & Gravel Corp	Box 23 Middle Island, NY 11953	Pit	Suffolk.
Valente Gravel Inc	Box 56, R.D. 5 Troy, NY 12180	Pits	Albany and Rensselaer.
Slag, iron:			
Buffalo Crushed Stone Corp.[3]	111 Great Arrow Ave. Buffalo, NY 14216	Plants	Allegany, Cattaraugus, Steuben.
Stone:			
Crushed:			
The General Crushed Stone Co., a subsidiary of Koppers Co. Inc.	Box 231 Easton, PA 18042	Quarries	Herkimer, Jefferson, Livingston, Onondaga, Ontario, Wayne.
New York Trap Rock Corp., a subsidiary of Lone Star Industries Inc.	Box 432 Montvale, NJ 07645	Quarry	Rockland.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Dimension:			
Darius Slate Products Inc	Box 4 Middle Granville, NY 12849	Quarry	Washington.
Heldeberg Bluestone & Marble Co	Box 36 East Berne, NY 12059	Quarries	Albany and Delaware.
Hilltop Slate Co	Middle Granville, NY 12849	Quarry	Washington.
Johnson & Rhodes Bluestone Co	East Branch, NY 13756	do	Delaware.
Lake Placid Granite Co	202 South 3rd Ave. Cold Spring, MN 56320	do	Essex.
Medina Sandstone Quarry Inc	8875 Quarry Rd. Niagara Falls, NY 14304	do	Orleans.
Ritchie Bros. Slate Co. Inc	Main St. Middle Granville, NY 12849	Quarries	Washington.
Stone Culture Inc	Box 43, Route 111 Alcove, NY 12007	do	Albany.
Talc:			
Gouverneur Talc Co. Inc., a subsidiary of R. T. Vanderbilt Co. Inc.	Gouverneur, NY 13642	Underground mine.	St. Lawrence.
Wollastonite:			
NYCO Div. of Processed Minerals Inc.[7]	Box 368 Willsboro, NY 12996	Underground and surface mines.	Essex.
R. T. Vanderbilt Co. Inc	30 Winfield St. Norwalk, CT 06855	Surface mine	Lewis.
Zinc:			
St. Joe Resources Co.[8]	250 Park Ave. New York, NY 10017	Mines	St. Lawrence.

[1]Also synthetic mullite and synthetic graphite.
[2]Also clays.
[3]Also stone.
[4]Also expanded perlite.
[5]Also ilmenite.
[6]Also salt.
[7]Also garnet.
[8]Also lead and silver.

The Mineral Industry of North Carolina

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Division of Land Resources, North Carolina Department of Natural Resources and Community Development, for collecting information on all nonfuel minerals.

By Doss H. White, Jr.,[1] and P. Albert Carpenter III[2]

The value of nonfuel mineral production in North Carolina in 1983 was $399 million, an increase of $100 million over the value reported in 1982. Mineral sales remained below the record high set in 1981 by $34 million as the State recovered from the longest recession since the end of World War II.

North Carolina continued to lead the world in the production of lithium minerals and ranked first in the United States in the mining of feldspar, scrap mica, olivine, and pyrophyllite. The State ranked second in the production of common clay and crushed granite and third in phosphate rock.

Table 1.—Nonfuel mineral production in North Carolina[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] thousand short tons	1,573	$5,243	2,068	$6,681
Feldspar short tons	428,755	12,255	508,641	13,610
Gem stones	NA	50	NA	50
Mica (scrap) thousand short tons	67	4,793	69	4,266
Sand and gravel:				
Construction do.	5,198	15,395	e5,600	e16,900
Industrial do.	716	4,878	1,066	11,689
Stone:				
Crushed do.	e27,500	e117,600	33,694	145,602
Dimension do.	e30	e2,814	87	8,267
Talc and pyrophyllite do.	83	1,266	89	1,452
Combined value of cement, clays (kaolin), lithium compounds, olivine, peat, and phosphate rock	XX	r135,142	XX	190,641
Total	XX	r299,436	XX	399,158

eEstimated. rRevised. NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes kaolin; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in North Carolina, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Alamance	W	$104	Clays.
Anson	$4,129	W	Sand and gravel (construction), sand and gravel (industrial).
Ashe	W	(2)	
Avery	2,928	W	Clays, mica.
Beaufort	W	W	Phosphate rock, sand and gravel (construction).
Bertie	(3)	W	Sand and gravel (construction).
Bladen	(3)	51	Do.
Brunswick	(3)	--	
Buncombe	W	740	Sand and gravel (construction), clays.
Burke	305	27	Sand and gravel (construction).
Cabarrus	W	W	Clays, sand and gravel (construction).
Caldwell	489	W	Sand and gravel (construction).
Camden	(3)	4	Do.
Caswell	W	(2)	
Catawba	W	(2)	
Chatham	869	940	Clays.
Cherokee	905	W	Talc.
Chowan	(3)	W	Sand and gravel (construction).
Cleveland	r40,476	30,367	Lithium, feldspar, mica, sand and gravel (industrial), clays, sand and gravel (construction).
Craven	W	W	Sand and gravel (construction).
Cumberland	(3)	643	Do.
Currituck	(3)	W	Do.
Dare	(3)	W	Do.
Davidson	W	W	Clays.
Davie	W	212	Sand and gravel (construction).
Duplin	W	(2)	
Durham	W	W	Clays.
Edgecombe	W	275	Sand and gravel (construction).
Forsyth	W	(2)	
Franklin	(3)	W	Sand and gravel (construction).
Gaston	r54,579	41,233	Lithium, mica, feldspar, sand and gravel (construction).
Greene	(3)	W	Sand and gravel (construction).
Guilford	W	W	Clays, sand and gravel (construction).
Halifax	125	W	Clays.
Harnett	W	W	Sand and gravel (construction), clays.
Haywood	1,073	1,010	Sand and gravel (construction).
Henderson	W	W	Clays.
Hertford	(3)	W	Sand and gravel (construction).
Hyde	(3)	95	Peat, sand and gravel (construction).
Iredell	2,128	W	Clays, sand and gravel (construction).
Jackson	W	W	Olivine, sand and gravel (construction).
Johnston	W	W	Sand and gravel (construction).
Jones	98	(2)	
Lee	W	456	Clays, sand and gravel (construction).
Lenoir	(3)	W	Sand and gravel (construction).
McDowell	W	430	Do.
Macon	1,406	W	Do.
Martin	(3)	14	Do.
Mecklenburg	W	(2)	
Mitchell	W	11,149	Feldspar, mica, sand and gravel (industrial), olivine.
Montgomery	99	W	Sand and gravel (construction), clays.
Moore	W	807	Talc, clays, sand and gravel (construction).
New Hanover	W	W	Cement, clays, sand and gravel (construction).
Northampton	(3)	W	Sand and gravel (construction).
Onslow	W	(2)	
Orange	W	W	Talc.
Pasquotank	(3)	W	Sand and gravel (construction).
Pender	572	(2)	
Pitt	W	244	Sand and gravel (construction).
Randolph	W	(2)	
Richmond	W	W	Sand and gravel (industrial), sand and gravel (construction).
Rockingham	W	W	Clays, sand and gravel (construction).
Rowan	W	W	Do.
Rutherford	W	(2)	
Sampson	122	--	
Scotland	(3)	W	Sand and gravel (construction).
Stanly	1,330	513	Clays.
Stokes	158	125	Clays, sand and gravel (construction).
Surry	3,473	W	Sand and gravel (construction).
Swain	367	(2)	
Transylvania	W	(2)	
Tyrrell	(3)	3	Sand and gravel (construction).
Union	W	243	Clays.
Vance	W	(2)	

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in North Carolina, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Wake	$10,775	W	Clays.
Washington	(3)	$28	Sand and gravel (construction), peat.
Watauga	1,079	(2)	
Wayne	(3)	357	Sand and gravel (construction).
Wilkes	W	(2)	
Wilson	W	(2)	
Yadkin	(3)	W	Sand and gravel (construction).
Yancey	W	W	Mica, sand and gravel (construction).
Undistributed[4]	287,445	88,953	
Sand and gravel (construction)	e18,330	XX	
Stone:			
Crushed	XX	e117,600	
Dimension	XX	e2,814	
Total	r433,260	5299,436	

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Alexander, Alleghany, Carteret, Clay, Columbus, Gates, Graham, Granville, Hoke, Lincoln, Madison, Nash, Pamlico, Perquimans, Person, Polk, Robeson, and Warren. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Stone, either crushed or dimension, was produced; data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of North Carolina business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,919.8	2,930.6	+0.4
Unemployment	do	330.9	236.7	-28.5
Employment (nonagricultural):				
Mining	do	4.2	4.3	+2.4
Manufacturing	do	765.4	806.4	+5.4
Contract construction	do	98.2	112.6	+14.7
Transportation and public utilities	do	117.0	119.8	+2.4
Wholesale and retail trade	do	478.6	513.7	+7.3
Finance, insurance, real estate	do	98.1	102.3	+4.3
Services	do	354.9	361.3	+1.8
Government	do	412.8	416.3	+.8
Total nonagricultural employment	do	2,329.2	2,436.7	+4.6
Personal income:				
Total	millions	$54,433	$58,725	+7.9
Per capita		$9,048	$9,656	+6.7
Construction activity:				
Number of private and public residential units authorized		33,326	50,130	+50.4
Value of nonresidential construction	millions	$886.7	$1,625.6	+83.3
Value of State road contract awards	do	$145.6	$202.5	+39.1
Shipments of portland and masonry cement to and within the State	thousand short tons	1,532	1,668	+8.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$299.4	$399.2	+33.3
Value per capita, resident population		$43	$66	+53.5
Value per square mile		$4,892	$7,579	+54.9

pPreliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

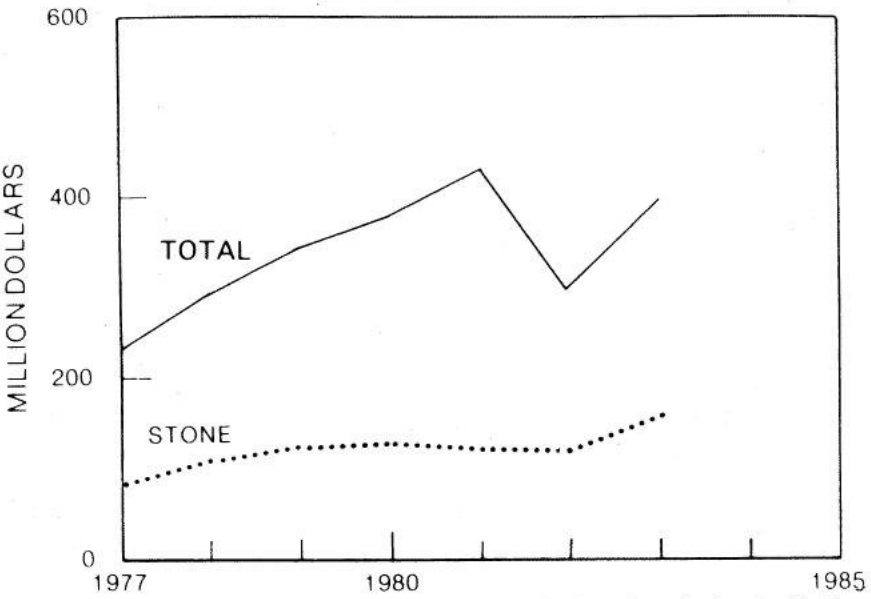

Figure 1.—Value of stone and total value of nonfuel mineral production in North Carolina.

Trends and Developments.—During the decade of the 1970's, the value of nonfuel mineral production in North Carolina increased from $99 million in 1970 to $342 million in 1979; mineral value for the 10-year period totaled $2 billion. In 1981, the State's mineral output was valued at a record-high $433 million.

However, in 1982, as the effects of the nationwide economic downturn began to be felt in North Carolina, mineral commodity sales started to decline significantly from the record high, and in 1982, plummeted $134 million below the 1981 level. During the third and fourth year of the 1980's (1982-83), North Carolina mineral producers lost over $167 million in sales when compared with the 1981 record-high year. The State lost several million in revenue from the mining and mineral processing operations and hundreds of mining personnel were faced with the spector of unemployment or shortened workweeks and reduced paychecks.

In November 1982, the National Bureau of Economic Research noted that the upward trend of the major economic indicators signaled the recession's end. In 1983, the North Carolina mineral industry made a phenomenal recovery and sales reached a new record high. By yearend 1983, developments in several segments of the mineral industry mirrored the economic upswing.

In July, the Aluminum Co. of America (Alcoa), which operates an aluminum smelter at Badin in west-central North Carolina, reactivated the last pot on a line that had been deactivated in May 1981, because of the recession and slackened demand for aluminum products. The smelter had been operating at 50% capacity until June when output was raised to 75%. The June and July actions resulted in the recall of 110 workers, raising employment to approximately 625.

Earlier in the year, Teledyne Allvac began operation of a new $20 million forging facility in Monroe. The facility can form bars, rounds, squares, and other shapes from the nickel and titanium alloys produced by the company.

Although the economic doldrums had a sombering effect on domestic fertilizer demand, foreign exports were an important part of Texasgulf Chemical Co.'s phosphate marketing plans. In June, 65,000 tons of calcined and uncalcined phosphate rock and triple superphosphate was loaded aboard

ship at the Morehead City State Port destined for Le Havre, France. This was the largest shipment of phosphate to pass through the two ports.

In other phosphate-related activity, the Carteret County Commissioners denied a special use permit requested by Texasgulf to construct a $10 million, 30,000-short-ton-capacity liquid anhydrous ammonia storage facility in the port industrial zone on Radio Island. In rejecting the permit, the council cited possible environmental and safety hazards. Following the rejection, Texasgulf reviewed alternative sites; the company hoped to site the ammonia storage facility as close as feasible to the fertilizer manufacturing complex at Lee Creek.

In other mineral activity, the State's largest industrial sand producer, Carolina Silica Inc. at Marston in the southeastern part of North Carolina, was acquired by Unimin Corp. of New Canaan, CN. The Marston plant supplies glass sand to a nearby plate glass manufacturing facility. The acquisition makes Unimin the third-ranked producer of industrial sand in the United States. Unimin has announced plans to spend several million dollars to expand the Marston plant.

A major market for North Carolina's glass sand producers is developing in Norwood where work is ongoing on the new plant of the Carolina Glass Works. The new facility, scheduled for completion in March 1984, will manufacture pharmaceutical glass containers. Carolina Glass Works is a division of Wheaton Industries.

The processing and/or use of a variety of mineral commodities imported from out-of-State sources continued as a basic step in the manufacturing process of a number of North Carolina manufacturing companies. Several of the mineral commodities processed or used, point of origin, and major end use are as follows:

Mineral commodity	Origin	Major use
Alumina	Alabama	Aluminum manufacture.
Clays	Ohio	Refractories manufacture.
Colemanite	Turkey	Fiberglass manufacture.
Gypsum	Canada	Wallboard manufacture.
Iodine	Japan	X-ray contrast medium.
Manganese ore.	South Carolina.	Brick colorant.
Perlite	New Mexico.	Concrete and/or plaster manufacture.
Sulfur	Gulf coast	Sulfuric acid manufacture.
Vermiculite	South Carolina.	Insulation.

Exploration Activities.—Although little information appeared in print on premining mineral activity in North Carolina, a number of companies were active in mineral exploration during the year. Favorable geological conditions and a past rich in mining lore were major incentives. A subsidiary of the Colorado-based American Copper and Nickel Co. continued a program that has been ongoing for 5 years in the Carolina slate belt and other areas of the State. Its personnel were active in the Alleghany and Ash County area where copper was mined in the 1800's. Mines were active at Stratford and Ore Knob; the company had leased the mineral rights to 2,400 acres in the Stratford area.[3]

A Canadian firm was exploring for gold in Montgomery County using both core drilling and ultralow frequency sound waves. Corvette Petroleum Co., a Vancouver-based company, was investigating the property of the old Montgomery Mine west of Candor. Along with a second Vancouver firm, Harlin Resources Inc., Corvette entered into a limited partnership with the Uwharrie Corp. with an option to buy 212 acres overlying the Montgomery Mine. Uwharrie spent 3 years assembling a lease package to cover the property and constructed the crushing plant for use by Corvette during the preliminary testing program.[4]

Marline Uranium Corp., a subsidiary of Marline Oil Corp., announced interest in

uranium exploration in Rockingham County. The company has 45,000 acres under lease in Pittsylvania County in Virginia.

Billiton Metals & Ores Inc. and Texasgulf continued work to determine the magnitude of tin resources in Cleveland and Rutherford Counties in the southwestern part of the State. The companies conducted stream sediment and geochemical soil sampling, and core drilled favorable areas identified by the sampling programs. The source of the tin mineralization was identified but proved to be uneconomical at current market conditions.

Legislation and Government Programs.—The North Carolina General Assembly passed a bill, The Control of Uranium Exploration Act of 1983, establishing regulations on uranium exploration, which invokes a multiyear waiting period between the issuance of exploration and mining permits.

Major provisions of the law require that a State exploration permit be issued prior to the disturbance of "any surface soil or submerged tidal soil or submerged tidal and estuarine land." In addition to the exploration permit, a company must post a $5,000 bond and submit a restoration plan prior to active exploration. The regulations require a 3-year waiting period between the time the exploration and mining permits are granted. In comparison, the Mining Act of 1971, which governs other mining activity in North Carolina, requires State action within 60 days after receiving a mining permit application.

In September, a bill was introduced in the U.S. House of Representatives (HR 3960) designating approximately 65,000 acres of national forest lands in North Carolina as additional wilderness and releasing 114,000 acres for multiple-use purposes. Wilderness designation precludes managing the land for multiple-use activity, including mineral extraction.

In June, the U.S. Department of the Interior and Cities Service Co. completed the transfer of 2,343 acres in Swain County within the boundaries of the Great Smoky Mountains National Park to the National Park Service; the purchase price was $1.074 million. Prior to the filling of Fontana Lake in 1944, Cities Service operated a copper mine on the property. The completion of the Fontana Dam and the creation of the lake forced the railroad to relocate track, which effectively closed the mine. Swain County residents questioned the property transfer and were considering court action against the Department of the Interior. The Federal Government owns 84% of the land in the county and citizens were concerned over the effects of the loss of property taxes on the county budget.

During fiscal year 1983, the U.S. Forest Service collected $239,000 from mineral extraction activity in three of the State's national forests.

In November, the U.S. Environmental Protection Agency awarded a $25,000 contract to a Durham firm for a study of methods of cooling molten slag without producing polluting emissions.

The North Carolina Geological Survey (NCGS), a section of the Division of Land Resources, is composed of a group of programs that relate to the survey, evaluation, conservation, development, and protection of the State's land, minerals, and related resources. Regulatory functions include the administration and enforcement of mining, sedimentation pollution control, dam safety, and oil and gas conservation laws.

The Division of Land Resources is subdivided into five sections: (1) Geological Survey, (2) Geodetic Survey, (3) Land Quality, (4) Earth Resources Planning, and (5) Land Resources Information Service.

As part of a cooperative program with the U.S. Geological Survey, preparation of 7-1/2-minute topographic maps continued. The basic coverage is scheduled for completion in 1985. Production of a new State Geologic Map is underway and is scheduled for completion in 1985. Initial planning is underway for three new programs: applied geology reports for selected counties, geologic mapping of State parks, and roadlogs for the interstate highway system. The NCGS maintains offices in Raleigh and Asheville.

Investigations on new and/or improved mineral beneficiation continued at the North Carolina Mineral Laboratory in Asheville. The laboratory, established in the mid-1940's, continued as a leader in the development of mineral beneficiation technology and enjoyed a world reputation in the field of minerals beneficiation.

During 1983, staff members presented several papers to various professional societies in both the United States and in other countries. Among these were papers entitled "Nonmetallic Mineral Processing," "North Carolina: Mineral Producer for the Ceramic Industry," and "Fabrication of Marking Crayons From Powdered Talc." Projects underway or completed during the year involved a variety of mineral commodities; among these were alumina, cassiterite, clay, dolomite, feldspar, olivine, platinum, sand, shale, sphalerite, spodumene, talc, vermiculite, and zirconium.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Ideal Basic Industries Inc. operated a plant at Castle Hayne in southeastern North Carolina. The plant, which ceased production twice in 1982 because of inventory buildup and cash flow problems, remained closed after November 1982, idling over 150 employees. For the first three-quarters of 1983, the plant was operated as a cement shipping terminal supplying eastern North Carolina.

In September, Ideal announced that the company had been unsuccessful in locating a buyer for the facility, and the plant would be closed and plant assets sold. The facility, constructed in 1963, used the energy intensive wet process. High operating costs and highly competitive market conditions, coupled with the downturn in construction activity related to the recession, were cited as the principal factors in the decision to close the facility.

At yearend, Moore McCormack Cement Co. was finalizing plans to purchase a number of Ideal's facilities. Included were the cement terminals in Castle Hayne and Statesville.

Clays.—For the first time in 5 years, the value of clay production in North Carolina increased above the level reported for the previous year. The end of the recession and an upswing in construction activity was the primary factor in the increase. However, sales, excluding kaolin, remained 1.5 million tons and $2.4 million below the record high established in 1978.

Table 4.—North Carolina: Common clay and shale sold or used by producers, by county

County	1982			1985		
	Number of mines	Quantity (short tons)	Value	Number of mines	Quantity (short tons)	Value
Alamance	2	42,591	$103,581	2	70,122	$184,842
Cabarrus and Durham	3	192,792	838,846	3	297,926	1,196,629
Chatham	3	170,841	939,580	3	270,500	1,385,960
Davidson, Guilford, Hanover, Montgomery	6	190,852	673,599	3	144,065	297,919
Iredell and Rockingham	3	241,420	429,458	3	230,908	416,664
Lee and Stanly	6	351,416	884,524	6	532,030	1,345,005
Rowan	4	121,723	740,183	3	156,297	953,416
Union	1	115,495	242,540	1	157,467	330,681
Stokes	1	35,538	98,796	1	35,538	98,796
Undistributed[1]	6	110,700	291,909	6	173,094	471,047
Total	35	1,573,368	5,243,016	31	2,067,947	6,680,959

[1]Includes Buncombe, Halifax, Harnett, Henderson, Moore, Sampson (1983), and Wake Counties.

In 1983, 20 companies operating 46 pits composed the North Carolina clay industry. Excluding two kaolin producers, the majority produced clay and/or shale for brick manufacture.

Many of the brick clay operations mine a saprolite developed from rocks of the Carolina slate belt and Triassic shales in 18 central North Carolina counties. Local clays were mined by one company in Henderson County in western North Carolina and Halifax County in the eastern part of the State. Several companies active in past years did not report production in 1983. Apparently, they did not survive the recession.

Cherokee Brick Co. in Moncure, a specialty shape brick producer, tripled capacity with the installation of two new shaping machines: a platen table to wire cut and set conventionally extruded brick slugs and a hydraulic press, which extrudes a clay slug through a die to form special shapes.

Kaolin was produced as a coproduct of mica beneficiation by Harris Mining Co. in Avery County near Spruce Pine, and by Kings Mountain Mica Co. at Kings Mountain in Cleveland County. Principal sales were to the insulator, ceramics, and specialty brick industries.

Feldspar.—Historically, North Carolina has led the Nation in feldspar production, which is a necessary ingredient in ceramic and glass manufacture. The State was the leader in 1983, and the industry, situated in the Spruce Pine and Kings Mountain-Cherryville areas, rebounded from a 3-year

slump, although sales were 15,000 tons below the 1979 record high.

Although the automotive and construction industries prospered during 1983, which increased the demand for glass fiber and whiteware, the expanding use of plastic containers by the beverage and food industries continued as a major nemesis to increasing feldspar sales.

The industry consists of three primary producers in the Spruce Pine area mining alaskite and using flotation to separate the feldspar from iron minerals, mica, and silica and three secondary producers in the Kings Mountain-Cherryville area producing lithium minerals and mica with feldspar-silica concentrates recovered as a byproduct. North Carolina's feldspar industry is summarized in table 5.

Table 5.—North Carolina: Feldspar industry in 1983

Company	Location	Ore type	Comments
Primary producers:			
The Feldspar Corp	Spruce Pine	Alaskite	Byproduct mica and construction-grade sand.
International Minerals & Chemical Corp.	do	do	Byproduct mica and industrial-grade sand.
Indusmin Inc	do	do	Byproduct mica and construction-grade sand.
Secondary producers:			
Foote Mineral Co	Kings Mountain	Spodumene-rich pegmatite.	Feldspar-silica concentrate from flotation cells.
Kings Mountain Mica Co. Inc	do	Mica-rich pegmatite	Byproduct with mica, clay, and silica recovery.
Lithium Corp. of America Inc	Cherryville	Spodumene-rich pegmatite.	Feldspar-silica concentrate from flotation cells.

Gem Stones.—North Carolina continued as the principal eastern State in the output of gem material and mineral specimens. Dozens of small mining operations in the western part of the State are open to interested collectors on a fee basis and provide the opportunity to collect a variety of precious and semiprecious stones at a minimal cost.

In August, an Elkview resident discovered a 307-1/2 carat ruby-sapphire combination stone at a mine on Cater Creek in the Cowee Valley. Uncut, the stone was valued at $3,000; cut, it could yield a 75-carat ruby and four sapphires worth approximately $20,000.

Principal gem stones and gem stone areas in western North Carolina are as follows:

County	Nearest city	Principal gem stones
Alexander	Hiddenite.	Emeralds and hiddenite.
Macon	Franklin	Rubies, sapphires, garnets.
Mitchell	Spruce Pine.	Emeralds and aquamarine.

In August, the Mitchell County Chamber of Commerce held its annual Mineral and Gem Festival in Spruce Pine. Exhibits, mine tours, mineral lectures, and gem and mineral sales were part of the 4-day festival.

Gypsum.—National Gypsum Co., Wilmington, imported Canadian gypsum as raw material for wallboard manufacture. In the wallboard manufacturing process, ground gypsum in slurry form is combined with additives and an accelerator and spread between moving sheets of paper. After rolling and edge molding, the board continues on a conveyor system until the material has set. The board is then cut into standard lengths and kiln dried.

Texasgulf Inc.'s wet-process phosphate fertilizer manufacturing facility at Lee Creek produced byproduct gypsum. A limited amount was sold for soil conditioning; the remainder was stockpiled.

Lithium.—The State continued as the world leader in the output of lithium, and production increased as the aluminum, glass, grease, and other lithium-dependent industries recovered from the effects of the economic slowdown. North Carolina's lithium production is divided between two companies—Foote Mineral Co., Kings Mountain, a subsidiary of Newmont Mining Corp., and Lithium Corp. of America Inc.

(Lithcoa), Gastonia, a subsidiary of Gulf Resources & Chemical Co.

Foote has developed a surface mine in a spodumene-rich pegmatite to supply head feed for a beneficiation and granular lithium carbonate plant. Several grades of spodumene concentrate are produced, a portion going to the lithium carbonate plant and additional tonnages being shipped to company-owned lithium chemical plants in Frazer, PA; New Johnsonville, TN; and Sunbright, VA. Some spodumene concentrate is sold directly to the ceramics industry.

In August of 1982, Foote closed the 18-million-pound-per-year lithium carbonate plant when production outstripped demand. The facility was reopened in 1983 to replenish depleted inventories after a 7-month closure.

Lithcoa operates surface mines near Bessemer City, a beneficiation facility, lithium carbonate plant, and lithium metal facility. The company markets lithium carbonate for a variety of applications and uses a portion in its lithium metal operation.

Mica.—For several decades North Carolina has led the United States in the production of scrap mica. In 1983, the State accounted for 66% of the value of the Nation's output. Production was from four companies mining mica in the Spruce Pine-Micaville-Kings Mountain area, three primary feldspar producers and two lithium producers. Pertinent data on North Carolina mica producers and fabricators is given in table 6.

Both wet- and dry-ground mica was produced and sales of both increased in 1983. The major market for wet-ground mica was for use in paints, and the major use for dry-ground mica was in wallboard joint cement.

At yearend 1982, Mitchell Mining & Manufacturing Inc., the newest wet-ground mica producer in the Spruce Pine area, was purchased by J. M. Huber Corp. During 1983, the Mitchell facility was used for test grinding, and at yearend, Huber officials were considering plans for a new mine and grinding facility in the Kings Mountain area.

Table 6.—North Carolina: Mica industry in 1983

Company	Location	Grinding process	Comments
Producers (mica):			
Harris Mining Co	Spruce Pine	Dry	Primary mica.
Deneen Mica Co	do	Dry	Do.
The Feldspar Corp	do	XX	Byproduct mica; sold to United States Gypsum Co.
Foote Mineral Co	Kings Mountain	XX	Byproduct mica; sold to Asheville Mica Co.
International Minerals & Chemical Corp.	Spruce Pine	XX	Byproduct mica; sold to Harris Mining Co.
Kings Mountain Mica Co. Inc	Kings Mountain	Dry and wet	Primary mica.
Lawson-United Feldspar & Minerals Co.	Spruce Pine	XX	Byproduct mica; sold to Harris Mining Co.
Lithium Corp. of America Inc	Cherryville	XX	Byproduct mica; sold to various firms.
Mitchell Mining & Manufacturing Inc.	Spruce Pine	Wet	Processes mica schist and scrap from mica fabricators.
Producers (sericite):			
Piedmont Minerals Co	Hillsboro	XX	Sold to brick and ceramics industries.
Processors of purchased mica:			
Asheville Mica Co	Asheville	Dry.	
Diamond Mica Co	Spruce Pine	Dry.	
Franklin Mineral Co	Franklin	Wet	Mica received from Georgia.
United States Gypsum Co	Spruce Pine and Kings Mountain.	Dry	Mica purchased from feldspar and lithium producers.
Fabricators:			
Spruce Pine Mica Co	Spruce Pine	XX	Mica obtained from foreign sources.
Tar Heel Mica Co	Plum Tree	XX	Do.

XX Not applicable.

Table 7.—North Carolina: Ground mica sold or used by producers, by use

Use	1982		1983	
	Quantity (short tons)	Value	Quantity (short tons)	Value
Paint	W	W	W	W
Well drilling	W	W	11,537	$1,294,158
Joint cement	27,156	$4,435,504	38,523	6,344,452
Other[1]	34,307	7,349,148	16,615	5,587,585
Total	61,463	11,784,652	66,675	13,226,195

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes insulation, plastics, roofing, rubber, textile coatings, welding rods, other miscellaneous uses, and uses indicated by symbol W.

Olivine.—North Carolina continued as the leading State and one of only two that produced olivine—magnesium silicate used in mold construction by the foundry industry. The recession-related slump in the steel and foundry industries severely depressed demand for North Carolina olivine. However, demand and sales increased in 1983 as new orders were received by the metal industries.

Three companies comprise the State's olivine industry. Data on these producers is given in table 8.

Table 8.—North Carolina: Olivine producers

Company	Location	Process
International Minerals & Chemical Corp.	Eddie and Burnsville.	Wet.
National Olivine	Dillsboro	Wet.
Spruce Pine Olivine Co	Spruce Pine	Dry.

Phosphate Rock.—The State continued to rank third behind Florida and Idaho in phosphate rock output. The worldwide recession reduced the demand for marketable phosphate rock, calcined rock, and fertilizers, but signs of recovery were evident during 1983. Texasgulf was the only company mining phosphate in the State, but work continued on North Carolina Phosphate Co.'s (NCPC) mine and calcining facility adjacent to the Texasgulf complex at Lee Creek, and NCPC is scheduled to begin stripping in 1985 or 1986. NCPC is scheduled to begin shipments of calcined phosphate rock from the $320 million complex in 1988 or 1989; annual capacity was reported to be 3.7 million tons.

During 1983, Texasgulf completed work on a system to convert the calcining kilns fuel from No. 6 fuel oil to coal, and at yearend, plans were underway to retrofit the Lee Creek sulfuric acid plant, the world's largest, to recover high-pressure steam for electrical generation. On completion, the $25 million project is expected to produce approximately 50% of the power used by the phosphate complex. Construction on the cogeneration facility is scheduled to begin in April 1984 and to be completed early in 1985. The company had sought the necessary permits to construct an ammonia storage and docking facility on Radio Island near Beauford in Carteret County, but County Commissioners rejected the plan following strong opposition by local citizens. Ammonia from the proposed $10 million facility would be used at the Lee Creek fertilizer complex. The company was reconsidering storage sites at Norfolk and Wilmington at yearend.

In June, the vessel *Mineral Samitri* docked at Morehead City State Port and loaded 65,000 tons of calcined and uncalcined phosphate rock and granulated triple superphosphate. The vessel, bound for Le Havre, France, carried the largest tonnage of phosphate material to be shipped through the State port.

In December, NCPC and the North Carolina Port Authority finalized an agreement for use of State facilities for phosphate rock export through the Morehead City Port. Under the terms of the agreement, NCPC is scheduled to construct $31 million in new facilities, including a dock, unloading facilities, conveyors, and storage silos. The company planned to ship an estimated 3.7 million tons of calcined phosphate rock through the port annually. NCPC, which has paid the port authority $100,000 per year for the lease of port property, is scheduled to pay $25,000 per year upon completion of the new facilities and $0.296 per ton of phosphate rock shipped as a fixed charge. The company is scheduled to reimburse the State for operation and maintenance charges at the port.

Contingent on the completion of an Environmental Impact Statement, construction is planned for 1985, and shipping would

commence by 1986.

Pyrophyllite.—North Carolina and California were the only States with pyrophyllite production in 1983. The material, a hydrous aluminum silicate, is used in extenders and filler applications and in refractories manufacture.

Two companies operated surface mines and processing facilities in Moore County in central North Carolina, and a third operated a surface mine and plant in Orange County in north-central North Carolina. The Moore County operations, Standard Minerals Co. Inc. and Glendon Pyrophyllite Inc., produced an insecticide filler and carrier, wallboard and latex foam filler, and refractory material.

Piedmont Minerals Co., Orange County, produced an andalucite pyrophyllite concentrate by surface mining and heavy-media beneficiation; the concentrate was trucked to Greensboro for refractory manufacture. The company also recovers sericite and quartzite during the stripping operation; the former is marketed as a brick clay additive and the latter for aggregate.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

In 1983, the production of construction sand and gravel exceeded that reported in 1982 by approximately 400,000 tons. This mirrored a 1983 construction activity increase in the State.

Industrial.—The nucleus of North Carolina's industrial sand industry is centered in the Anson-Richmond County area in the extreme south-central part of the State. Four companies in this area produced 858,000 tons of industrial sand, 80% of the output reported in the State. Industrial sand production was reported from two other counties, Cleveland and Harnett, in descending order of production. The Cleveland County output was a coproduct with mica production. International Minerals & Chemical Corp. in Mitchell County produced a high-purity, electronics-grade product from silica recovered during alaskite beneficiation. Output and value from this operation are not included in the State total.

Leading industrial sand sales, in decreasing tonnage, were for glass container manufacture, in sandblasting, and for use in filtration. However, over 80% of the tonnage produced was reported in the "Other" end-use category. Industrial gravel sales were for ferrosilicon applications and other uses.

Table 9.—North Carolina: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	3,353	$8,633	$2.58	NA	NA	NA
Gravel	1,313	5,943	4.53	NA	NA	NA
Sand and gravel (unprocessed)	533	819	1.54	NA	NA	NA
Total or average	[1]5,198	15,395	2.96	[e]5,600	[e]$16,900	[e]$3.02
Industrial:						
Sand	425	2,166	5.09	696	W	W
Gravel	291	2,712	9.33	370	W	W
Total or average	716	4,878	6.81	1,066	11,689	10.97
Grand total or average	5,914	20,273	3.43	[e]6,666	[e]28,589	[e]4.29

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total or average."

[1]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years ony; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

In 1983, 36 companies reported the production of 1 or more types of crushed stone: 27 companies produced granite; 5 produced limestone; 4, traprock; 3, marl; 1, slate; and 1, quartzite. Stone was produced in 50 of the State's 100 counties. Output and value by stone type is given in table 10.

Although output and sales of crushed stone increased in 1983, reversing a 3-year trend of annual declines, the performance of the North Carolina stone industry in 1983 remained almost 6.2 million tons in quantity below the record high set in 1979.

Table 10.—North Carolina: Crushed stone production in 1983, by kind

Kind	Number of quarries	Quantity (thousand short tons)	Value (thousands)
Granite	58	26,797	$112,786
Limestone and dolomite:			
West North Carolina	4	1,503	6,301
East North Carolina	6	3,064	15,319
Traprock	5	2,225	10,546
Marl, slate, quartzite	5	104	650

Table 11.—North Carolina: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	196	675
Riprap and jetty stone	259	1,463
Filter stone	62	365
Coarse aggregate, graded:		
Concrete aggregate, coarse	5,737	27,123
Bituminous aggregate, coarse	4,684	21,578
Bituminous surface treatment aggregate	854	4,519
Railroad ballast	1,660	6,525
Fine aggregate (-3/8 inch):		
Stone sand, concrete	61	233
Stone sand, bituminous mix or seal	120	248
Screening, undesignated	1,486	5,525
Coarse and fine aggregate:		
Graded road base or subbase	7,343	30,836
Unpaved road surfacing	194	860
Crusher run or fill or waste	3,736	12,541
Agricultural:		
Poultry grit and mineral food	9	96
Other agricultural uses	61	529
Special:		
Asphalt fillers or extenders	10	W
Other[2]	7,223	32,486
Total	[3]33,694	145,602

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes limestone, granite, marl, quartzite, traprock, and slate.
[2]Includes agricultural limestone, sulfur oxide removal, other coarse and fine aggregate, uses not specified, and uses indicated by symbol W.
[3]Data do not add to total shown because of independent rounding.

Table 12.—North Carolina: Dimension stone[1] sold or used by producers in 1983, by use

Use	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Rough blocks for building and construction	9,117	153	$801
Other[2]	3,941	48	301
Dressed stone: Other[3]	73,678	888	7,165
Total[4]	86,736	1,089	8,267

[1]Includes granite, sandstone, and slate.
[2]Includes irregular-shaped stone, rubble, and monumental.
[3]Includes ashlars and partially squared pieces, slabs and blocks for building and construction, monumental, flagging, structural and sanitary, and flooring slate.

Talc.—The Warner Corp., Murphy, operated an underground mine and plant in Murphy in Cherokee County in the southwestern part of the State. Crude talc was milled into a cosmetic powder and sawed into talc pencils for the metal industry.

METALS

Aluminum.—North Carolina's aluminum industry is located at Badin in the west-central part of the State. Alcoa operates a 127,000-short-ton-per-year primary aluminum smelter in Stanly County. During 1983, the company reactivated a potline shut down in 1981.

Cobalt.—Carolmet Inc. is a subsidiary of Métallurgie Hoboken-Overpelt SA of Belgium. Electrolytic cobalt is imported from Zaire and processed into extra-fine cobalt powder used to manufacture tungsten carbide. The company was closed during the initial part of 1983 because of market conditions.

Copper.—Powdered copper was produced by SCM Co. Glidden Metals Div. at Durham. The powder, produced from scrap, is used in the bearing and friction products industries.

Lithium Metal.—The two lithium companies produced lithium metal ingots, rod, wire, shot, and dispersion using a molten salt electrolysis process.

Steel.—Florida Steel Co. operated a two-furnace minimill at Charlotte. The improved economy resulted in an increase in orders over those received in 1982.

Titanium.—In 1983, Teledyne Allvac opened a new forging facility at Monroe. An 80-million-pound-annual-capacity rotary forging machine is the heart of the forging shop. The rotary forge was built by a Streyrm, Austria, firm. Other forging shop equipment included heating furnaces, cooling beds, a large abrasive saw, and a computer-controlled crane that loads the forge with ingots weighing up to 5 tons. The facility is designed to produce various bar configurations of nickel-based superalloys used in parts fabrication for jet and gas turbine engines and chemical processing plants as well as components for sour gas deep-drilling rigs. The aerospace and biomedical industries are the principal markets for the company's titanium alloys.

---

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, AL.
[2]Geologist, North Carolina Geological Survey Section, Raleigh, NC.
[3]Blue Ridge Sun (Sparta, NC). Exploration Routine, No Find Expected. June 15, 1983.
[4]Montgomery Herald (Troy, NC). Gold Mining Explored. May 26, 1983.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum, smelter:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Stanly.
Clays:			
Pine Hall Brick & Pipe Co	Box 11044 Winston-Salem, NC 27105	Open pit mines and plant.	Rockingham and Stokes.
Sanford Brick Corp	Box 505 Norwood, NC 28128	do	Lee and Stanly.
Solite Corp	Box 27211 Richmond, VA 23261	do	Rockingham and Stanly.
Feldspar:			
The Feldspar Corp.[1]	Box 99 Spruce Pine, NC 28777	Open pit mines and plants.	Mitchell.
Indusmin Inc	Box 309 Spruce Pine, NC 28777	do	Do.
International Minerals & Chemical Corp.[1]	23157 Sanders Rd. Northbrook, IL 60062	do	Do.
Lithium:			
Foote Mineral Co.[2]	Box 792 Kings Mountain, NC 28086	Open pit mine and plant.	Cleveland.
Lithium Corp. of America Inc.[2]	449 North Cox Rd. Gastonia, NC 28052	do	Gaston.
Mica:			
Deneen Mica Co	Box 28 Micaville, NC 28755	Open pit mines	Yancey.
Harris Mining Co.[3]	Box 628 Spruce Pine, NC 28777	do	Avery.
Kings Mountain Mica Co. Inc.[2]	Box 709 Kings Mountain, NC 28086	do	Cleveland.
Olivine:			
International Minerals & Chemical Corp.	Box 672 Spruce Pine, NC 28777	do	Jackson and Yancey.
Perlite (expanded):			
Carolina Perlite Co. Inc	Box 741 Hillside, NJ 07205	Plant	Rowan.
Phosphate rock:			
Texasgulf Inc.[4]	Box 48 Aurora, NC 27806	Open pit mine and plant.	Beaufort.
Pyrophyllite:			
Glendon Pyrophyllite Inc	Box 306 Carthage, NC 28327	Open pit mines and plant.	Alamance and Moore.
Piedmont Minerals Co.[5]	Box 566 Hillsborough, NC 27278	Open pit mine and plant.	Orange.
Standard Minerals Co. Inc	Box 278 Robbins, NC 27325	do	Moore.
Sand and gravel (construction, 1982):			
Becker Sand & Gravel Co	Box 848 Cheraw, SC 29520	Pits	Anson and Harnett.
W. R. Bonsal Co	Box 38 Lilesville, NC 28091	do	Anson.
B. V. Hedrick Gravel and Sand Co.[1]	Box 425 Swannanoa, NC 28778	do	Buncombe.
Stone:			
Martin Marietta Corp	Box 30013 Raleigh, NC 27612	do	Various.
Nello L. Teer Co	Box 1131 Durham, NC 27702	do	Do.
Vulcan Materials Co., Mideast Div.	Box 4195 Winston-Salem, NC 27109	do	Do.
Talc:			
Warner Corp	Box 459 Murphy, NC 28906	Underground mine	Cherokee.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Guilford.

[1]Also mica.
[2]Also feldspar.
[3]Also clays.
[4]Also byproduct gypsum.
[5]Also sericite.

The Mineral Industry of North Dakota

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the North Dakota Geological Survey for collecting information on all nonfuel minerals.

By James H. Aase[1]

Nonfuel mineral production in North Dakota during 1983 was valued at an estimated $25.4 million, an increase of $12.4 million over that of 1982, setting a new high for the State. The estimated two-thirds increase in construction sand and gravel output and a near doubling of its attendant unit price were the principal reasons for the sharp rise in 1983.

Among the six nonfuel minerals produced during the year, construction sand and gravel led in value, comprising an estimated 59% of the total nonfuel mineral value. Other nonfuel minerals produced, in descending order of their 1983 production value, included lime, salt, clays, peat, and gem stones. Only construction sand and gravel and lime values gained over those of 1982.

North Dakota, 47th among the States for the value of its nonfuel mineral production, accounted for less than 1% of the U.S. total. Nationally, the quantity of salt mined in North Dakota was ranked 12th among 15 producing States; peat, 22d of 22; lime, 30th of 39; construction sand and gravel, estimated 42d of 50; and clays, 42d of 44.

The North Dakota State Soil Conservation Committee (NDSSCC) reported that surface mining for minerals other than coal affected 442 acres, from which 2,885,594 cubic yards of mineral materials was mined and 380,420 cubic yards of overburden was disturbed. NDSSCC indicated that 128 pits were operated, ranging from 0.125 to 11 acres.

Employment in the State's nonfuel mineral industry during 1983, the North Dakota Job Service reported, averaged 380 workers, ranging from a low of 180 in February to a high of 510 in July and August.

Table 1.—Nonfuel mineral production in North Dakota[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$2	NA	$2
Lime thousand short tons	W	W	57	6,798
Sand and gravel (construction) do	2,347	4,873	e3,800	e15,000
Combined value of clays, peat, salt, and value indicated by symbol W	XX	8,102	XX	3,570
Total	XX	12,977	XX	25,370

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in North Dakota, by county[1]

(Thousands)

County	1981[2]	1982	Minerals produced in 1982 in order of value
Barnes	(3)	$78	Sand and gravel (construction).
Benson	(3)	--	
Bottineau	$36	W	Peat, sand and gravel (construction).
Bowman	(3)	W	Salt, sand and gravel (construction).
Burke	(3)	W	Sand and gravel (construction).
Burleigh	(3)	525	Do.
Cass	(3)	W	Do.
Dickey	--	41	Do.
Divide	(3)	42	Do.
Eddy	(3)	W	Do.
Emmons	(3)	--	
Foster	(3)	--	
Grand Forks	(3)	--	
Kidder	(3)	36	Sand and gravel (construction).
McHenry	(3)	W	Do.
McKenzie	W	350	Do.
McLean	(3)	218	Do.
Mercer	(3)	--	
Morton	W	W	Clays, sand and gravel (construction).
Mountrail	(3)	300	Sand and gravel (construction).
Pembina	1,037	W	Lime, sand and gravel (construction).
Pierce	(3)	W	Sand and gravel (construction).
Ramsey	(3)	--	
Ransom	(3)	--	
Renville	(3)	--	
Richland	W	W	Lime, sand and gravel (construction).
Rolette	(3)	67	Sand and gravel (construction).
Stark	(3)	W	Do.
Stutsman	(3)	548	Do.
Towner	(3)	W	Do.
Traill	(3)	W	Lime, sand and gravel (construction).
Walsh	(3)	114	Sand and gravel (construction).
Ward	(3)	W	Do.
Wells	--	W	Do.
Williams	W	W	Salt, sand and gravel (construction).
Undistributed[4]	7,275	10,658	
Sand and gravel (construction)	e6,500	XX	
Total	14,848	12,977	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Adams, Billings, Cavalier, Dunn, Golden Valley, Grant, Griggs, Hettinger, La Moure, Logan, McIntosh, Nelson, Oliver, Sargent, Sheridan, Sioux, Slope, and Steele.

[2]County distribution for construction sand and gravel is not available; total State value shown separately under "Sand and gravel (construction)."

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes gem stones and some sand and gravel (construction, 1982) that cannot be assigned to specific counties and values indicated by symbol W.

The State received approximately $10 million during fiscal year 1983 as its 50% share of receipts the Federal Government collected on all mineral leasing rents, royalties, and bonuses in the State. The payments by the Federal Government are in accordance with the Mineral Leasing Act of 1920.

The Mining and Mineral Resources and Research Institute at the University of North Dakota, Grand Forks, was awarded a grant of $150,000 by the U.S. Bureau of Mines in 1983 for operations and research designed to encourage the training of engineers and scientists in mineral-related studies.

The North Dakota Geological Survey (NDGS) reported that it issued no permits during 1983 for nonfuel mineral exploration in the State.

During 1983, NDGS released a variety of new publications related to the State's mineral and water resources and geology. Included among the many publications were reports on the ground water resources of Bottineau, Logan, Rolette, and Towner Counties as well as geological reports on Billings, Golden Valley, Morton, and Slope Counties; geological reports on the Pennsylvanian Tyler Formation and on the carbonate bodies in the basal Jurassic Swift Formation; a volume of production performance curves for selected North Dakota oilfields; several environmentally oriented study reports on the geology and geotechnical conditions in the Minot area; earth-resistivity studies of reclaimed lignite-mine spoils; and geological and geochemical controls of undisturbed and surface-mined landscapes.

Table 3.—Indicators of North Dakota business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	294.5	298.3	+1.3
Unemployment	do.	23.3	23.4	+.4
Employment (nonagricultural):				
Mining[1]	do.	6.8	7.4	+8.8
Manufacturing	do.	14.4	15.1	+4.9
Contract construction	do.	12.6	12.9	+2.4
Transportation and public utilities	do.	15.7	16.2	+3.2
Wholesale and retail trade	do.	62.6	63.6	+1.6
Finance, insurance, real estate	do.	11.7	11.9	+1.7
Services	do.	54.6	56.0	+2.6
Government	do.	62.1	61.8	-.5
Total nonagricultural employment[1]	do.	240.5	244.9	+1.8
Personal income:				
Total	millions	$7,290	$7,724	+6.0
Per capita		$10,830	$11,350	+4.8
Construction activity:				
Number of private and public residential units authorized		2,805	4,192	+49.4
Value of nonresidential construction	millions	$95.7	$102.6	+7.2
Value of State road contract awards	do.	$78.7	$102.8	+30.6
Shipments of portland and masonry cement to and within the State	thousand short tons	272	323	+18.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$13.0	$25.4	+95.4
Value per capita, resident population		$19	$37	+94.7
Value per square mile		$184	$359	+95.1

[p]Preliminary.
[1]Includes coal and oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

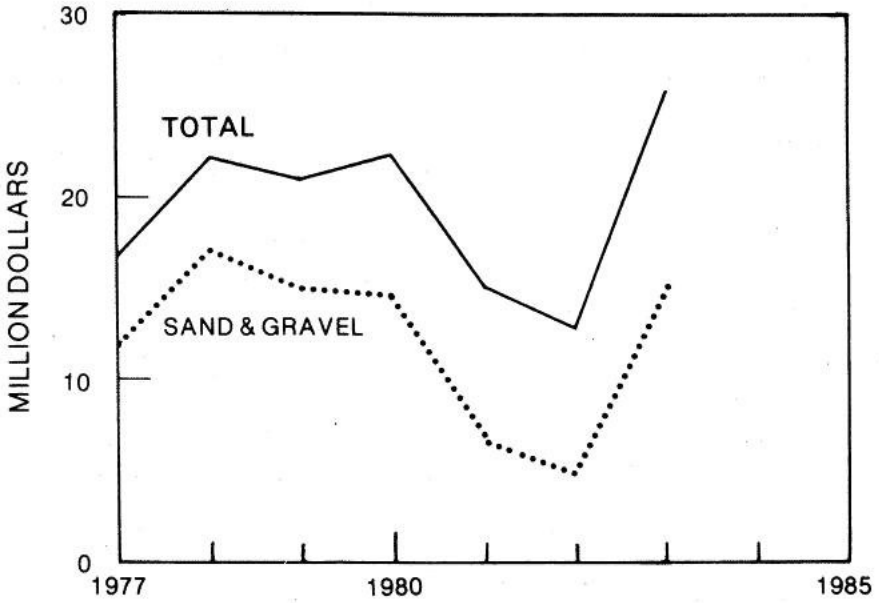

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in North Dakota.

During 1983, NDGS reported that 675 people, mostly industry geologists, used its Core and Sample Library facilities, studying more than 10 miles of core.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—Clay production in 1983 was about the same as in 1982; however, the total value declined slightly. The material mined was consumed locally in manufacturing brick and lightweight aggregate.

Output during the year was from two firms in Morton County—Hebron Brick Co. at Hebron and U.S. Noonlite Ltd. near Mandan.

Gem Stones.—No commercial gem stone operations were reported in the State during 1983. Material mineral collectors and other hobbyists collected consisted principally of agate, chalcedony, and petrified wood, estimated to be valued at not more than $2,000.

Lime.—The State's lime output in 1983 decreased in quantity compared with that of 1982; however, total value increased. American Crystal Sugar Co.'s plants near Drayton and Hillsboro and Minn-Dak Farmers Coop.'s operation near Wahpeton produced the entire output. All lime the two firms produced was used on-site at their respective sugar refining facilities. All limestone used in manufacturing their quicklime was obtained from out-of-State sources.

Total lime consumed in the State during 1983, obtained from U.S. sources, was approximately 88,000 tons.

Peat.—The value of peat produced in 1983 was down slightly from that of 1982. Consisting of the reed-sedge variety, output was harvested at a single operation by Peat Products Co. from the Turtle Mountain area in Bottineau County. The material was marketed principally in bulk form for golf courses and as an ingredient in potting soils.

Salt.—Compared with 1982 levels, salt production decreased slightly in quantity and value. Three companies accounted for the entire salt production in the State during 1983. Near Williston in Williams County, the Hardy Salt Co. conducted a solution-mining operation to obtain its output. Marketed products included evaporated salt for a variety of uses, including food processing and water softening, and salt brine for use as a component in oil and gas drilling muds. Salt brine Williams Exploration Co. and Koch Exploration Co. produced in Bowman County was used as an oil and gas drilling mud component.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

Table 4.—North Dakota: Construction sand and gravel sold or used by producers

	1982			1983[e]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	444	$1,180	$2.65	NA	NA	NA
Gravel	1,753	3,396	1.94	NA	NA	NA
Sand and gravel (unprocessed)	150	297	1.98	NA	NA	NA
Total or average	2,347	4,873	2.08	3,800	$15,000	$3.95

[e]Estimated. NA Not available.

Sulfur (Recovered).—Elemental sulfur, recovered as a byproduct from natural gas processing, increased modestly in both quantity and value compared with that of 1982. Production during 1983 was from plants operated by Aminoil USA Inc. at Tioga in Williams County, Warren Petroleum Corp. at Little Knife in Billings County, Western Gas Processors Ltd. near Roosevelt in Billings County, and Koch Hydrocarbon Co. in McKenzie County.

Vermiculite (Exfoliated).—Robinson Insulation Co.'s exfoliating plant at Minot in Ward County was inactive the entire year.

[1]State Liaison Officer, Bureau of Mines, Minneapolis, MN.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Hebron Brick Co	Hebron, ND 58638	Pit and plant	Morton.
U.S. Noonlite Ltd	Box 117 Mandan, ND 58554	do	Do.
Lime:			
American Crystal Sugar Co	101 North 3d St. Moorhead, MN 56560	Shaft kilns at beet sugar refineries.	Pembina and Traill.
Minn-Dak Farmers Coop	Wahpeton, ND 58075	do	Richland.
Peat:			
Peat Products Co	821 4th St. Bismarck, ND 58501	Bog	Bottineau.
Salt:			
Hardy Salt Co	Drawer 449 St. Louis, MO 63166	Brine well and plant	Williams.
Koch Exploration Co	Box 2256 Wichita, KS 67201	do	Bowman.
Williams Exploration Co	3025 South Parker Rd. Suite 600 Aurora, CO 80014	do	Do.
Sand and gravel (construction, 1982):			
Ames Sand & Gravel Inc	Box 2702 Fargo, ND 58102	Pit and plant	Burke.
Des Lacs Sand & Gravel Co	Box 66 Des Lacs, ND 58733	Pits and plants	Mountrail.
Fisher Sand & Gravel Co	Box 1034 Dickinson, ND 58601	do	Bowman, McLean, Stark.
Minot Sand & Gravel Co	Box 116 Minot, ND 58701	do	Ward.
Northern Improvement Co	Box 1254 Bismarck, ND 58501	do	Burleigh.
Sheyenne Sand & Gravel Inc	Box 178 Sheyenne, ND 58374	Pit and plant	Eddy.
Sulfur (recovered):			
Aminoil USA Inc	Box 94193 Houston, TX 77018	Plant	Williams.
Koch Hydrocarbon Co	Box 2256 Wichita, KS 67201	do	McKenzie.
Warren Petroleum Corp., a division of Gulf Oil Corp.	Box 1589 Tulsa, OK 74101	do	Billings.
Western Gas Processors Ltd	10701 Melody Dr. No. 609 Northglenn, CO 80234	do	Do.

The Mineral Industry of Ohio

By William A. Bonin[1]

In 1983, the value of nonfuel mineral production, which includes shipments of lime and cement, was $479 million, compared with $450 million in 1982. Major mineral commodities produced included crushed stone, construction and industrial sand and gravel, salt, clays, dimension stone, and gypsum. Peat and abrasives, including artificial industrial diamonds, were also produced.

Iron ore concentrates, alumina, beryllia, and titanium raw materials were shipped into the State for the production of metals. Iron and steel slag was processed for use as construction aggregate and fill. Talc, perlite, vermiculite, and fluorspar were received and processed into higher value-added products. Zinc oxide was manufactured from shipments of zinc concentrates, and refined zinc and zirconium materials were also manufactured. Various strontium compounds were produced from shipments of strontium carbonate derived from Mexican celestite, and barium chemicals were produced from shipments of barium carbonate derived from domestic barite ores. Elemental sulfur was recovered as a nondiscretionary byproduct of petroleum refining and coke production. Synthetic graphite was manufactured, and cultured quartz crystals were grown from imported lasca. Titanium dioxide and synthetic iron oxide pigments were produced.

Table 1.—Nonfuel mineral production in Ohio[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	86	$6,170	97	$7,454
Portland	do.	1,326	59,598	1,575	71,599
Clays	do.	1,451	6,100	1,716	8,061
Gypsum	do.	109	1,335	W	W
Lime	do.	1,666	76,370	1,906	84,928
Peat	do.	5	144	W	W
Salt	do.	3,514	90,572	2,565	85,988
Sand and gravel:					
Construction	do.	r26,160	r83,015	e27,200	e84,600
Industrial	do.	1,223	17,816	1,226	17,848
Stone:					
Crushed	do.	e30,300	e105,200	32,937	114,059
Dimension	do.	W	W	49	2,923
Combined value of abrasives, gem stones, and values indicated by symbol W		XX	3,240	XX	1,684
Total		XX	r449,560	XX	479,144

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Ohio, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Adams	W	[2]	
Allen	$3,065	[2]	
Ashland	W	W	Sand and gravel (construction), clays.
Ashtabula	W	W	Lime, sand and gravel (construction).
Athens	W	W	Sand and gravel (construction).
Auglaize	W	W	Sand and gravel (construction), clays.
Belmont	657	W	Sand and gravel (construction).
Brown	3	[2]	
Butler	[3]	$4,458	Sand and gravel (construction).
Carroll	W	129	Do.
Champaign	[3]	572	Do.
Clark	531	2,198	Do.
Clermont	[3]	144	Do.
Clinton	W	[2]	
Columbiana	W	W	Sand and gravel (construction), clays.
Coshocton	W	W	Do.
Crawford	W	[2]	
Cuyahoga	28,499	25,995	Salt, lime, clays, peat.
Darke	[3]	1,765	Sand and gravel (construction).
Delaware	2,611	[2]	
Erie	W	W	Lime, sand and gravel (industrial), sand and gravel (construction).
Fairfield	[3]	W	Sand and gravel (construction).
Fayette	W	[2]	
Franklin	W	6,519	Sand and gravel (construction).
Gallia	W	197	Sand and gravel (construction), sand and gravel (industrial).
Geauga	W	7,108	Sand and gravel (industrial), sand and gravel (construction).
Greene	25,376	W	Cement, sand and gravel (construction), clays.
Hamilton	[3]	8,078	Sand and gravel (construction).
Hancock	1,960	[2]	
Hardin	377	[2]	
Harrison	W	W	Clays.
Henry	W	W	Sand and gravel (construction), clays.
Highland	W	[2]	
Hocking	W	520	Sand and gravel (construction), clays.
Holmes	W	W	Clays, sand and gravel (construction).
Huron	W	W	Sand and gravel (construction).
Jackson	W	W	Clays, sand and gravel (industrial).
Jefferson	W	—	
Knox	W	W	Sand and gravel (industrial), sand and gravel (construction).
Lake	W	31,110	Salt, lime, sand and gravel (construction).
Lawrence	W	W	Cement, clays.
Licking	W	W	Sand and gravel (construction), clays.
Logan	W	W	Sand and gravel (construction), peat.
Lorain	W	W	Sand and gravel (construction), abrasives.
Lucas	W	W	Cement, sand and gravel (construction), clays.
Mahoning	W	W	Clays, peat.
Marion	1,985	92	Sand and gravel (construction).
Medina	W	W	Sand and gravel (construction), clays.
Meigs	[3]	7,482	Sand and gravel (construction).
Mercer	W	[2]	
Miami	W	1,052	Sand and gravel (construction).
Monroe	W	[2]	
Montgomery	W	2,071	Sand and gravel (construction).
Morgan	244	W	Do.
Morrow	[3]	191	Do.
Muskingum	W	W	Cement, sand and gravel (construction), clays.
Noble	1,760	[2]	
Ottawa	W	W	Lime, gypsum.
Paulding	W	W	Cement, clays.
Perry	W	W	Sand and gravel (industrial), clays.
Pickaway	W	W	Sand and gravel (construction), sand and gravel (industrial).
Pike	W	W	Sand and gravel (construction).
Portage	[3]	7,615	Do.
Preble	W	W	Do.
Putnam	W	W	Clays.
Richland	W	W	Sand and gravel (construction), clays.
Ross	W	W	Sand and gravel (industrial), sand and gravel (construction).
Sandusky	W	W	Lime.
Scioto	W	W	Sand and gravel (construction), clays.
Seneca	15,787	W	Lime.
Shelby	654	552	Sand and gravel (construction).
Stark	W	11,103	Cement, sand and gravel (construction), clays.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Ohio, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Summit	W	W	Salt, sand and gravel (construction), sand and gravel (industrial).
Trumbull	$479	W	Sand and gravel (construction).
Tuscarawas	W	W	Sand and gravel (construction), clays, sand and gravel (industrial).
Union	W	(2)	
Van Wert	1,105	(2)	
Warren	(3)	$2,783	Sand and gravel (construction).
Washington	111	712	Do.
Wayne	37,307	W	Salt, sand and gravel (construction).
Williams	6	W	Sand and gravel (construction), peat.
Wood	3,513	(2)	
Wyandot	W	4,396	Lime, sand and gravel (construction), peat, clays.
Undistributed[4]	330,571	217,518	
Sand and gravel (construction)	e95,570	XX	
Stone:			
Crushed	XX	e105,200	
Dimension	XX	W	
Total	[5]552,160	449,560	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Defiance, Fulton, Guernsey, Madison, and Vinton Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Stone, either crushed or dimension, was produced; data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes gem stones and some sand and gravel (industrial) that cannot be assigned to specific counties, and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Ohio business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	4,913.2	4,963.8	+1.0
Unemployment	do	710.9	511.7	-28.0
Employment (nonagricultural):				
Mining[1]	do	25.6	27.0	+5.5
Manufacturing	do	1,030.8	1,101.0	+6.8
Contract construction	do	103.6	115.0	+11.0
Transportation and public utilities	do	193.5	193.1	-.2
Wholesale and retail trade	do	886.0	911.9	+2.9
Finance, insurance, real estate	do	205.2	210.8	+2.7
Services	do	849.5	868.3	+2.2
Government	do	668.5	656.3	-1.8
Total nonagricultural employment[1]	do	3,962.7	[2]4,083.3	+3.0
Personal income:				
Total	millions	$115,087	$120,936	+5.1
Per capita		$10,667	$11,254	+5.5
Construction activity:				
Number of private and public residential units authorized		16,640	26,851	+61.4
Value of nonresidential construction	millions	$1,534.2	$1,962.2	+27.9
Value of State road contract awards	do	$345.0	$548.0	+58.8
Shipments of portland and masonry cement to and within the State	thousand short tons	2,139	2,427	+13.5
Nonfuel mineral production value:				
Total crude mineral value	millions	$449.6	$479.1	+6.6
Value per capita, resident population		$42	$45	+7.1
Value per square mile		$10,922	$11,593	+6.1

pPreliminary.

[1]Includes bituminous coal and gas extraction.

[2]Data do not add to total shown because of independent rounding.

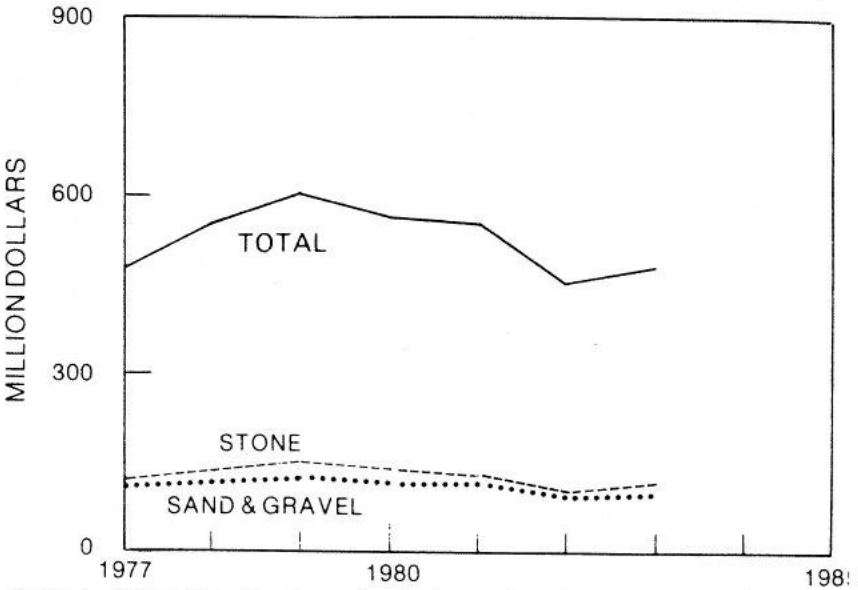

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Ohio.

Nationally, Ohio continued to rank 15th in the value of nonfuel mineral production. The State ranked first in ferroalloy shipments and first in the production of lime, steel slag, and exfoliated vermiculite; second in pig iron and fire clay; third in iron slag; fourth in salt and construction sand and gravel; and fifth in common clay.

Trends and Developments.—The Ohio mineral industry in 1983 fully participated in the recovery from the recession of the past few years as total value of production increased 7% over 1982 levels.

Compared with 1982, when the combined values of cement, clays, calcined gypsum, lime, construction sand and gravel, and crushed stone fell $178.4 million (34%) below the 1979 record-high levels, these values in 1983 rose by $35.8 million (10%) over 1982 levels. The value of construction-related commodities produced in Ohio in 1979, 1982, and 1983 are shown in the following:

Commodity	Million dollars			Percent change		
	1979	1982	1983	1979-82	1979-83	1982-83
Cement:						
Masonry	10.9	6.2	7.5	-43	-31	+21
Portland	87.5	59.6	71.6	-32	-18	+20
Clays	13.5	6.1	8.1	-55	-40	+33
Gypsum (calcined)	11.7	5.1	6.5	-56	-44	+27
Lime	141.7	76.4	85.0	-46	-40	+11
Sand and gravel (construction)	104.9	r83.0	e84.6	-21	-19	+2
Stone (crushed)	149.8	e105.2	114.1	-30	-24	+8
Total	520.0	341.6	377.4	-34	-27	+10

eEstimated. rRevised.

In Ohio, the number of authorized private and public residential units increased by 61% (26,851 in 1983 compared with 16,640 in 1982), while in the United States that indicator of economic activity increased by 59%. The value of private residential construction in Ohio increased $428 million or 28%, compared with a nationwide increase of only 8%. Also significant as indicators of Ohio's participation in the national recovery were the increases in the value of State road contract awards and the shipments of cement to and within the State, up 59% and 14%, respectively.

After 4 years of economic recession, the State's nonfuel mineral producers and processors began to rebound in all areas except for salt, which decreased in both production and value, 27% and 5%, respectively, and industrial sand, which remained essentially unchanged from 1982 levels. Most of Ohio salt production is used for highway ice control. As such, shipments are subject to the vagaries of winters, State and municipal government stockpiles, and the trend, brought on by economic constraint and environmental concerns, to salt less often and less extensively. Most of Ohio's industrial sand production was used as glassmaking and foundry sand. The glass container industry continued to suffer from aging equipment, excess capacity, and increasing use of alternative containers, while foundries continued to operate at or below 50% of capacities.

In total tonnage produced in Ohio, the percentage increases over 1982 levels compared favorably with U.S. production in all areas except for construction sand and gravel and masonry cement, which lagged 6 and 8 percentage points, respectively.

The production of construction-related commodites in Ohio and the United States in 1982 and 1983 are shown in the following:

Commodity	Ohio			United States		
	1982	1983	Change, percent	1982	1983	Change, percent
	Quantity (thousand short tons)			Quantity (million short tons)		
Cement:						
Masonry	86	97	+13	2.4	2.9	+21
Portland	1,326	1,575	+19	61.1	67.2	+10
Clays	1,451	1,716	+18	35.5	40.9	+15
Gypsum (calcined)	213	291	+37	11.2	13.9	+24
Lime	1,666	1,906	+14	14.1	14.9	+6
Sand and gravel (construction)	r26,160	e27,200	+4	r594.0	e655.1	+10
Stone (crushed)	e30,300	32,937	+9	e790.0	862.7	+9
Total	61,202	65,722	+7	1,508.3	1,657.6	+10

eEstimated. rRevised.

The percentage changes from 1979 to 1982 and from 1982 to 1983, in both the quantity and value of mineral production demonstrate that less of these commodities are required to maintain the infrastructure of a mature society than were required to initially construct and expand that infrastructure as the society developed. For example, most major highway systems have been built and the need for large quantities of construction aggregate is gone. Most highway money is now spent on resurfacing pavements and repairing bridges. Also, as population growth levels off, there is a shift to multiple-family dwellings and a trend toward rebuilding and refurbishing inner city residences. This reduces the need for new streets and water and sewer systems.

In the very important iron and steel and ferroalloy sectors of both the State and national economy, Ohio producers during 1983 only managed to cut their loss. Caught between weak demand and oversupply in what has become an international market place, and overcapacity and high production costs, the domestic steel industry continued to modernize, rationalize, restructure, and reorganize in a massive effort to regain profitability. In 1983, as in 1982, management sought reductions in wages, fringe benefits, and changes in work rules to reduce production cost. Labor, for the most part, conceded. For the survivors in this industry, the so-called "leaner and meaner" return to profitability remained a distant objective and for some only a distant hope.

The significant increases in the production of raw steel from 1982 to 1983 levels

pale in comparison to the decreases experienced by the industry in previous years to the record low output of 1982. These comparisons demonstrate the severity of the problems faced by steelmakers in Ohio and the Nation. In addition to reduced demand for steel to which ferroalloy producers are closely aligned, some changes in the steel industry have resulted in further permanent reductions in the use of ferroalloys.

For the second consecutive year, operating rates for Ohio's producers of bulk ferroalloys averaged about one-third of capacity owing to weak markets for their products and strong competition from low-priced imports. Operating rates were also low for specialty ferroalloys producers in 1983. However, capacity utilization of silicon metal producers increased by about 20% from 1982 levels.

The participation of Ohio's iron and steel and ferroalloys producers in the trends and developments of 1983 is further discussed and highlighted in the "Metals" section of this chapter.

The nonferrous sector of Ohio's primary metals industry, including aluminum, beryllium, and titanium, lagged behind the rest of the economy during the 1983 recovery, while some products responded more quickly than others to the overall economic improvement.

In a year when aluminum significantly outperformed other metals, the estimated production of primary aluminum by Oregon Metallurgical Corp. (Ormet) at Hannibal remained essentially unchanged from 1982, which was the lowest annual production rate in the Nation since 1968.

According to the annual report of Brush-Wellman Inc. at Elmore, 1983 was the most successful year in its history, as production of beryllium-copper alloys and beryllia ceramics increased, although production of the metal declined slightly. Sales and earnings reached an all-time high despite the negative impact of the continuing depression in the construction equipment industry. The Elmore plant produced high-energy friction materials and long-wearing edges. These parts were sold for use in clutches, brakes, power shifts, and automatic transmissions in off-road equipment, farm tractors, and trucks.

RMI Co. at Niles, again in 1983, operated at a loss because of a continued decrease in titanium mill product shipments and depressed selling prices. In 1982, sales plunged 32% to $179 million, compared with a record-breaking $265 million in 1981.

Exploration Activities.—Although mineral production has somewhat increased, there was still no sufficient market improvement to stimulate extensive exploration programs in Ohio during 1983.

An exception to this relatively low level of exploration activity was seen in eastern Ohio where there was considerable core-drilling activity for deep coal-reserve potential in parts of Belmont, Monroe, and Noble Counties. The area was intensively drilled by at least two major oil companies and was identified by the Ohio Division of Geological Survey, on the basis of its drilling program, to have more than 500 million tons of recoverable coal.

The ongoing exploration program of the Ohio Survey in 1983 included a deep-coal drilling program in Guernsey County. A total of 14 holes averaging over 600 feet deep and penetrating the entire coal-bearing sequence were expected to be completed by the end of 1984. The Ohio Survey's deep-coal "broad brush" exploration program is directed toward the possibility of finding low-sulfur coal in seams at depths greater than those previously mined in the State. The Ohio Survey continued expanding its geological mapping and mineral inventory capabilities throughout the year. Mapping of sand and gravel deposits was resumed in Butler County in southwestern Ohio and Champaign County in west-central Ohio. Plans called for completing the mapping of sand and gravel deposits in the remaining counties of the Miami River Basin. Also scheduled was the drilling of several deep holes in northwest Ohio in search of sulfide mineralization.

Negative exploration results caused the Crystal Mining Co. to abandon exploration activity and allow its leases to expire. Crystal Mining had reportedly leased 12,000 acres in Medina and Wayne Counties. Lack of favorable geology forced cancellation of the project after three cores were drilled to 2,600 feet in search of potash.

Legislation and Government Programs.—Reflecting a decade-long trend of increasingly greater utilization of geologic information, the Ohio Survey received over 51,000 inquiries and distributed over 214,000 maps, publications, and technical records to industry, government agencies, and individuals during the year.

Progress continued in the Ohio Survey's mapping program. In the 1983 field season, glacial geology mapping began and top-of-

rock and drift-thickness maps were completed in Huron and Crawford Counties. The Ohio Survey's other program activities in progress during 1983 included mapping the elevation of bedrock surface in Erie, Wyandot, and Hamilton Counties; thickness of glacial drift in Erie, Wyandot, Hamilton, and Geauga Counties; and sand and gravel resources in Butler and Champaign Counties. These maps are of considerable value to explorationists needing to know the thickness and nature of the material overlying the consolidated rock surface.

Coal-resource evaluations, studies of coals to investigate their potential washability, and publication of a report on the physical properties of limestone aggregates highlighted technical work during 1983. Also published during the year was a report on the geology and natural gas potential of Ohio's Devonian black shales. In 1983, data compilation was completed and a manuscript aeromagnetic map of Ohio was drafted by the U.S. Geological Survey (USGS) under terms of a USGS and Ohio Geological Survey cooperative agreement. The map, to be published at a scale of 1:500,000 and available in mid-1984, will be a valuable aid for explorationists.

Commencing in 1982, the Ohio Survey began collecting production data from Ohio's mineral industries. The Ohio Survey prepares yearly reports based upon this information. This function was formerly carried out by the Ohio Department of Industrial Relations, Division of Mines. The 1981 report has been published, the 1982 report was in production, and the 1983 report (the first utilizing data collected entirely by the Ohio Survey) was on schedule.

The Mining and Mineral Resources and Research Institute at Ohio State University, authorized by the Surface Mining Control and Reclamation Act of 1977, received $150,000 in fiscal year 1983 from the U.S. Bureau of Mines. The funds are designed to encourage the training of mining engineers and other scientists involved in mineral-related studies. These funds must be matched with non-Federal funds and can be used for research projects, demonstrations, fellowships, or other programs.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—*Manufactured.*—Three companies produced metallic abrasives during the year. Globe Steel Abrasive, Mansfield, in Richland County, and National Metal Abrasive Co., Wadsworth, in Medina County, produced steel shot and grit. Steel Abrasives Inc. at its Hamilton plant in Butler County produced both annealed and chilled shot and grit. Production and sales, reflecting continued reduced economic activity in the related industrial sectors, fell below 1982 levels and were again reported at their lowest levels since 1963.

The bonded abrasive operation of The Carborundum Co. in Logan was purchased by two former Carborundum executives and will be operated as the Carborundum Grinding Co. In March, Standard Oil Co. (Ohio), citing overcapacity in a down market, announced plans to close the worldwide bonded abrasive operations of Carborundum and sell its coated abrasive operations. The Logan closure would have meant the loss of 250 jobs.

The General Electric Co. (GE), Specialty Materials Dept. at Worthington in Franklin County, manufactured industrial abrasives and diamonds. GE is one of five companies producing artificial diamonds in the United States.

Natural.—Cleveland Quarries Co. produced grindstones and deburring media as coproducts of its dimension sandstone quarrying operations in the South Amherst area of Lorain County. The company is the largest producer and fabricator of sandstone in the world and the sole producer of natural grindstone in the Nation.

Cement.—Five companies operated six cement plants in Ohio during 1983. Columbia Portland Cement Corp. at Zanesville, General Portland Inc. at Paulding, Lone Star Marquette Co. at Superior, and Southwestern Portland Cement Co. at Fairborn produced both portland and masonry cement. Only portland cement was produced by SME Cement Inc. at its Middlebury and Sylvania plants. The value of portland and masonry cement shipments in 1983 increased by 20% over 1982 levels, while production increased by 19% and 13%, respectively.

Table 4.—Ohio: Portland cement salient statistics

(Short tons unless otherwise specified)

	1982	1983
Number of active plants	6	6
Production	1,380,902	1,629,517
Shipments from mills:		
Quantity	1,326,035	1,574,762
Value	$59,597,511	$71,598,540
Stocks at mills, Dec. 31	157,552	212,491

Table 5.—Ohio: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1982	1983
Number of active plants	4	4
Production	78,673	97,707
Shipments from mills:		
Quantity	86,472	97,475
Value	$6,170,030	$7,454,010
Stocks at mills, Dec. 31	19,914	20,897

Clays.—In 1983, 30 companies at 44 operations produced 1.5 million tons of common clay and shale valued at $4.6 million. A total of 11 companies at 12 operations mined 248,000 tons of fire clay valued at $3.4 million.

Total production of common clay and shale increased by 13% over 1982 levels, while value increased 19%. These materials were used in the manufacture of brick, portland cement clinker, concrete blocks, tile, flue lining, sewer pipe, and other structural clay products. The 1983 production and value of common clay and shale used in building brick was 839,000 tons and $2.7 million—a 50% increase over 1982 levels.

Production of fire clay increased by 63% over 1982 levels, while value increased 55%. Major end uses were in the manufacture of refractories, foundry sand, and fire brick. Dresser Industries Inc. closed its Harbison-Walker Refractories plant at Portsmouth. The plant, which employed as many as 150 workers, produced clay coke-oven brick, but there had been essentially no production since December 1982.

Fluorspar.—Seaforth Mineral & Ore Co., Cleveland, operated a fluorspar concentrate drying and processing mill in East Liverpool on the Ohio River. The facility received imported acid-grade fluorspar.

Graphite (Synthetic).—The Carbon Products Div. of Union Carbide Corp., Fostoria, and Ohio Carbon Co., Cleveland, manufactured graphite. Union Carbide's graphite products included low-modulus cloth, low- and high-modulus fibers, and machined and unmachined shapes. Union Carbide also produced electrodes and electric motor brushes, and manufactured carbon raiser for steelmaking from powder and scrap. Ohio Carbon produced machined and unmachined graphite shapes and electric motor brushes.

Gypsum.—Ohio's gypsum industry during the year followed the high activity of the housing and construction industries. Wallboard shipments increased modestly in the first half of the year and then, spurred by lower interest rates and pent-up demand for housing, increased very rapidly with all-time monthly records set in the second half of 1983.

Celotex Corp., a subsidiary of Jim Walter Corp., continued to be the only company that mined gypsum in Ohio. The company reported increased production from its open pit mine on Marblehead Peninsula in Ottawa County. The 148,000 tons produced in 1981 was valued at $1.57 million and the 1982 production of 109,000 tons was valued at $1.34 million. According to company data reported to the Ohio Survey, Ohio's production in 1983 was 224,100 tons valued at $1.87 million—up 106% and 40%, respectively, over 1982 levels.

National Gypsum Co. at its plant in Lorain County and Celotex and United States Gypsum Co. at plants in Ottawa County calcined crude gypsum mined in Ohio and other States. These three plants calcined 291,000 tons valued at $6.5 million—a 37% increase in production and a 27% increase in value over 1982 levels. Of the total calcined gypsum, 96% was used for wallboard and 4% was used for plasters. The United States Gypsum plant, which had ceased operations in early 1982, resumed production in 1983.

Lime.—Ohio continued to lead the Nation in lime production and to rank second in consumption. Two of the Nation's top 10 lime-producing plants are located in the State. Ranked fifth is the Woodville No. 1 plant of Martin Marietta Corp.'s Chemical Div. in Sandusky County and ninth is the Grand River plant of Inland Steel Co. in Lake County. A total of 11 companies at 14 plants produced 1.9 million tons of lime valued at $84.9 million. Production and value increased 14.4% and 11.2%, respectively, over 1982 levels. The State increased its share of total U.S. production from about 12% in 1982 to almost 13% in 1983. The

record high year for the State's output of lime was 1978 when it attained 17.2% of total domestic production with 3.5 million tons valued at $129.3 million, as shown in the following:

Year	Million short tons		Ohio as percent of U.S. production
	Ohio	United States	
1977	3.2	20.0	16.0
1978	3.5	20.4	17.2
1979	3.4	21.0	16.2
1980	2.8	19.0	14.7
1981	2.8	18.9	14.8
1982	1.7	14.1	12.1
1983	1.9	14.9	12.8

The lime industry in the United States in 1983 showed a modest 5.7% gain over 1982 levels, reaching 14.9 million tons. Despite this gain, however, 1983 was the third worst year for total lime production since 1963. Fluxing lime for steel showed the largest gain, up 13% over that of 1982. Building lime for masonry and plastering gained 18%, again related to the improved construction market. Chemical and industrial uses increased modestly, while only agricultural lime experienced a slight decline.

In 1983, Ohio was the leading consumer of quicklime and ranked third behind Texas and Pennsylvania in the consumption of hydrated lime. The leading uses of lime were in steel furnaces, refractories, and water purification. Ohio was one of the top three lime producers for basic oxygen furnaces and electric-furnace steel with 23% and 10%, respectively, of total domestic production.

Despite the 1983 gains in the quantity and value of lime sold or used by Ohio's producers, several plants in the State were closed during the year, reflecting continued depressed markets for lime. CE-Basic Inc. permanently closed its Maple Grove plant at yearend; Cuyahoga Lime Co. permanently ceased operations in July; Pfizer Inc. shut down its Gibsonburg dolomitic lime plant in January; and United States Steel Corp.'s Lorain plant, dormant since late 1981, remained closed.

Table 6.—Ohio: Lime sold or used by producers, by use

Use	1982		1983	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, basic oxygen furnace	723,174	$34,178	966,898	$43,528
Refractories	107,072	4,842	149,998	7,508
Steel, electric	127,571	6,491	81,235	4,091
Water purification	W	W	43,600	1,984
Steel, open-hearth	140,908	6,741	27,077	1,417
Glass	115,814	4,832	W	W
Agriculture	7,665	357	W	W
Sewage treatment	8,731	399	22,121	974
Other[1]	435,099	18,530	614,905	25,426
Total	1,666,034	76,370	1,905,834	84,928

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes acid water neutralization, calcium carbide, fertilizer (1982), finishing lime, magnesia from seawater or brine, mason's lime (1982), magnesium, other chemical and industrial uses, other construction lime (1982), other metallurgy (1982), paper and pulp (1983), road stabilization, sugar refining, and uses indicated by symbol W.

Peat.—Six companies harvested peat in Ohio. The packaged product, totaling about 90% of production, was used for soil improvement and potting soil. Bulk sales were used primarily for soil improvement, and at nurseries, on golf courses, and in greenhouses.

Agricultural Laboratories Inc., at its humus plant in Carey, Wyandot County, processed a small quantity of peat to produce a high-value product for use as seed innoculant.

Perlite (Expanded).—Celotex, Cincinnati, and Cleveland Builders Supply Co., Cleveland, expanded crude perlite shipments from Western States. Production and value increased 2% and 11%, respectively, over 1982 levels. Construction industry-related uses, such as aggregate for concrete, plaster, and formed products, and loose-fill insulation, accounted for two-thirds of domestic sales. Although consumption of expanded perlite declined 10% in the Nation, sales for concrete aggregate increased 29%.

Quartz Crystal (Cultured).—The Eastlake facility of Sawyer Research Products Inc. in Lake County used imported, as well as Arkansas, lascas to grow cultured quartz crystals for manufacture of frequency-control oscillators. Lasca is high-purity, lump quartz needed to grow quartz crystals. Growing time ranges from 1 to 6 months,

depending on the size and type of bar to be grown.

Sawyer Research Products was the former wholly owned subsidiary of Brush-Wellman of Cleveland. It was sold in November to a domestic investor group for about $6 million. The Eastlake facility represents more than one-half of the installed capacity for growing single-crystal quartz in the Nation. This material is the best for frequency-control oscillators.

Salt.—In 1983, Ohio ranked fourth in salt production behind Louisiana, Texas, and New York and produced 7% of the national total. The 2.6 million tons sold in 1983 was valued at $86 million. Compared with 1982 shipments, the 27% decline was offset in part by only a 5% decline in value.

Rock salt was recovered at two underground mines. Reserves are enormous and these two mines could conceivably operate indefinitely. The Fairport Harbor Mine of the Morton Salt Co. Inc. is located on the Lake Erie shore on the west side of the Grand River in Lake County. Mining is by room-and-pillar method in a 17-foot interval within the upper part of the Salina salt bed at a depth of 1,900 feet beneath the surface. The mine, served by two vertical shafts, is beneath Headlands Beach State Park and Lake Erie. Almost the entire production from the mine is used for highway de-icing. The International Salt Co. Mine is on Whiskey Island in Cleveland, Cuyahoga County, and, like the Morton Salt Mine, is beneath Lake Erie. The salt is mined by the room-and-pillar method from a 14- to 17-foot interval at a depth of 1,700 feet. Two shafts, each 16 feet in diameter, provide access, ventilation, and removal of salt. Most of the salt produced at this mine is also used as highway salt. Production from these mines declined because State and municipal governments had stockpiled large quantities in 1982 and because the current trend is to salt only main highways instead of all or most secondary roads.

Artificial brine was produced from Salina salt beds at three operations—PPG Industries Inc. and Diamond Crystal Salt Co. in Summit County and Morton Salt in Wayne County. PPG's brine production is used solely by the company to produce chlorine and caustic soda by electrolysis. Morton and Diamond Crystal Salt evaporate brine to produce salt that is used for a variety of products including table salt, preservative and food-processing salt, water-conditioning salt, pressed salt blocks for livestock, and salt needed for various chemical processes. Salt consumption in the chlorine and caustic soda industry increased, while salt consumption by food-related industries remained virtually unchanged.

Morton Salt, at its Rittman refining plant, was developing a pneumatic system of padding brine cavities to improve extraction of mineral reserves.

The R. H. Penick Co. in Licking County produced natural brine from 12 wells. Its entire production is used for de-icing and dust control on secondary roads.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Based on these estimates, Ohio continued to rank fourth in production behind California, Texas, and Alaska. And, although production at 27.2 million tons was up 4% over 1982 levels, value at $84.6 million increased only 1.9%. These increases did not compare favorably with U.S. totals, where production and value increased 10.3% and 15.6%, respectively. Across the Nation, 1983 was the second lowest production level since 1958. It was 32% below the record high production of 1978 and only 10% higher than that of 1982, when a full annual survey was conducted.

Industrial.—In 1983, 8 companies operated 12 quarries with on-site processing plants that produced 1.2 million tons of industrial sand and gravel valued at $17.8 million. Production and value remained essentially unchanged from 1982 levels. Most of Ohio's industrial sand was used as glassmaking, foundry, and fiberglass sand. Other uses included blasting, pottery, hydraulic fracturing, traction, filtration, fillers, and roofing granules. The industrial gravel was used for silicon-ferrosilicon and filtration in metallurgy.

Table 7.—Ohio: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	NA	NA	NA
Gravel	NA	NA	NA	NA	NA	NA
Sand and gravel (unprocessed)	NA	NA	NA	NA	NA	NA
Total or average	r26,160	r$83,015	r$3.17	e27,200	e$84,600	e$3.11
Industrial:						
Sand	1,169	17,410	14.89	W	W	14.92
Gravel	53	405	7.64	W	W	9.40
Total[1] or average	1,223	17,816	14.57	1,226	17,848	14.56
Grand total or average	r27,383	r100,831	r3.68	e28,426	e102,448	e3.60

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Data may not add to totals shown because of independent rounding.

Slag, Iron and Steel.—In 1983, Ohio maintained its national ranking in sales of both iron and steel slag—third in iron and first in steel. As a percentage of total U.S. shipments, Ohio sales of iron slag and steel slag were 17.6% and 25.8%, respectively. In 1983, Ohio sales of iron slag totaled 2.4 million short tons valued at $11.4 million, increases of 10.1% and 12.8%, respectively, over 1982. Sales of steel slag in 1983 were 1.2 million short tons valued at $3.7 million. Although quantity was 8.8% above that of 1982, the total value declined 1.6%. Slag comprised 5.5% of the total construction aggregate used in the State.

Three companies—Standard Slag Co., American Materials Corp., and United States Steel processed air-cooled iron slag. Standard Slag also processed granulated slag. Air-cooled slag was used mainly for road base, fill, and concrete and asphaltic concrete aggregate. Of the total blast furnace slag sold or used, 91% was air-cooled. Granulated slag was used typically as a lightweight aggregate and in concrete products. A total of 59% of blast furnace slag was marketed in Pennsylvania, Indiana, and Ohio.

Steel slag was processed by four companies—Heckett Co., Stein Inc., McCraw Construction Co., and International Mill Service Co. Electric arc furnaces, three basic oxygen furnaces, and an open-hearth furnace were the sources of the steel slag. It was typically used as road base and fill, or recycled to the blast furnace.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—In 1983, a total of 32.9 million tons of crushed stone valued at $114.1 million, f.o.b. plant, was produced in Ohio. Shipments and value increased 8% over 1982 levels. This tonnage is 35% below the recent high production of 1979, and although Ohio continued to make up 3.8% of domestic sales, it was no longer ranked in the top 10. The quantity and value of crushed stone sold or used by producers in Ohio and the United States over the past 14 years are as follows in million tons and million dollars:

Year	Ohio		United States	
	Quantity	Value	Quantity	Value
1970	47.2	$81.5	867.6	$1.4
1971	46.8	84.2	874.1	1.5
1972	48.4	87.9	918.9	1.6
1973	55.1	98.0	1,058.5	1.9
1974	51.7	105.1	1,041.6	2.1
1975	46.2	105.6	900.0	2.0
1976	42.6	104.1	900.3	2.1
1977	44.9	116.4	954.0	2.4
1978	49.3	130.5	1,049.6	2.8
1979	50.7	149.8	1,096.3	3.3
1980	42.4	136.9	983.5	3.3
1981	37.0	125.6	873.1	3.1
1982e	30.3	105.2	790.0	2.9
1983	32.9	114.1	862.7	3.3

eEstimated.

Crushed stone was produced by 84 companies at 121 quarries in 54 of the State's 88 counties. Limestone and dolomite comprised 99.8% of production with sandstone and

quartzite making up the remainder.

The primary uses of crushed stone were for construction aggregate (64%), cement manufacture (5%), agricultural limestone (3%), lime manufacturing, flux stone, dead-burned dolomite, and other special uses such as mine dusting-acid water treatment, and whiting-whiting substitutes.

The average unit values per ton of crushed stone for various uses were $4.27 for cement manufacture, $4.29 for agricultural limestone, $2.95 for lime manufacturing, $3.35 for flux stone, $2.47 for dead-burned dolomite, and $7.22 for mine dusting and acid water treatment. Quartzite for fill sold for $6.00 per ton. The highest unit value was $30.93 for crushed limestone for the manufacture of whiting and whiting substitute. About 88% of shipments was by truck, and three times as much material was moved by rail as by waterway.

Table 8.—Ohio: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	2,937	$8,518
Riprap and jetty stone	719	2,283
Filter stone	26	90
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,840	12,570
Bituminous aggregate, coarse	1,696	6,145
Bituminous surface treatment aggregate	1,259	4,627
Railroad ballast	641	2,031
Fine aggregate (-3/8 inch):		
Stone sand, concrete	198	685
Stone sand, bituminous mix or seal	358	1,168
Screening, undesignated	317	847
Coarse and fine aggregate:		
Graded road base or subbase	3,706	13,132
Unpaved road surfacing	4,004	14,065
Crusher run or fill or waste	1,511	4,602
Agricultural: Agricultural limestone	1,056	4,531
Chemical and metallurgical:		
Cement manufacture	1,656	7,062
Lime manufacture	444	1,312
Flux stone	437	1,462
Special: Other[2]	8,131	28,930
Total[3]	32,937	114,059

[1]Includes limestone, dolomite, sandstone, and quartzite.
[2]Includes other agricultural uses, terrazzo and exposed aggregate, dead-burned dolomite, mine dusting or acid water treatment, asphalt fillers or extenders, whiting or whiting substitute, other fillers or extenders, building products, glass manufacture, roofing granules, fine aggregates, and other uses not specified.
[3]Data do not add to totals shown because of independent rounding.

Dimension.—In 1983, a total of 663,000 cubic feet of dimension stone valued at $2.9 million was produced in Ohio. The industry consisted of 8 companies operating 17 quarries in 8 counties. Most of the production was sandstone and most was from Lorain County.

Ohio again led the Nation in the production of dimension sandstone with over 30% of domestic sales in 1983. The largest uses of Ohio's dimension sandstone production were for sawed and cut stone, rough irregular-shaped stone, flagging, and curbing. The France Stone Co. and Lintner & Luft Inc. at four operations in Seneca County produced rough irregular-shaped limestone block.

Strontium Compounds.—Barium & Chemicals Inc., Steubenville, produced various strontium compounds from shipments of strontium carbonate ($SrCO_3$) produced from celestite ($SrSO_4$) imported from Mexico. Strontium compounds were used in television picture tubes, pyrotechnics, ferric ceramic magnets, purifying electrolytic zinc, and pigments. Domestic consumption of primary strontium on a $SrCO_3$ equivalent basis increased 28% over 1982 levels. Television picture tubes continued to be the major end use for strontium chemicals in the United States. Thus, sales of strontium chemicals are closely linked to the sale of television sets. The company also produced barium chemicals from shipments of barium carbonate ($BaCO_3$) produced from domestic barite ($BaSO_4$) ores.

Sulfur (Recovered).—Elemental sulfur was recovered as a nondiscretionary byproduct from petroleum refining operations by Standard Oil Co. of Ohio at its refineries

in Lima and Toledo and Ashland Oil Inc. at Canton. Republic Steel Corp. also recovered sulfur from its coking plants in Cuyahoga and Trumbull Counties. Production in Ohio increased 39% to 38,500 metric tons from 1982 to 1983, while the value of shipments increased 23% to $3.8 million.

Talc.—The AFC Corp. Canfield operations in Mahoning County processed crude ore imported from France. Ground talc, shipped within Ohio and to Pennsylvania, West Virginia, and Texas, was used in ceramics.

Vermiculite (Exfoliated).—Ohio continued to rank first in output among 29 States producing exfoliated vermiculite in 1983. Cleveland Gypsum Co. in Cleveland and O. M. Scott & Sons Co. in Marysville, Union County, exfoliated vermiculite shipped in from other States. From 1982 levels, estimated production and value decreased 16% and 8%, respectively. The product was used primarily as a fertilizer carrier. A small amount was used for loose fill, block, and high-temperature insulation; for horticulture; and as a paint additive.

METALS

Aluminum.—Ohio ranked eighth among the 16 States in which primary aluminum was produced in 1983. The estimated production of Ormet at Hannibal remained essentially unchanged from 1982, and yearend annual production capacity increased 8% to 270,000 tons. Total domestic production increased by 2.5% from 3.6 million tons in 1982, which was the lowest annual production rate since 1968. This modest increase reflected the consumer-fed upswing, starting with the automobile and housing industries.

Consolidated Aluminum Corp. (Conalco) at its aluminum rolling mill in Hannibal began calling back workers late in 1983, and at one point achieved full employment. Conalco, the 66% owner of Ormet, markets sheet and plate nationwide.

The 5-year, $39 million modernization program at the extrusion plant of Kaiser Aluminum & Chemical Corp. in Newark was over 90% completed at yearend. Improvements in the remelt shop have increased its capacity to 200 million pounds of metal per year. However, like the rest of the mill, its operating rate during 1983 was about 50% of capacity. The Newark mill is Kaiser's largest rod, bar, and wire plant and accounts for 90% of the company's production.

ASARCO Incorporated began production in March of steel mill deoxidizing alloy at its smelter in Painesville. Initial plans called for 15,000 tons of the alloy to be produced annually in the form of Grade 1, 5-pound notch bars. The 45,000-ton-per-year secondary smelter was started up in December 1981 but was closed almost immediately in the face of weak market demand. The company also planned to eventually manufacture diecasting and foundry alloys at Painesville to absorb that facility's remaining 15,000 tons of annual capacity. Asarco also operated a plant at its Maple Heights headquarters.

A new 8,000-ton forging press at the Cleveland works of the Aluminum Co. of America began supplying the growing demand for forged aluminum truck wheels.

In March, Barmet Industries, an aluminum reclamation and recycling firm, began producing narrow aluminum strip at its new 5-ton-per-month-capacity rolling mill in Akron. The $12 million mill, located next to the company's Livia, KY, aluminum recycling plant, used low copper and segregated 3000-series aluminum scrap to produce the narrow strip coil. Barmet's new facility consists of five gas-fired melting furnaces; two gas-fired holding furnaces; a Haslett continuous caster with a capacity to cast 16,000 pounds of metal per hour; a continuous annealing line; a three-strand, four-high hot rolling mill; and a two-strand, four-high cold mill. This plant, along with a doubling of melting and milling capacity at Barmet's Uhrichsville facility (completed in 1982), will give the company the capacity to produce about 200,000 tons of secondary aluminum in 1983.

Wabash Alloys Inc. in late August resumed production at its Cleveland secondary aluminum smelter. About 83 members of the union had walked off the job on February 1 at the expiration of the previous contract. The firm's other secondary smelter in Wabash, IN, continued production during the strike as workers there were covered by a different labor agreement.

In October, Alumax Inc. formed the Alumax Recycling Group, which will operate the secondary aluminum smelters of its subsidiary, Apex International Alloys Inc. The smelters are located in Cleveland, OH, and Bicknell, IN.

Beryllium.—Brush-Wellman, the Western World's only integrated producer of beryllium, produced beryllium alloys, metallic beryllium, and beryllia ceramics at its Elmore plant. The $13 million moderniza-

tion and expansion for making beryllium-copper alloy wire, tubes, and rods was completed in late 1983.

In September, Brush-Wellman was awarded a $14,340,000 contract by the General Services Administration to deliver 60,000 pounds of beryllium metal to the National Defense Stockpile by December 12, 1984. The metal, as hot-pressed powder, will be shipped from the Elmore plant in the form of large cylindrical blocks suitable for nuclear and aerospace applications.

Although production of beryllium-copper alloys and beryllia ceramics increased, production of the metal declined slightly.

Ferroalloys.—Although domestic shipments in 1983 were up 5% over 1982 levels, they were 37% below the low levels of 1981. This slight increase was attributed to the modest recovery of the steel and ferrous foundry industries and a surge in demand for silicon metal by the secondary aluminum industry. In this domestic market, Ohio led the United States and again accounted for 38% of the Nation's total shipments in what constituted the industry's second most dismal year since 1939. Continued weak demand by the iron and steel industries, the major consumer of ferroalloys, combined with overcapacity and oversupply continued to plague ferroalloy producers in 1983.

Shipments of ferroalloys by Ohio and total domestic shipments for 1981-83 were as follows:

Year	Ohio		United States	
	Quantity (thousand short tons)	Value (thousands)	Quantity (thousand short tons)	Value (thousands)
1981	461.6	$375.9	1,486.1	$1,129.9
1982	314.0	228.0	826.0	652.2
1983	332.8	208.1	867.1	550.4

In September, Ashland Chemical Co. began production of specialty ferroalloys at its new aluminothermic and silicothermic reduction plant in Cleveland. Some of the company's production equipment was acquired from The Pesses Co., a former specialty ferroalloys producer, which was declared bankrupt at midyear.

The Foote Mineral Co. plant in Cambridge was shut down for about 1 month owing to a strike that began in October. A new 3-year labor agreement, which included wage and benefit concessions, was ratified by the workers. The facility produces ferrovanadium and ferroboron.

Ratification of a new labor agreement in July enabled Ohio Ferro-Alloys Corp. to resume ferrosilicon production at its Philo facility. The plant, idle since late 1982, is the company's only ferrosilicon facility. The lengthy shutdown depleted Ohio Ferro-Alloy's inventories of some grades of magnesium ferrosilicon and had left stocks of other grades of regular ferrosilicon and magnesium ferrosilicon at very low levels. The company also resumed silicon metal production at its Powhatan Point plant after being out of production since late 1981.

Iron Oxide Pigments (Synthetic).—During 1983, shipments of finished iron oxide pigments increased 20% to 7,900 tons, while value fell 44% to $3.2 million compared with 1982 sales. Paints and coatings continued to be the largest end-use area for synthetic iron oxide pigments. Iron oxide usage in ferrite and other magnetic and electronic applications captured a smaller market share of reported iron oxide pigments consumed.

The Hilton-Davis Chemical Co. Div., Sterling Drug Inc., at Cincinnati, produces industrial flushed and dry colors. Ottawa Chemical Div., Ferro Corp., at Toledo, produces ferrite powder.

Iron and Steel.—While demand for steel by manufacturers of consumer goods such as automobiles and appliances increased, demand for steel for capital goods decreased further because of unused capacity or excess inventories in these industries. In response to this market, the domestic steel industry continued to restructure to reduce costs and adjust capacity to the demand expected in years ahead. The results of these efforts in Ohio were significant, as pig iron shipments and raw steel production increased 18% and 20%, respectively, over 1982 levels. In these areas, Ohio's performance was better than that of the Nation as a whole in 1983, but for Ohio, like the Nation, 1982 was the worst year for the steel industry since 1946.

Pig iron shipments and raw steel production for 1979-83 are shown in the following in million short tons:

Year	Pig iron		Raw steel	
	Ohio	United States	Ohio	United States
1979	14.1	87.8	21.1	136.3
1980	10.7	69.4	16.1	111.8
1981	11.8	74.2	18.1	120.8
1982	7.9	43.4	12.2	74.6
1983	9.3	49.1.	14.6	84.6

In 1983, Ohio continued to rank second behind Indiana and ahead of Pennsylvania in both pig iron shipments and raw steel production. These three States accounted for 67% of pig iron shipments and 56% of total domestic raw steel production.

Although most steel companies received wage and benefit concessions and work rule changes from the unionized workers during both 1982 and 1983, the industry as a whole continued to be unprofitable.

Jones & Laughlin Steel Corp. (J&L) completed a renovation of the seamless pipe mill at its Campbell Works in Youngstown. The $65 million modernization project doubled the plant's capacity to 600,000 tons per year while reducing the work force from 1,500 to 1,000. The facility has North America's largest reheat furnace. J&L's continuous caster at Aliquippa, PA, provides raw steel to the Campbell plant. Also, Republic Steel at its Cleveland works cast the first steel slab from its new $100 million continuous caster. The caster was to go into full production in the first quarter of 1984, producing 150,000 tons of steel slabs per month. In September, the J&L subsidiary of LTV Corp. and Republic Steel, the Nation's third and fifth largest steelmakers, announced plans to merge. At yearend, the agreement remained subject to shareholder and Justice Department approval.

J&L's principal facilities consist of five steelworks located at Aliquippa, Pittsburgh, and Midland, PA; Cleveland, OH; and East Chicago, IN; and two steel finishing plants located at Hennepin, IL, and Youngstown, OH. Republic Steel's principal facilities consist of six steelworks located at Cleveland, Youngstown, Canton, and Massillon, OH; Gadsden, AL; and Chicago, IL. The two companies had a combined raw steel capacity of over 24 million tons per year, about one-sixth of the U.S. total. The new company, to be called LTV Steel Co., was expected to be the Nation's No. 2 steelmaker, after United States Steel Corp.

United States Steel put into production its continuous caster to produce 500,000 tons per year of semifinished steel rounds to feed the pipe mill at its Lorain-Cuyahoga works. The caster is part of the $80 million capital improvement installed at the works in 1983.

The Timken Co.'s new $500 million Faircrest plant in Canton was 30% completed at yearend. It was scheduled for full operation with 500,000 tons per year of specialty alloy steelmaking capacity by late 1988.

In 1983, Wheeling-Pittsburgh Steel Corp., with a new slab caster at Steubenville, achieved the capacity to continuously cast 100% of its raw steel production.

McDonald Steel Corp., Youngstown, was producing nonstandard section bars in a former United States Steel plant. The company, which had started up one bar mill in 1981, reactivated a second in 1983. Also, Hunt Steel Corp. started its new pipe mill, which was installed at the old Briar Hill works of Youngstown Sheet & Tube Co. The Youngstown plant can produce 360,000 tons per year of seamless "oil country" casing.

During the third quarter of 1983, Armco Inc. announced a long-term plan to combine its Middletown, OH, and Ashland, KY, plants into one operating unit. The open-hearth furnaces at Middletown and the hot strip mill at Ashland would be phased out of production.

In September, Marion Steel Co. ended steelmaking operations and filed for reorganization under chapter 11 of the Federal Bankruptcy Code. The plant at Marion was formerly owned by Armco and had reopened as an independent company in 1982.

Titanium.—*Metal.*—RMI, the Nation's second largest integrated producer of titanium, produced titanium sponge at its Ashtabula facilities and processed the sponge into semifinished and finished mill products at its company headquarters plant in Niles. The Timet Div. of Titanium Metals Corp. of America manufactured titanium mill products at its rolling mill in Toronto. The lightweight, high-strength, corrosion-resistant metal is used in jet engines, airplanes, space missile applications, and various nonaerospace applications.

The titanium industry remained beset by low prices and high excess capacity, and the two largest domestic producers, RMI and Timet, remained available for purchase. RMI is 50% owned by United States Steel and 50% owned by National Distillers & Chemical Corp. Ownership of Timet is split evenly between NL Industries Inc. and Allegheny International Inc.

During 1983, demand for titanium metal declined somewhat further as hopes for an early recovery in the commercial aircraft market failed to materialize. With the exception of military aircraft, all market sectors declined in 1983. Mill product usage was estimated to be 75% for aerospace and 25% for other uses. In response, RMI at yearend announced plans to gain a larger share of the nonaerospace titanium market.

Nonaerospace uses include the chemical, water desalination, nuclear, and well-drilling industries. The company planned to build its own tube-forming and welding mill, and to enter into long-term agreements with outside contractors for strip mill services. In a related matter, RMI in early 1983 made an agreement with Kobe Steel Ltd. to ship commercially pure titanium ingots and other products to Kobe in Japan for processing into tube and pipe and possible sheet and strip to strengthen its relatively small function in the international market. The company began operation in its new melt shop at Niles in July. It will utilize the latest controls and procedures on its arc remelt furnace to produce the largest ingots in the world on a continuous basis. The shop can handle ingots up to 48 inches in excess of 40,000 pounds—double the size of prior production.

In the military aircraft market, RMI picked up a major share of titanium mill products. Shipments of titanium plate, sheet, and billets to Rockwell International, the prime contractor for the B-1 bomber, began in June. Titanium supplied by the RMI plant at Niles is used for the wing carry-through structure in the aircraft; in vertical and horizontal stabilizers; and in the wing lugs, which attach the wings to the aircraft. The high-strength, lightweight special aluminum-vanadium alloy is difficult to produce and meets very rigid specifications. For Ohio, the project will create 16,000 jobs. Rockwell will employ 7,000 at its Columbus assembly plant. General Electric Co. makes the B-1 bomber's engines at its Evendale plant near Cincinnati.

In other developments, the titanium dioxide and titanium tetrachloride facilities of Gulf + Western Industries Inc. (G+W) in Ashtabula were purchased by the SCM Corp. RMI purchases its raw material, titanium tetrachloride, from that facility by way of pipeline for its production of sponge. Also, concessions by workers at the sodium plant of RMI in Ashtabula 10 months before the expiration of their 3-year contract saved that facility. According to RMI, without concessions it would have been less costly to purchase sodium from E. I. du Pont de Nemours & Co. Inc. in Buffalo, NY, than to produce its own. Sodium is used for the production of sponge, which is used in the production of titanium. The sodium plant, in operation since 1950, employs 500 workers.

RMI filed two separate actions on November 4 seeking to block the purchase of titanium sponge by the General Services Administration (GSA). On October 28, GSA had announced contract awards for the purchase of 4,500 tons of primary titanium for the Government's National Defense Stockpile. The target of the protest and legal action was the awards for 3,000 tons from Japanese suppliers and 500 tons from a British supplier. In essence, RMI complained that the 17% duty used in the GSA's calculations was not assessed against an accurate price at the primary titanium point of shipping origin; that the British primary titanium had not been approved as a source material for rotating jet engine parts; that the awards undermine the integrity of the Strategic and Critical Materials Stockpile Act to aid domestic supply sources; and that the award was premature since the protest against the purchase by Ormet had not been resolved.

The Japanese and British bids were $3.20 and $2.92 per pound, delivered, respectively. One domestic firm, Timet, was chosen to supply 1,000 tons of sponge at an average price of $3.57 per pound although it bid to supply the entire 4,500 tons. RMI's bid to supply the Government was $3.79 per pound.

Pigments.—SCM Glidden Pigments Group purchased for $48 million the titanium dioxide (TiO_2) and titanium tetrachloride plant of G+W at Ashtabula following a decision by the Federal Trade Commission (FTC) not to oppose the merger. Because of SCM's dominance in the TiO_2 market, it had to wait for approval of the purchase by the FTC. SCM is the Nation's second largest producer of TiO_2 after Dupont and ranks among the world's four or five largest makers of TiO_2. This is SCM's second Ashtabula TiO_2 plant. It acquired its first from Sherwin-Williams Co. in 1974. The company planned to spend $25 million to upgrade the technology and expand the capacity of its newly accquired plant to the 42,000 ton-per-year capacity of its other chloride-process plants. Modernization and expansion at the former G+W plant would preserve 185 jobs and create a few hundred jobs during the 18-month renovation. The former Sherwin-Williams plant employs 200 people. The G+W plant will add 35,000 tons per year to SCM's existing chloride-process TiO_2 capacity of 42,000 at Ashtabula and 42,000 at Baltimore, MD. SCM's total annual capacity, including its 66,000-ton-per-year sulfate-process plant at Baltimore, will then be

185,000 tons or 20% of U.S. annual capacity.

U.S. production and consumption of titanium dioxide pigments in 1983 were 757,000 tons and 850,000 tons, respectively—each 15% higher than 1982 levels. Consumption of TiO_2 pigments rose to a new peak, mainly because of recovery in the homebuilding industry. Domestic uses of the white pigment and opacifier in 1983 were in paints (49%), paper (27%), plastics (13%), rubber (2%), ceramics (1%), and other applications (8%).

Zinc Oxide.—The 1983 production of zinc oxide at the Asarco refinery in Columbus totaled 16,300 tons (metal content), 22% over the depressed level of 1982. The increase was primarily due to the increased demand from the tire and rubber industry. During 1983, the plant operated at 73% capacity under normal operating conditions and based on average metal content of input material. The facility, which employs 250, also manufactured sulfuric acid.

Zirconium Materials.—Eight companies in Ohio produced zirconium materials in 1983. These materials included milled zircon, refractories, ceramics and ceramic colors, alloys, oxide, welding rods, and zircon ores. The producers, locations, and products were as follows:

Company	Location	Products
Continental Mineral Processing Corp.	Sharonville, OH.	Milled zircon.
Didier-Taylor Refractories Corp.	Cincinnati, OH.	Refractories.
Ferro Corp	Cleveland, OH.	Ceramics and ceramic colors.
Foote Mineral Co	Cambridge, OH.	Alloys.
Harshaw Chemical Co. Inc	Cleveland, OH.	Oxide.
Lincoln Electric Co. Inc	do	Welding rods.
TRW Inc	do	Zircon ores.
ZIRCOA Products	do	Oxide and ceramics.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives (manufactured):			
Carborundum Grinding Co.[1]	Box 759 Logan, OH 43138	Plant (bonded abrasives).	Hocking.
General Electric Co., Specialty Materials Dept.	6325 Huntley Rd. Worthington, OH 43085	Research activities (synthetic diamonds).	Franklin.
Globe Steel Abrasive	238 1st Ave., Box 1179 Mansfield, OH 44901	Plant (metallic abrasives).	Richland.
National Metal Abrasive Co	142 Auble St., Box 158 Wadsworth, OH 44281	do	Medina.
Steel Abrasives Inc	2727 Symmes Rd., Box 97 Hamilton, OH 45014	do	Butler.
Abrasives (natural):			
Cleveland Quarries Co.[2]	Amherst, OH 44001	Quarry	Lorain.
Aluminum (primary):			
Oregon Metallurgical Corp	Box 176 Hannibal, OH 43931	Plant	Monroe.
Beryllium:			
Brush-Wellman Inc	R.D. 1 Elmore, OH 43416	do	Ottawa.
Cement:			
Columbia Portland Cement Corp.[3 4]	Box 1531 Zanesville, OH 43701	do	Muskingum.
General Portland Inc.[3 4]	Box 109 Paulding, OH 45879	do	Paulding.
Lone Star Marquette Co.[4]	Box 8, Route 93 Pedro, OH 45659	do	Lawrence.
SME Cement Inc.[3 4]	Box 1187 Uniontown, PA 15401	Plants	Stark and Lucas.
Southwestern Portland Cement Co.[3 4]	Box 191 Fairborn, OH 45324	Plant	Greene.
Clays:			
Common:			
Belden Brick Co	Box 910 Canton, OH 44701	Pits	Tuscarawas.
Hydraulic Press Brick Co	Box 7786 Independence, OH 44131	Pit	Cuyahoga.
Fire:			
Cedar Heights Clay Co	50 Portsmouth Rd., Box 368 Oak Hill, OH 45656	Pits	Jackson.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Ferroalloys:			
Elkem Metals Co.[5]	Box 80, Lake Rd. East Ashtabula, OH 44004	Plants	Ashtabula and Washington.
Foote Mineral Co	Box 310 Cambridge, OH 43725	Plant	Guernsey.
Interlake Inc	Box 157 Beverly, OH 45715	do	Washington.
Ohio Ferro-Alloys Corp	Box 158 Philo, OH 43771	do	Muskingum.
Do	Box 517 Powhatan Point, OH 43942	do	Monroe.
The Pesses Co.[6]	29605 Hall St. Solon, OH 44139	Plants	Cuyahoga and Trumbull.
Satra Corp	Box 536 Steubenville, OH 43452	Plant	Jefferson.
Union Carbide Corp., Metal Div	Box 299, Route 7 Rd. Four St. Marietta, OH 45750	do	Washington.
Graphite (synthetic):			
Ohio Carbon Co	12508 Berea Rd. Cleveland, OH 44111	do	Cuyahoga.
Union Carbide Corp	Box J, 200 N. Town St. Fostoria, OH 44830	do	Seneca.
Gypsum:			
Celotex Corp.[7]	320 South Wayne Ave. Cincinnati, OH 45215	Pit and plant	Ottawa.
National Gypsum Co.[7]	1901 Henderson Dr. Lorain, OH 44052	Plant	Lorain.
United States Gypsum Co.[3 5]	Gypsum, OH 43433	do	Ottawa.
Iron oxide pigments (synthetic):			
Ferro Corp., Ottawa Chemical Div	700 North Wheeling St. Toledo, OH 43605	do	Lucas.
The Hilton-Davis Chemical Co., Div., Sterling Drug Inc.	Box 37869 2235 Langdon Farm Rd. Cincinnati, OH 45237	do	Hamilton.
Iron and steel:			
Armco Inc., Advanced Materials Div	1724 Linden Ave. Zanesville, OH 43701	Mill	Muskingum.
Armco Inc., Marion Steel Co	912 Cheney Ave. Marion, OH 43302	do	Marion.
Copperweld Steel Corp	Box 351, 4000 Mahoning Ave. Warren, OH 44483	do	Trumbull.
Cyclops Corp., Empire Detroit Steel Div.	Box 247, 913 Bowman St. Mansfield, OH 44901	do	Richland.
Jones & Laughlin Steel Corp	3341 Jennings Rd. Cleveland, OH 44109	do	Cuyahoga.
Do	Box 20, 1500 West Main Louisville, OH 44641	do	Stark.
Republic Steel Corp.[5 8]	Box 700 Canton, OH 44701	do	Do.
Timken Co	1835 Dueber Ave., SW Canton, OH 44706	Mill and plant	Do.
United States Steel Corp., Youngstown Works.	912 Salt Spring Rd. Youngstown, OH 44509	Mill	Mahoning.
Wheeling-Pittsburgh Steel Corp	South 3d St. Steubenville, OH 43952	do	Jefferson.
Lime:			
Cuyahoga Lime Co.[9]	1002 Belt Line Rd. Cleveland, OH 44109	Quarry and plant	Cuyahoga.
Huron Lime Co	Box 451, 100 Meeker Huron, OH 44839	do	Erie.
Martin Marietta Corp.[10]	755 Lime Rd. Woodsville, OH 43469	do	Sandusky.
Ohio Lime Co.[10]	128 East Main St. Woodville, OH 43469	Quarries and plants	Do.
Pfizer Inc.[11]	Box F Gibsonburg, OH 43431	Quarry and plant	Do.
Republic Steel Corp	Williams St. Grand River, OH 44045	Plant	Lake.
Peat:			
Buckeye Peat Moss	R.D. 2 West Liberty, OH 43357	Bog	Logan.
Sphagnum Moss Peat Products	Route 1, 9797 Thompson Rd. West Liberty, OH 43357	Bog	Do.
Perlite (expanded):			
Celotex Corp	320 South Wayne Ave. Cincinnati, OH 45215	Plant	Hamilton.
Cleveland Builders Supply Co.[12]	2100 West 3d St. Cleveland, OH 44113	do	Cuyahoga.
Quartz crystal (cultured):			
Sawyer Research Products Inc	35400 Lakeland Blvd. Eastlake, OH 44094	do	Lake.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Salt:			
Diamond Crystal Salt Co	Box 149, 2065 Manchester Rd. Akron, OH 44309	Well and plant	Summit.
International Salt Co	2400 Ships Channel Cleveland, OH 44101	Underground mine and plant.	Cuyahoga.
Morton Salt Co. Inc	151 South Indl St. Rittman, OH 44270	Underground mine, wells, plant.	Lake and Wayne.
PPG Industries Inc	Box 31 Barberton, OH 44203	Wells and plant	Summit.
Sand and gravel:			
Construction:			
American Aggregates Corp.[3 13]	Drawer 160, Garst Ave. Greenville, OH 45331	Pits and plants (19 operations).	Butler, Champaign, Clark, Darke, Franklin, Green, Hamilton.
Ohio Gravel Co., a division of Dravo Corp.	5253 Wooster Rd. Cincinnati, OH 45226	Pits and plants (7 operations).	Butler, Hamilton, Meigs, Warren.
Industrial:			
Central Silica Co	806 Market St. Zanesville, OH 43701	Quarries and mills	Perry and Knox.
Best Sand Inc	Box 87 Chardon, OH 44024	Quarry and mill	Geauga.
Southern Silica Inc	Box 22, Whiskey Run Rd. Richmondale, OH 45673	____do	Ross.
Slag:			
Iron:			
Standard Slag Co.[3 14]	Box 1378 Youngstown, OH 44501	Plants (5 operations).	Cuyahoga, Jefferson, Trumbull.
United States Steel Corp	1807 E. 28th St. Lorain, OH 44055	Plant	Lorain.
Iron and steel:			
Heckett Co	Box 1071, N. Main St. Butler, PA 16001	Plants (3 operations).	Richland, Stark, Trumbull.
Stein Inc	Box 31178 Cleveland, OH 44131	Plants (2 operations).	Cuyahoga and Lorain.
Stone:			
Crushed:			
American Aggregates Corp	Drawer 160, Garst Ave. Greenville, OH 45331	Quarries and plants.	Clark, Fayette, Franklin, Greene, Montgomery, Warren.
The France Stone Co.[2]	Box 1928, 1800 Toledo Trust Toledo, OH 43603	Quarries and plant	Lucas, Sandusky, Seneca, Wood.
Martin Marietta Refractories	755 Lime Rd. Woodville, OH 43469	Quarry and plant	Sandusky.
National Lime & Stone Co	First National Bank Bldg. Findlay, OH 45840	Quarries and plants.	Allen, Auglaize, Crawford, Delaware, Hancock, Marion, Putnam, Wyandot.
Sandusky Crushed Stone Co. Inc., a subsidiary of Ralph Rodgers Co.	Box 527 Sandusky, OH 44870	Quarry and plant	Erie.
SME Lime & Chemical Co	Box 310 Sylvania, OH 43560	Quarries and plant	Lucas.
Dimension:			
Briar Hill Stone Co	Box 148, State Route 520 Glenmont, OH 44628	____do	Coshocton, Holmes, Knox.
Cleveland Quarries Co.[4]	Quarry Rd. Amherst, OH 44001	Quarries and plants.	Lorain.
The France Stone Co	Box 1928, 1800 Toledo Trust Toledo, OH 43603	Quarries and plant	Seneca.
Waller Bros. Stone Quarry Co	134 County Rd. McDermont, OH 45652	Quarry and plant	Scioto.
Sulfur (recovered):			
Standard Oil Co. of Ohio	1750 Midland Bldg. Cleveland, OH 44115	Refineries	Allen and Lucas.
Titanium:			
RMI Co	Box 269, 1000 Warren Ave. Niles, OH 44446	Plants	Ashtabula and Trumbull.
Titanium dioxide:			
Gulf + Western Industries Inc., Natural Resources Group.	Box 160, Middle Rd. Ashtabula, OH 44004	Plant	Ashtabula.
SCM Corp	2900 Middle Rd. Ashtabula, OH 44004	____do	Do.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Vermiculite (exfoliated):			
Cleveland Gypsum Co., a division of Cleveland Builders Supply Co.	2100 West 3d St. Cleveland, OH 44113	Plant	Cuyahoga.
O. M. Scott & Sons Co	333 North Main St. Marysville, OH 43040	do	Union.
Zinc oxide:			
ASARCO Incorporated	Box 327 Columbus, OH 43216	do	Franklin.

[1]Formerly Bonded Abrasives Div., Carborundum Co. Inc.
[2]Also dimension stone.
[3]Also crushed stone.
[4]Also clays.
[5]Also lime.
[6]Declared bankrupt at midyear.
[7]Also expanded perlite.
[8]Also sulfur (recovered).
[9]Ceased operations permanently Dec. 31, 1983.
[10]Refractory dead-burned dolomite and dolomite lime.
[11]Closed Jan. 1983.
[12]Also exfoliated vermiculite.
[13]Also iron slag.
[14]Also construction sand and gravel.

The Mineral Industry of Oklahoma

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Oklahoma Geological Survey for collecting information on all nonfuel minerals.

By Lorraine B. Burgin[1]

The value of nonfuel minerals in Oklahoma stabilized at $226 million in 1983, reflecting a moderate recovery from 1982's recession. In 1982, production dipped to $225 million from 1981's record high $235 million. Construction materials continued to represent most of the output value with portland cement, crushed stone, and construction sand and gravel leading the commodities produced in Oklahoma, followed by industrial sand, gypsum, iodine, masonry cement, lime, and clays. Of the raw materials surveyed, value of production increased in all except construction sand and gravel, dimension and crushed stone, salt, and tripoli. Nationally, the State ranked first in output of iodine and third in crude gypsum production.

Table 1.—Nonfuel mineral production in Oklahoma[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	W	W	45	$3,074
Portland	do	W	W	1,719	83,685
Clays	do	752	$1,907	862	2,288
Gem stones		NA	2	NA	2
Gypsum	thousand short tons	1,254	10,089	1,351	11,571
Pumice	do	1	W	1	W
Sand and gravel:					
Construction	do	7,490	17,733	e7,500	e17,300
Industrial	do	1,222	13,114	1,184	13,221
Stone:					
Crushed	do	e30,100	e84,200	23,865	76,941
Dimension	do	e18	e968	10	737
Combined value of feldspar, iodine, lime, salt, tripoli, and values indicated by symbol W		XX	97,031	XX	17,367
Total		XX	225,044	XX	226,186

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data; included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Oklahoma, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Adair	[2]	--	
Alfalfa	[2]	--	
Atoka	W	[3]	
Beaver	W	W	Pumice.
Blaine	W	W	Gypsum, sand and gravel (construction).
Bryan	W	W	Sand and gravel (construction).
Caddo	W	$2,278	Gypsum.
Canadian	W	W	Sand and gravel (construction), clays.
Carter	W	[3]	
Cherokee	W	[3]	
Choctaw	$2,536	768	Sand and gravel (construction).
Cimarron	1,538	--	
Cleveland	[2]	1,382	Sand and gravel (construction).
Coal	W	[3]	
Comanche	W	W	Gypsum.
Cotton	[2]	1,278	Sand and gravel (construction).
Craig	W	[3]	
Creek	W	W	Sand and gravel (construction), clays.
Custer	W	W	Do.
Garfield	--	W	Sand and gravel (construction).
Garvin	[2]	W	Do.
Greer	W	W	Clays, sand and gravel (construction).
Harmon	W	W	Salt.
Haskell	360	[3]	
Hughes	[2]	W	Sand and gravel (construction).
Jackson	W	W	Gypsum.
Johnston	W	W	Sand (industrial).
Kay	W	599	Sand and gravel (construction).
Kingfisher	[2]	W	Sand and gravel (construction), iodine.
Kiowa	W	[3]	
Le Flore	W	W	Clays, sand and gravel (construction).
Logan	[2]	W	Sand and gravel (construction).
McClain	[2]	W	Do.
McCurtain	1,342	565	Do.
McIntosh	W	[3]	
Major	W	[3]	
Marshall	W	[3]	
Mayes	W	W	Cement, clays.
Murray	13,248	W	Sand and gravel (construction).
Muskogee	W	W	Feldspar, sand (industrial), sand and gravel (construction).
Noble	W	[3]	
Oklahoma	W	W	Sand and gravel (construction), clays.
Okmulgee	W	[3]	
Osage	1,280	[3]	
Ottawa	W	W	Tripoli.
Pawnee	1,364	W	Sand and gravel (construction).
Payne	665	W	Do.
Pittsburg	W	W	Do.
Pontotoc	W	31,896	Cement, sand (industrial), clays, sand and gravel (construction).
Pottawatomie	[2]	W	Sand and gravel (construction).
Pushmataha	[2]	W	Do.
Rogers	W	W	Cement.
Seminole	W	407	Clays, sand and gravel (construction).
Sequoyah	W	W	Lime, sand and gravel (construction).
Stephens	[2]	--	
Texas	[2]	W	Sand and gravel (construction).
Tillman	[2]	[3]	
Tulsa	7,564	3,016	Sand and gravel (construction).
Wagoner	[2]	180	Do.
Washington	W	[3]	
Woodward	W	W	Iodine, sand and gravel (construction).
Undistributed[4]	182,916	97,508	
Sand and gravel (construction)	[e]21,700	XX	
Stone:			
Crushed	XX	[e]84,200	
Dimension	XX	[e]968	
Total[5]	234,512	225,044	

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Beckham, Delaware, Dewey, Ellis, Grady, Grant, Harper, Jefferson, Latimer, Lincoln, Love, Nowata, Okfuskee, Roger Mills, Washita, and Woods Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension was produced; data not available by county.

[4]Includes gem stones and some sand and gravel (construction, 1982) that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Oklahoma business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,519.9	1,524.1	+0.3
Unemployment	do.	153.4	131.4	-14.3
Employment (nonagricultural):				
Mining[1]	do.	81.9	73.9	-9.8
Manufacturing	do.	163.9	168.3	+2.7
Contract construction	do.	47.6	44.9	-5.7
Transportation and public utilities	do.	67.3	66.8	-.7
Wholesale and retail trade	do.	276.2	284.3	+2.9
Finance, insurance, real estate	do.	61.3	61.5	+.3
Services	do.	211.1	216.8	+2.7
Government	do.	247.9	244.6	-1.3
Total nonagricultural employment[1]	do.	1,157.2	1,161.1	+.3
Personal income:				
Total	millions	$36,121	$36,896	+2.1
Per capita		$11,247	$11,187	-.5
Construction activity:				
Number of private and public residential units authorized		28,741	40,134	+39.6
Value of nonresidential construction	millions	$835.6	$713.1	-14.7
Value of State road contract awards	do.	$179.1	$195.4	+9.1
Shipments of portland and masonry cement to and within the State	thousand short tons	1,912	1,824	-4.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$225.0	$226.2	+.5
Value per capita, resident population		$71	$69	-2.8
Value per square mile		$3,219	$3,233	+.4

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Trends and Developments.—The Center for Economic and Management Research at the University of Oklahoma reported that economic conditions in Oklahoma improved slowly from the effects of the recession despite a 13% decline in natural gas production and low-level activity in agriculture. Crude oil production held steady in 1983, increasing 0.7% over that of 1982. Residential construction, which increased the first part of 1983, decreased during the last half of the year; however, the dollar volume of total construction activity reached $2.4 billion, exceeding that of 1982 by 12.7%. Unemployment in Oklahoma rose to 9% in 1983 from 5.2% in 1982 and in 3.7% in 1981.[2]

Mining employees, including those in oil and gas production, declined from 105,600 in 1982 to 77,500 in 1983.[3] According to the Oklahoma Employment Security Commission, the oil and gas production industry employed 74,500 in 1983, a 27% drop from that of 1982. Average employment in the coal mining industry fell from 1,700 workers in 1982 to 1,200 in 1983. In the nonfuel, nonmetallic mining industry, employment was stable at 1,700 workers for both years. Workers in the metal mining industry dropped below 100 in 1983.

Oklahoma was becoming increasingly concerned about its water supplies. From 1940 to 1980, the Ogallala aquifer water level in the northwest part of the State declined 50 feet; the Rush Springs aquifer water level in the west-central part dropped as much as 10 feet in the past 8 years; little water was available for development in western Oklahoma; natural brine seeps and springs made water unusable along the Arkansas, Cimarron, Red, and Salt Fork Rivers; sulfates from gypsum affected the Washita River; and Tar Creek pollution from abandoned zinc-lead mines threatened the Roubidoux aquifer in northeast Oklahoma.

In fiscal year 1983, Oklahoma received $2.02 million from the U.S. Bureau of Land Management, under the Mineral Leasing Act, compared with $2.21 million in 1982.

Exploration Activities.—Exploration continued to be depressed, and no known exploration projects were in progress.

The Oklahoma Geological Survey described and analyzed copper mineralization in the Triassic Sheep Pen sandstone in Cimarron County, OK, and adjacent parts of Colorado and New Mexico. Occurrences of azurite, chalcocite, and malachite were found in lenticular veins or pads or disseminated in sandstones. In the 3-State area, 210 copper prospects in the Sheep Pen Formation are known.[4] In 1975, Eagle-Picher Industries Inc. shut down its Permian shale

Creta deposits in Jackson County, the last copper mined in the State.

Legislation and Government Programs.—The U.S. Department of the Interior, Office of Surface Mining, conducted public hearings to determine whether the Oklahoma Department of Mines should continue regulating strip mining in the State. The hearings could lead to the first Federal takeover of a State agency's regulatory duties. Under the law, if a State is unable or unwilling to correct significant problems, the Federal Government could assume responsibility. Problems stemmed from surface mining an area honeycombed with abandoned underground coal mines filled with contaminated water. Fears were that the tainted mine waters would pollute the surrounding area. The decision could affect all surface mining and could control how Oklahoma's 7.8 billion short tons of bituminous coal reserves is developed.

The U.S. Geological Survey continued to update its MR-34 map entitled "Silver Resources of the United States" and analyzed mineralization samples obtained in Oklahoma in fiscal year 1982. Also under preparation was a geologic map of the Ouachita Mountains and a report on the structural framework of the area. The Survey published its Geologic Map Index of Oklahoma in 1982.[5]

A new report released by the U.S. Bureau of Mines provided geologic information for long-range planning of subsurface coal and gas production from the Hartshorne Coalbeds of southeastern Oklahoma. These coalbeds in the Western Arkoma Basin contain more than 1 billion tons of minable metallurgical and steam coal and about 325 billion cubic feet of methane gas. Development of the resource has been hindered by excessive methane emissions and complex geologic conditions, including steeply dipping beds, geologic faults, varying coal stability, and poor roof-rock stability.[6]

Celebrating its 75th year, the Oklahoma Geological Survey noted its accomplishments in investigating the State's metal and nonmetal mineral resources, petroleum and natural gas, coal, geothermal resources, water resources, and environmental problems, as well as basic geologic studies and acquisition of the Oklahoma Geophysical Laboratory. In its 75 years, the Survey published 135 bulletins, 86 circulars, 36 mineral reports, 26 geologic maps, 21 special publications, 4 educational publications, 9 hydrologic atlases, and 43 volumes of "The Hopper" and "Oklahoma Geology Notes."[7]

Although restricted by limited funds in 1983, the Oklahoma Geological Survey published reports, including among others, "A Map of Oklahoma Showing Localities of Reported Uranium and Radioactive Values" by Matthew W. Totten; "A Study of Stability Problems and Hazard Evaluation of the Oklahoma Portion of the Tri-State Mining Area" by Kenneth V. Luza; "A History of the Oklahoma Geological Survey, 1908-1983" by Elizabeth A. Ham; and "Copper Deposits in Sheep Pen Sandstone (Triassic) in Cimarron County, Oklahoma, and Adjacent Parts of Colorado and New Mexico" by Robert O. Fay.

The Oklahoma Mining and Minerals Research Institute, one of 31 institutes established nationwide by the U.S. Bureau of Mines, was operated as a division of the Energy Resources Institute, University of Oklahoma, Norman. Founded in part to upgrade the University of Oklahoma's minerals curriculum through research, the institute was funded on a matching basis by the Bureau and received a $150,000 allotment for fellowship awards, research support, and administrative expenses.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Cement producers in Oklahoma included Ideal Basic Industries Inc., Lone Star Industries Inc., and Martin Marietta Corp.'s Martin Marietta Cement Western Div. (after May 1983, Blue Circle Inc.). Built in 1959 at Ada, the Ideal Cement Co. wet-process plant had a rated annual capacity of 610,000 short tons and served south-central Oklahoma and a part of Texas. In 1983, a clinker-cooler dust-collection system was being installed at an estimated cost of $5.4 million.[8] The two existing clinker coolers will be replaced with two reciprocating-grate coolers.

Lone Star's two-kiln, dry-process cement plant at Pryor had a 799,000-ton-per-year cement-grinding capacity and a 683-ton-per-day clinker capacity.[9]

Blue Circle Industries PLC of London, England, acquired Martin Marietta's cement plant at Tulsa and depot at Oklahoma City, two dry-process cement plants in Ala-

bama and Georgia, and a lime plant and six depots for $103 million; Blue Circle Inc. will manage the U.S. subsidiary. The Tulsa dry-process cement plant included two coal-fired kilns.[10] As part of a modernization program, the company planned to expand its grinding facilities at Tulsa at yearend. The plant had a 694,000-ton-per-year cement-grinding capacity and a 1,058-ton-per-day clinker capacity.[11]

After declining in 1982, portland and masonry cement shipments increased significantly in 1983. Gray cement, classified as general use and moderate heat, sold by all three companies, increased in quantity and value; the other varieties of gray cement, high-early-strength, high-sulfate-resistance, and oil well, declined in 1983. Ready-mixed concrete companies led in purchasing finished portland cement, followed by building material dealers, concrete product manufacturers, highway contractors, and others; building material dealers' use rose about 97% in 1983. The companies shipped much of their portland cement from the plant to terminal by rail, thence to consumers by truck. A small amount of cement was barged to consumers. Production of portland cement dropped slightly as 1982's unsold inventories were marketed. Prepared masonry cement production and sales increased. Principal raw materials consumed included cement rock and limestone, followed by clays, shale, gypsum, iron ore, and sand; except for clays and gypsum, all materials used declined. Consumption of bituminous coal, natural gas, and electrical energy also dipped.

Clays.—Oklahoma's clay and shale industry recovered substantially from the 1982 production slump. Clay producers, in descending order of quantity mined, included Ideal Basic from its Lawrence pit in Pontotoc County, Blue Circle Inc. from its Tulsa pit in Rogers County, Justin Industries Inc.'s Acme Brick Co. from its Clinton pit in Custer County and from its Edmond pit in Oklahoma County, Commercial Brick Corp. from its Commercial pit near Wewoka in Seminole County, Chandler Materials Co. from its Haydite pit near Choctaw in Oklahoma County, Oklahoma Brick Corp. from its Canadian pit in Canadian County, W. S. Dickey Clay Manufacturing Co. from its Chandler clay mine at Monroe in Le Flore County, Mangum Brick Co. at its Mangum pit in Greer County, and Frankoma Pottery Co. Inc. at its Sugar Loaf Hill pit at Sapulpa in Creek County. Common clay and shale was used principally for portland cement and face and common brick, followed by concrete block, structural concrete, sewer pipe, and pottery. The average unit value was $2.66.

Feldspar.—Oklahoma was one of the six States reporting feldspar production. Arkhola Sand and Gravel Co. continued to recover feldspar from sands dredged from the bed of the Arkansas River near Muskogee. Processed to a product containing 25% feldspar and the remainder quartz, the mixture was utilized by glass industries in the State. Although output increased slightly, its value climbed over one-fifth because of improved markets in the latter half of the year.

Gypsum.—Oklahoma was the third largest producer of crude gypsum in the Nation in 1983. Output increased nearly 8% in 1983; production value, however, jumped about 15%, reflecting higher prices for the raw material. Companies mining crude gypsum in the State, in descending order of quantity produced, included United States Gypsum Co. at Southard, Blaine County; Republic Gypsum Co. near Duke, Jackson County; Temple Eastex Inc. at Fletcher, Comanche County; Harrison Gypsum Co. Inc. south of Cement, Caddo County; Lehigh Portland Cement Co. at Watonga, Blaine County; and Western Plains Materials at McFaddin, Woodward County. The Raymond Schweitzer Gypsum Co. Calumet Mine in Canadian County and the Walton Gypsum Co. Okeene Mine in Blaine County were dormant. Production from the calcining facilities at the Republic Gypsum and U.S. Gypsum operations declined, while value increased.

U.S. Gypsum's new Slurry Hydrocal-C-Base plant at Southard started up in 1983. Computerized equipment was used at two operating places; the grinding, calcining, and thermo-tank storage area and at the filtering, tube milling, and screening site to the finished storage bins.

Iodine.—Oklahoma produced most of the Nation's iodine; although output increased about 18%, value rose just 5%.

Woodward Iodine Operations, 51% owned by PPG Industries Inc. and 49% owned by Amoco Production Co., recovered iodine associated with a byproduct natural gas at its plant approximately 8 miles northeast of Woodward, Woodward County. According to the company, the plant was fed from nine production wells sunk more than 7,000 feet to the Pennsylvanian Morrowan Formation. Managing the field and depending on demand, Amoco could pump nearly 2.5 mil-

lion gallons per day to the Woodward iodine facility for processing. Brines were fed to a stripping column to obtain an iodine-rich vapor, then in another column, absorbed into solution and moved to the recovery section where the iodine solution was crystallized, filtered, and dried before being melted at temperatures between 250° and 280° F. Through a cooling process, the molten iodine was flaked and dropped into 150- and 50-kilogram drums for marketing; the reject brines were neutralized, filtered, and returned to the underground formation by means of six injection wells.

North American Brine Resources, a joint venture of Beard Oil Co. of Oklahoma City (40%) and two Japanese firms—Godoe USA Inc., a subsidiary of United Resources Industry Co. (50%), and Inorgchem Development Inc., a subsidiary of Mitsui & Co. (10%)—recovered iodine from oilfield waste brines at its miniplants in Dover and Hennessey, Kingfisher County.

Iodine was used chiefly for catalysts, animal-feed additives, pharmaceuticals, disinfectants, and stabilizers, followed by inks and colorants, photographic equipment, iodized salt, smog inhibitors, and other products.

Lime.—St. Clair Lime Co. continued mining a high-calcium lime for producing quicklime and hydrated lime at its operation in Marble City, Sequoyah County. Production increased nearly 7% in quantity and 20% in value.

Pumice (Volcanic Ash).—Volcanic ash was mined and processed at Axtell Mining Corp.'s Beaver No. 1 Mine near Gate, Beaver County, in the eastern panhandle area of Oklahoma. Deposited in a Pleistocene Age lake, the 40- to 70-foot-thick volcanic-ash bed consisted largely of volcanic glass shards, mixed with lesser amounts of clay, feldspar, mica, quartz, and diatom fossils. Output and value increased during 1983; the product was shipped mainly for use in abrasives and a small amount was for road construction and maintenance.

Salt.—Acme Salt Co. at Erick, Harmon County, produced crystal salt from brines evaporated in solar ponds. Salt production decreased sharply to nearly one-half the 1982 output. The State's natural brines originate in shallow underground salt beds in the Permian Flowerpot Shale. Commercial brines are pumped from shallow wells drilled into brine-filled solution cavities in salt beds.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

Reflecting the lingering recession that depressed construction nationwide, Oklahoma's construction sand and gravel production held its own, increasing slightly in tonnage shipped and dropping just 2% in value. Industrial sand output declined 3% in 1983; however, its value was just over that of 1982.

Table 4.—Oklahoma: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	5,551	$13,515	$2.43	NA	NA	NA
Gravel	869	2,571	2.96	NA	NA	NA
Sand and gravel (unprocessed)	1,069	1,647	1.54	NA	NA	NA
Total or average	[1]7,490	17,733	2.37	[e]7,500	[e]$17,300	[e]$2.31
Industrial sand	1,222	13,114	10.73	1,184	13,221	11.17
Grand total or average	8,712	30,847	3.54	[e]8,684	[e]30,521	[e]3.51

[e]Estimated. NA Not available.
[1]Data do not add to total shown because of independent rounding.

Leading producers of industrial sand in 1983 included Pennsylvania Glass Sand Corp. near Mill Creek, Johnston County; Mid-Continent Glass Sand Co. at Ada, Pontotoc County; and Arkhola Sand and Gravel near Muskogee, Muskogee County. About 48% of Oklahoma's industrial sand production was used for glassmaking for containers, plate and window glass, specialty glass, and fiberglass. Other uses included abrasives, foundry sands, roofing granules, and hydraulic fracturing sands. The unit value of industrial sand ranged from $8.08 to $36.77 per short ton in 1983; however, the average value was $11.17 per ton, compared with $10.73 in 1982. Most industrial sand was shipped by railroad and the rest by truck.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Crushed stone produced fell to its lowest point since 1977; the commodity declined in value, once again surrendering its long-held position as the leading nonfuel mineral. Crushed stone was quarried in 34 counties; listed in descending order of tonnage, more than 78% came from Comanche, Rogers, Murray, Kiowa, Tulsa, Caddo, Pontotoc, Pawnee, Seminole, Johnston, and Mayes Counties. Nearly 96% of the output was limestone and dolomite; however, some granite was quarried in Greer and Seminole Counties and sandstone in McIntosh and McCurtain Counties. Leading uses of limestone included dense road base, concrete aggregate, cement manufacture, fill, surface treatment of roads, bituminous aggregate, and railroad ballast. Among other uses, dolomite was utilized for agricultural limestone, fill, glass manufacture, and roofing granules. Granite was used for dense road base, riprap and jetty stone, fill, and fine aggregate; some sandstone was used for road construction. During the year, 42 companies produced crushed stone at 60 quarries in Oklahoma. In descending order of tonnage, major producers included Dolese Bros. Co., Arkhola Sand and Gravel, Materials Producers Inc., Anchor Stone Co., Koppers Co. Inc.'s Tulsa Rock Co., McNabb Coal Co. Inc., Hallett Construction Co., The Quapaw Co., Ideal Basic, Blue Circle Inc., Bellco Materials Inc., and Boorhem-Fields Inc.

The Balagna Excavating Co. limestone operation southwest of Wewoka, Seminole County, commenced crushing rock for road construction. Maximum daily capacity of the new plant was 2,000 short tons; 13 workers were employed at the site.

Table 5.—Oklahoma: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	212	890
Filter stone	43	179
Coarse aggregate, graded:		
Concrete aggregate, coarse	4,500	17,857
Bituminous aggregate, coarse	918	3,788
Bituminous surface-treatment aggregate	1,230	5,922
Railroad ballast	834	3,460
Other graded coarse aggregate	143	500
Fine aggregate (-3/8 inch): Screening, undesignated	690	1,335
Coarse and fine aggregate:		
Graded road base or subbase	4,751	11,725
Unpaved road surfacing	62	128
Crusher run or fill or waste	1,650	4,786
Agricultural: Agricultural limestone	57	248
Chemical and metallurgical:		
Cement manufacture	1,633	2,664
Glass manufacture	168	W
Special:		
Roofing granules	174	W
Other[2]	6,801	23,460
Total[3]	23,865	76,941

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."

[1]Includes limestone, dolomite, granite, sandstone, and miscellaneous stone.

[2]Includes other agricultural uses; macadam; stone sand, bituminous mix or seal; uses not specified; and uses indicated by symbol W.

[3]Data do not add to totals shown because of independent rounding.

Dimension.—Output of dimension stone slumped to nearly one-half the 1982 production; however, the average value per ton moved from $54.31 in 1982 to $74.18 in 1983. Fifty-four percent of the output was granite used principally for monumental stone; the remainder was sandstone. Listed in descending order of output, granite producers included Boadie L. Anderson Quarries Inc. in Johnston County, and Fairfax Granite Inc. of the Rock of Ages Corp., Roosevelt Granite Co. Inc., and Sierra Granite Co. Inc. in Kiowa County. Barbee Stone quarried sandstone for rough blocks in Haskell County, Miller Wilson for cut stone in Le Flore County, and TDM Quarry Co. for irregular shapes and flagging in Pittsburg County.

Sulfur (Recovered).—Sulfur was recovered in natural gas processing and petroleum-refining operations by Tosco Corp. at its Duncan refinery in Stephens County.

Sulfuric Acid.—Production of sulfuric acid recovered in smelting and refining zinc concentrates increased in quantity and decreased in value.

Tripoli.—Of the three States producing tripoli in the Nation, Oklahoma ranked second with more than one-fifth of the total output. Illinois and Arkansas were the other producing States. The American Tripoli Co. mined tripoli in east-central Ottawa County, northeast Oklahoma, and processed the material in Seneca, MO. The Carborundum Co. sold its American Tripoli division to a group of investors in 1982. Tripoli is a naturally occurring microcrystalline, finely particulated, friable form of silica leached from a siliceous limestone or calcareous chert. Used principally as an abrasive in polishing and buffing compounds, tripoli output declined in quantity and value in 1983.

Vermiculite (Exfoliated).—W. R. Grace & Co. produced exfoliated vermiculite at its plant in Oklahoma City; vermiculite concentrate was shipped in from out of State. Production and sales of the material declined slightly in quantity and value. Leading uses of the product included block insulation, loose-fill insulation, and concrete aggregate; a small amount was sold for horticultural applications.

METALS

No metallic ore was mined in Oklahoma during 1983. Several metals, however, were recovered from instate smelters that used recycled materials from local and out-of-State sources and from ore concentrates from out-of-State producers.

Iron and Steel.—Oklahoma's only steel facility, the Sheffield Steel Corp. of Sand Springs, 7 miles west of Tulsa, made reinforcing bars for the construction industry. The company was owned by HMK Industries, Houston, TX, which bought the plant from Armco Inc., Middletown, OH, in 1981. Faced with closure in 1982, Sheffield Steel's union agreed to a 46-month concession contract in December, the first in the Nation for the United Steelworkers of America; the $2.51 per hour "give back" the union approved was partly returned during the year. In addition, a Labor Management Participation Team, required in the contract, met and approved major moves at the plant including capital projects. In 1983, the group planned to improve efficiency and broaden its product line.

Sales of steel slag increased in quantity and value in 1983.

Vanadium.—The Bartlesville operation of Somex Ltd., a division of Phibro-Salomon Inc., remained idle during the year. The vanadium-extraction plant, impacted with a labor strike in the third quarter, was closed in November 1982 because of technological problems and plummeting demand for the metal. In December 1983, private investors purchased Somex and three other Phibro-Salomon companies for $40 million; a new company, Continental Resources and Development Inc., was formed to operate the four companies.[12] More than $2 million had been spent on designing and constructing the Somex chemical leaching plant alone. The facility was built in 1979 to process power-station boiler ash, refinery residues, and spent refinery catalysts, recovering a 95% to 96% V_2O_5 fused-oxide flake. Vanadium is used as a steel and titanium alloying agent and as a catalyst.

Zinc-Lead.—National Zinc Co., a subsidiary of Phibro-Salomon, operated a 55,000-short-ton-per-year electrolytic zinc refinery for producing slab zinc, byproduct cadmium, and sulfuric acid. In December, Phibro-Salomon sold its National Zinc company and three other companies to private investors who planned to operate under the name Continental Resources and Development Inc. Though extensively modernized, the 76-year-old plant had been only marginally profitable because of its location. Since the shutdown of its major suppliers in the Picher District, ores were purchased from mining operations in Canada, Colorado, Mexico, Missouri, Peru, and Tennessee.

Covering a 6-square-mile area in Ottawa County, OK, and Cherokee County, KS, the

Picher Field is part of the Tri-State (Kansas, Missouri, and Oklahoma) mining region, one of the most productive zinc-lead mining areas in the world. From 1904 to 1970, its ores yielded more than $1 billion from over 7 million tons of zinc and 2 million tons of lead. The mines have been closed for many years.

Confined to the flat or gently dipping Boone Formation, the ores consisted chiefly of the zinc mineral sphalerite and the lead mineral galena; and small amounts of the copper minerals chalcopyrite, enargite, and luzonite. The iron sulfides marcasite and pyrite were abundant accessory minerals. Mining and milling by many small operators on 40-acre tracts in the early days left many openings and abandoned underground workings. In 1930, centralized milling was begun, and operations were consolidated. These large-scale mining activities ended in the 1960's, and the pumps were removed from the underground mines. By 1979, the surface mines flooded, and acidic mine water began to discharge from the mine shafts and boreholes. Water leached the oxidized pyrite left as waste in the underground mines and also picked up contaminants in the surrounding area, producing an acidic solution. In addition to acidity, major pollutants in the mine-drainage water flowing into the Tar Creek watershed included sulfate, iron, zinc, cadmium, lead, chromium, and fluoride.

The Tar Creek drainage system originates in Cherokee County, KS, and flows through Ottawa County in northeastern Oklahoma until it reaches the confluence of the Neosho River, thence to Grand Lake, a major drinking-water source and popular recreation area.

Many abandoned wells in the Picher area provided direct access for the mine water to migrate downward to the Roubidoux aquifer, posing an additional pollution source from acidity. Estimates were that, assuming the production of acid mine waters had ceased, it would take 60 to 100 years to flush out about 76,000 acre feet of acidic mine waters in the flooded, abandoned mines beneath Ottawa County, OK, and southeastern Kansas.[13]

In October 1981, the Tar Creek area was classified one of the most hazardous waste sites in the Nation and eligible for Federal funds under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 for remedial investigation and feasibility studies. With the Oklahoma Water Resources Board as the lead agency, monitoring and sampling work began in July 1982.

The final phase of the 3-year study began in September 1983; two experimental wells, one adjacent to the No. 2 Consolidated Mine, 1 mile east of Picher, and the other near Skeleton, 1 mile south of Picher, were plugged with concrete to test the feasibility of plugging about 100 abandoned wells in the area to protect the potable water of the aquifer. In December, the 24-member Tar Creek Task Force appointed by the Governor suggested in the completed feasibility study that the Tar Creek pollution could be partly solved by using dikes and ditches to divert surface runoff away from the mine workings, by treating the mine waters flowing from the mines, and by plugging deep wells to slow the water flow into the Roubidoux aquifer. The protective measures required the cooperation of Kansas; thus, by mid-November, the Governors of Oklahoma and Kansas signed a Memorandum of Understanding to abate ground water pollution in the Picher area. Overall, $750,000 was allocated for the corrective measures in Oklahoma, including $550,000 in Federal monies ($450,000 from the Federal Superfund) and more than $120,000 from State and local funds.

---

[1]State Liaison Officer, Bureau of Mines, Denver, CO.

[2]Dikeman, N. J. Business Highlights. OK Bus. Bull., v. 52, No. 3, Mar. 1984, p. 1 (Center for Economic & Management Research, University of Oklahoma).

[3]U.S. Department of Labor. Employment and Earnings. V. 33, No. 5, May 1984, p. 133.

[4]Fay, R. O. Copper Deposits in the Sheep Pen Sandstone (Triassic) in Cimarron County, Oklahoma, and Adjacent Parts of Colorado and New Mexico. OK Geol. Surv. Circ. 86, 1983, 24 pp.

[5]McIntosh, W. L., and M. F. Eister. Geologic Map Index of Oklahoma. U.S. Geol. Surv., compiled 1978, printed 1982, 16 pp.

[6]Iannacchione, A. T., C. A. Kertis, D. W. Houseknecht, and J. H. Perry. Problems Facing Coal Mining and Gas Production in the Hartshorne Coalbeds of the Western Arkoma Basin, Oklahoma. BuMines RI 8795, 1983, 25 pp.

[7]Ham, E. A. A History of the Oklahoma Geological Survey, 1908-1983. OK Geol. Surv., Spec. Publ. 83-2, 60 pp.

[8]Ideal Basic Industries Inc. 1983 10K Annual Report. Pp. 3, 15.

[9]Smith, M. North American Cement. Ind. Miner. (London), No. 196, Jan. 1984, pp. 51-65.

[10]Industrial Minerals (London). Blue Circle Deal Complete Martin Marietta. No. 189, June 1983, pp. 15-16.

[11]Work cited in footnote 9.

[12]Mining Journal (London). Phibro-Salomon Sells Minerals and Energy Subsidiaries. V. 302, No. 7742, Jan. 6, 1984, pp. 14-15.

[13]Oklahoma Water Resources Board, Water Quality Division. Tar Creek Feasibility Investigation. Task II.1.A. Identification and Assessment of Potential Remedial Alternatives. EPA Grant No. CX810192-01-0, Dec. 1983, p. 2.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Blue Circle Inc., a subsidiary of Blue Circle Industries Ltd.[1 2]	2609 North 145 East Ave. Tulsa, OK 74116	Quarry and plant	Rogers.
Ideal Basic Industries Inc., Ideal Cement Co.[1 2]	Box 8789 Denver, CO 80201	do	Pontotoc.
Lone Star Industries Inc.[1 2]	Box 68 Pryor, OK 74361	do	Mayes.
Clays:			
Acme Brick Co., a subsidiary of Justin Industries Inc.	Box 24012 Oklahoma City, OK 73124	Pits and plants	Custer and Oklahoma.
Chandler Materials Co	5805 East 15th St. Tulsa, OK 74102	do	Oklahoma and Rogers.
Commercial Brick Corp	Box 1382 Wewoka, OK 74884	Pit and plant	Seminole.
W. S. Dickey Clay Manufacturing Co	Box 6 Pittsburg, KS 66762	Pit	Le Flore.
Mangum Brick Co	Box 296 Mangum, OK 73554	Pit and plant	Greer.
Oklahoma Brick Corp	Box 75368 Oklahoma City, OK 73147	do	Canadian.
Feldspar:			
Arkhola Sand and Gravel Co., a division of APAC-Arkansas Inc., a subsidiary of Ashland Oil Inc.[2 3]	Box 1401 Muskogee, OK 74401	Dredge and plant	Muskogee.
Gypsum:			
Harrison Gypsum Co. Inc	Box 336 Lindsay, OK 73052	Quarry	Caddo.
Republic Gypsum Co	Drawer C Duke, OK 73532	Quarry and plant	Jackson.
Temple Eastex Inc	Box 101 Fletcher, OK 73541	Quarry	Comanche.
United States Gypsum Co	Box 187 Southard, OK 73770	Quarry and plant	Blaine.
Iodine:			
North American Brine Resources	c/o Beard Oil Co. 2000 Classen Center Bldg. Oklahoma City, OK 73106	Oilfield brines and plant.	Kingfisher.
PPG Industries Inc., Woodward Iodine Operations.	Box 1245 Woodward, OK 73801	Brine field and plant.	Woodward.
Lime:			
St. Clair Lime Co	Box 569 Sallisaw, OK 74955	Quarry and plant	Sequoyah.
Pumice (volcanic ash):			
Axtell Mining Corp	Box 92 Gate, OK 73844	Open pit	Beaver.
Salt:			
Acme Salt Co	Box 420 Erick, OK 73645	Solar evaporation	Harmon.
Sand and gravel:			
Dolese Bros. Co	Box 677 Oklahoma City, OK 73101	Pits and plants	Canadian, Garfield, Kingfisher, Logan, McClain.
E & A Materials Inc	Box 365 Wichita Falls, TX 76307	Pit and plant	Cotton.
General Materials Co. Inc	Box 24044 Oklahoma City, OK 73124	Pits and plant	Cleveland, McClain, Oklahoma.
McMichael Concrete Co., a subsidiary of Koppers Co. Inc.[2]	Box 3878 Tulsa, OK 74102	Pit and plant	Tulsa.
Mid-Continent Glass Sand Co	Box 248 Roff, OK 74865	do	Pontotoc.
Mohawk Rock and Sand Co	Box 640 Sand Springs, OK 74063	do	Tulsa.
Pennsylvania Glass Sand Corp., Oklahoma Works.	Box 36 Mill Creek, OK 74856	do	Johnston.
Shoffner Sand of Oklahoma Inc	Box 863 Edmond, OK 73034	do	Oklahoma.
Stone:			
Anchor Stone Co.[3]	Box 94750 Tulsa, OK 74194	Quarries and plant	Creek and Tulsa.
Boadie L. Anderson Quarries Inc	Box 1648 Ada, OK 74820	Quarry	Johnston.
Dolese Bros. Co	Box 677 Oklahoma City, OK 73101	Quarries	Caddo, Coal, Comanche, Kiowa, Murray, Pittsburg, Seminole, Tulsa.
Fairfax Granite Inc., a subsidiary of Rock of Ages Corp.	c/o Rock of Ages Corp. Box 482 Barre, VT 05641	Quarry	Kiowa.
Hallett Construction Co	Box 13 Boone, IA 50036	do	Murray.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Materials Producers Inc.	Box 577 Norman, OK 73070	Quarry	Murray.
McNabb Coal Co. Inc.	Drawer C Catoosa, OK 74015	do	Rogers.
The Quapaw Co	Box 72 Drumright, OK 74030	do	Creek.
Roosevelt Granite Co. Inc	Box 307 Snyder, OK 73566	Quarries and plant	Kiowa.
Standard Industries, a division of APAC-Oklahoma Inc., a subsidiary of Ashland Oil Inc.	Box 580670 Tulsa, OK 74158	Quarries	Cherokee, Kay, Tulsa.
Tulsa Rock Co., a subsidiary of Koppers Co. Inc.	Box 3878 Tulsa, OK 74102	Quarry	[2] Rogers.
Tripoli:			
American Tripoli Co	Box 489 Seneca, MO 64865	Mines	Ottawa.

[1] Also clays.
[2] Also stone.
[3] Also sand and gravel.

The Mineral Industry Of Oregon

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Oregon Department of Geology and Mineral Industries for collecting information on all nonfuel minerals.

By Herbert R. Babitzke[1] and Mark Ferns[2]

Nonfuel mineral production in Oregon was $111 million in 1983, an increase of 3% over that of 1982. Nonmetallic minerals accounted for nearly 100% of the mineral value reported for the year. Leading commodities produced, accounting for 97% of the total, were stone, sand and gravel, cement, and lime. Oregon ranked 37th nationally in total nonfuel mineral production value. According to the Oregon Department of Geology and Mineral Industries, 3.2 billion cubic feet of natural gas was produced from the Mist Gasfield with a value of $9.5 million.

Oregon's economy turned the corner in 1983 and began to pull out of its long recession. The recovery pace for Oregon turned out to be stronger than was predicted at the beginning of the year.

Table 1.—Nonfuel mineral production in Oregon[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	149	$212	188	$275
Gem stones	NA	500	NA	600
Gold (recoverable content of ores, etc.) troy ounces	W	W	322	137
Nickel (content of ores and concentrates) short tons	3,203	W	--	--
Sand and gravel (construction) thousand short tons	9,513	30,629	e11,000	e37,000
Silver (recoverable content of ores, etc.) thousand troy ounces	--	--	1	10
Stone:				
Crushed thousand short tons	e14,200	e41,900	13,089	39,876
Dimension do.	e(2)	e5	W	W
Talc and soapstone do.	(2)	82	(2)	123
Combined value of cement, copper (1983), diatomite, lead (1983), lime, pumice, sand and gravel (industrial, 1983), and values indicated by symbol W	XX	r34,516	XX	32,922
Total	XX	r107,844	XX	110,943

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Less than 1/2 unit.

Table 2.—Value of nonfuel mineral production in Oregon, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Baker	$20,570	$11,299	Cement, sand and gravel (construction), clays.
Benton	1,004	1,075	Sand and gravel (construction).
Clackamas	W	W	Cement, sand and gravel (construction).
Clatsop	901	W	Do.
Columbia	455	W	Do.
Coos	1,236	W	Do.
Crook	W	W	Do.
Curry	69	W	Do.
Deschutes	W	W	Pumice.
Douglas	W	W	Nickel, sand and gravel (construction).
Gilliam	--	W	Sand and gravel (construction).
Grant	3	W	Do.
Hood River	81	(2)	
Jackson	W	1,628	Sand and gravel (construction), talc.
Jefferson	260	(2)	
Josephine	61	W	Sand and gravel (construction), gold.
Klamath	W	W	Clays.
Lake	W	W	Diatomite, sand and gravel (construction).
Lane	844	2,905	Sand and gravel (construction).
Lincoln	1,586	(2)	
Linn	236	535	Sand and gravel (construction).
Malheur	W	1,977	Lime, sand and gravel (construction), gold.
Marion	17	1,653	Sand and gravel (construction).
Morrow	100	W	Do.
Multnomah	6,497	16,474	Sand and gravel (construction), lime, clays.
Polk	638	122	Sand and gravel (construction).
Tillamook	362	W	Do.
Umatilla	W	470	Do.
Union	181	143	Do.
Wallowa	(3)	4	Do.
Washington	5,491	182	Do.
Yamhill	702	305	Do.
Undistributed[4]	63,151	27,169	
Sand and gravel (construction)	e35,100	XX	
Stone:			
Crushed	XX	e41,900	
Dimension	XX	e5	
Total[5]	139,547	107,844	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Harney, Sherman, Wasco, and Wheeler Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Stone, either crushed or dimension, was produced; data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Trends and Developments.—The Hanna Mining Co. reopened its Riddle smelter on November 7 after an 18-month closure. More than one-half of Hanna's laid-off workers were recalled. The plant will continue to operate because of an offpeak power rate agreement for electricity signed with the Bonneville Power Administration. The Riddle plant is the Nation's only combined nickel mining and smelting operation. Reynolds Metals Co. reopened its last idle aluminum potline at Troutdale on December 1, bringing the smelter to full-capacity operation for the first time since October 1981. Martin Marietta Aluminum Inc. recalled all laid-off workers in August, and at yearend, the company's smelter at The Dalles was operating at full capacity. Oregon Metallurgical Corp. (OREMET) temporarily closed its titanium melt shop in September owing to high inventories and a depressed market. Transition Metals Corp. expanded its operation, which processes rare metals and their carbides. Albany Titanium Inc. (ALTi) reorganized the company and reported that production of titanium powder and sponge would commence in 1984.

Exploration Activities.—Acquisition, exploration, and evaluation of precious-metal deposits around the State continued at a strong pace in 1983. Development activity declined, however, in part owing to falling metal prices. The principal exploration areas continued to be the newly recognized zones of Tertiary epithermal gold mineralization in Harney, Lake, and Malheur Counties and the old gold districts in Baker and Grant Counties, northeast Oregon; and in Douglas, Jackson, and Josephine Counties, southwest Oregon.

American Copper and Nickel Co. continued its exploration program in Grant and Baker Counties, having just completed an

Table 3.—Indicators of Oregon business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,315.2	1,301.4	-1.0
Unemployment	do	177.8	156.8	-11.8
Employment (nonagricultural):				
Mining	do	1.4	1.4	--
Manufacturing	do	176.1	187.1	+6.2
Contract construction	do	22.3	24.2	+8.5
Transportation and public utilities	do	54.4	54.8	+.7
Wholesale and retail trade	do	228.8	244.6	+6.9
Finance, insurance, real estate	do	62.6	65.0	+3.8
Services	do	189.8	192.9	+1.6
Government	do	196.5	195.8	-.4
Total nonagricultural employment	do	931.9	965.8	+3.6
Personal income:				
Total	millions	$27,350	$29,065	+6.3
Per capita		$10,231	$10,920	+6.7
Construction activity:				
Number of private and public residential units authorized		7,720	8,832	+14.4
Value of nonresidential construction	millions	$484.1	$423.4	-12.5
Value of State road contract awards	do	$172.4	$226.8	+31.6
Shipments of portland and masonry cement to and within the State	thousand short tons	574	554	-3.5
Nonfuel mineral production value:				
Total crude mineral value	millions	$107.8	$110.9	+2.9
Value per capita, resident population		$41	$42	+2.4
Value per square mile		$1,112	$1,143	+2.8

[p]Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

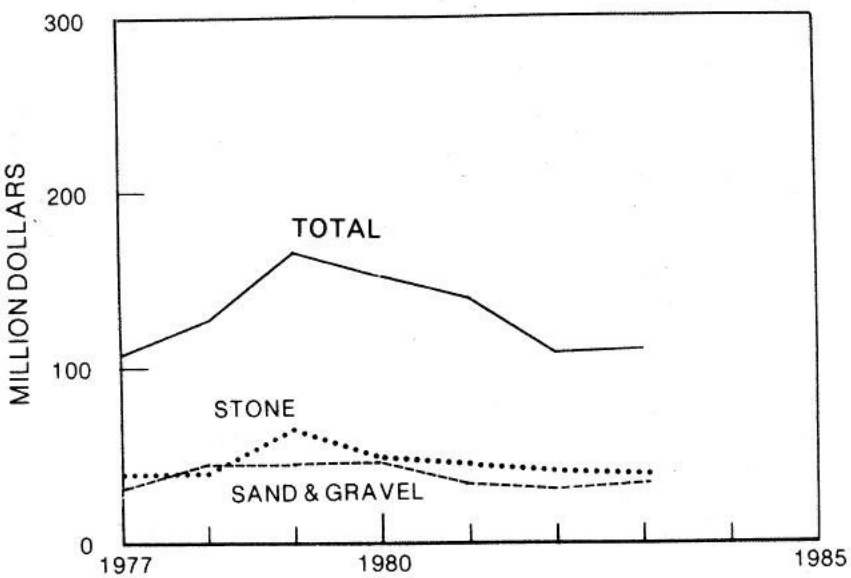

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Oregon.

extensive diamond drilling program on the Badger, Bull of the Woods, and Gem veins in the old Susanville district. Nerco Minerals Co. completed the initial phase of their Bald Mountain-Ibex evaluation program, in which over 50,000 feet of underground diamond drilling was done on the Bald Mountain-Ibex vein. Nerco announced a joint venture exploration program of the property with American Copper and Nickel for 1984. Plans call for an aboveground diamond-drilling program to be started on the Grand Trunk and Belle of Baker claims to the east of the main Bald Mountain workings.

UNC Resources Inc. acquired full ownership of the Cornucopia Mine in eastern Baker County. Exploration and development of the property was at a low level in 1983. Company officials announced that the mine should be in operation in 1985.

Silver King Mines Inc. acquired the two-thirds interest of Texasgulf Inc. in the Iron Dyke Mine on the Snake River, Baker County. Silver King had been in a joint venture partnership with Texasgulf on the Iron Dyke since 1978. The property had produced 36,000 tons of high-grade gold-copper ore when last operated in 1980 and 1981. Silver King has also begun an exploration and evaluation program at the Bay Horse Mine, about 70 miles south of the Iron Dyke on the Snake River. Plans call for stockpiling the ore from both properties for shipment to the company's mill at Copper Cliffs, ID.

Volcanogenic sulfide deposits continued to be the focus of exploration activity in southwestern Oregon. Boise Cascade Corp. and Exxon Minerals Co. were continuing exploration in the McCullogh Creek area of Douglas County. Ray Rock Mines Inc. was attempting to extend the ore reserves previously established by Noranda Exploration Inc. at the Turner-Albright Mine, Josephine County. Noranda had announced that its exploration program outlined over 3 million tons of gold-copper ore at the Turner-Albright Mine.

Diamond-drill programs were under way at Idol City, Harney County; Quartz Mountain, Lake County; and in the Vale-Weiser area of Malheur County. Many of the prospects undergoing evaluation are new gold prospects discovered since 1978.

Low-level exploration of base-metal deposits continued despite depressed metal prices. Manville Products Corp. continued shallow diamond-drilling programs at Meadow Lakes, Baker and Grant Counties, and Grouse Springs, Baker County.

Legislation and Government Programs.—The Department of Geology and Mineral Industries (DOGAMI) is an independent State agency reporting directly to the legislature and the Governor of Oregon. The agency is administered from its main office in Portland and has field offices in Albany, Baker, and Grants Pass. Ongoing geology programs include basic geologic mapping, geothermal resource investigations, inventories of metallic and nonmetallic resources, and oil and gas investigations. Mapping efforts in 1983 included the mineralized ophiolite terrains in northeastern and southwestern Oregon and the Tertiary volcanic accumulations making up the Cascade Range. Major publications included two geologic maps, three special publications, and seven open-file reports.

Major activities of the Mined Land Reclamation Program centered around permitting and regulation of more than 600 sites, including sand and gravel, stone, nonmetallics, and metallic mines (primarily placer gold). Specific activities included issuance of operating permits and limited exemptions to operators based upon the adequacy of the operator's reclamation plans and accomplishments. Periodic field inspections were made to ensure compliance and to properly administer bonding provisions of the Mined Land Reclamation Act. These activities were interfaced with other responsible Federal, State, and local governments.

Several changes in the law governing reclamation were made by the 1983 Legislative Assembly. Authority was granted to increase new permit fees from $390 per year to a maximum of $415 and renewal fees from $290 per year to a maximum of $315 (Oregon Revised Statute (ORS) 517.800). Another act (ORS 517.810) authorized a "per site" bond of up to $2,000 on "aggregate" sites, in addition to the existing maximum bond of $500 per acre. The act added a provision authorizing an acceptance of a single bond covering two or more sites operated by a single company or owned by a single landowner. Other changes relative to aggregate sites were an increase in the authorized lien from $500 per acre to $2,000 per site, plus $1,500 per acre (ORS 517.865).

Another series of amendments were added to ORS 517.750 that broaden the definition of "surface mining" to include the "surface impacts of underground mining." In addition, the previously existing defini-

tion of surface mining was partly rewritten in an attempt to define more clearly what is and what is not surface mining under this law.

ORS 517.780 provides for a city or county to administer the Mined Land Reclamation Law. An added provision (ORS 517.780(2)) directs DOGAMI to review the implementation of county ordinances and withdraw approval of such ordinances upon finding that implementation does not meet standards prescribed by the law and State rules. The newly added ORS 517.785 terminates a city or county option unless the political unit had a reclamation ordinance approved by DOGAMI prior to July 1, 1984.

The law (ORS 517.170 and ORS 517.180) provides a procedure for the owner of land, in which another holds a mineral interest, to extinguish that interest if unused for 30 years. The law requires the landowner to publish notice of lapse of interest and to file notice and affidavit of publication. It creates a procedure for mineral interest holders to avoid extinguishment by filing a "Statement of Claim" before the end of the 30-year period or within 30 days of filing of notice. For a mineral interest that was 30 years old at the effective date of the law, October 15, 1983, the owner has 2 years to file a statement of claim. The law also provides for a Dormant Mineral Interest Record.

Rules to implement all of the ORS changes have been drafted for review.

Distribution of proceeds in lieu of taxes from the U.S. Bureau of Land Management (BLM) to Oregon local governments was $2.6 million in fiscal year 1983. This amount was in addition to the $5.1 million the State received from the BLM under the Minerals Leasing Act.

The March 1983 presidential declaration of the Exclusive Economic Zone opened 4 billion acres of ocean floor for minerals potential exploration. Activities by the U.S. Department of the Interior focused on several spreading oceanic ridges, such as those found on the Juan de Fuca Ridge off the coasts of Oregon and Washington, which are believed to contain deposits high in copper, iron, and zinc, and lesser amounts of cadmium, chromium, platinum, and silver. Recent exploration along the ridge has shown that mineral deposits are significantly larger than estimated earlier.

Hearings were held in Bend and Salem during the months of July and August on Federal legislation that would place nearly 1 million acres of roadless areas into the wilderness system, thus closing the areas to further minerals potential evaluations. Passage of the bill was expected by early 1984.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Value of nonmetallic minerals increased 6% over that of 1982. Recovery in Oregon's construction industry has been slow, with gains confined to heavy construction and, to some extent, housing.

There were more than 600 sites under permit in 1983 under the Surface Mined Land Reclamation Program, most of which were for nonmetallic minerals (primarily sand and gravel and stone).

Cement.—On August 18, 1983, Ash Grove Cement Co. of Overland Park, KS, purchased Oregon Portland Cement Co. Ash Grove was the sole producer of cement in the State in 1983. Production increased over that of 1982, and as in the previous year, production was only from the Durkee plant. The Lake Oswego kilns were not operated during the year, but the plant was used to finish grind clinker and for cement distribution. Market conditions were not adequate to operate at full capacity.

Portland cement produced was used as follows: 73% by ready-mix companies, 20% by highway contractors, and 7% by building material dealers, concrete manufacturers, and others. Raw materials used to produce cement were clays, gypsum, iron ore, limestone, and shale.

Clays.—Common clays were produced in Baker, Klamath, and Multnomah Counties and were used chiefly in brick and cement. Both quantity and value increased over those in 1982. Production of bentonite and zeolite continued at the Teague Mineral Products Co. plant near Adrian, in Malheur County. The bentonite was mined from pits near the head of Sucker Creek, and the zeolite came from deposits near Rome.

Diatomite.—Oil-Dri Production Co. at Christmas Valley was the sole company that mined and processed diatomaceous earth in Oregon during 1983. End use was for absorbents. Production was down from that of 1982.

Eagle-Picher Industries Inc. continued evaluation of diatomite deposits near Harper and announced plans to build a $13

million processing plant west of Vale. The plant will produce filter-grade diatomite.

Lime.—Ash Grove Cement in Multnomah County and Amalgamated Sugar Co. in Malheur County continued production of lime during the year. Most of the lime produced was quicklime; some hydrated lime was produced by Ash Grove. The Ash Grove lime was used by the pulp and paper and the electric steel industries, while that produced by Amalgamated Sugar was used in the company's own sugar refinery. The hydrated lime was used primarily for oil and grease treatment, paper and pulp, animal feed, and soil stabilization.

Pumice.—Pumice was produced by three companies in Baker and Deschutes Counties. All production was from three pits, two of which were in Deschutes County. Primary uses were for concrete aggregate, road construction, landscaping, and roofing.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Ross Island Sand & Gravel Co. in Multnomah County produced industrial sand. All production was used for roofing granules. In addition, Coos Sand Corp. produced industrial sand near Coos Bay. The sand was used primarily for glass, molding sand, sandblasting, and foundries.

Table 4.—Oregon: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	1,387	$4,959	$3.58	NA	NA	NA
Gravel	6,986	22,768	3.26	NA	NA	NA
Sand and gravel (unprocessed)	1,139	2,901	2.55	NA	NA	NA
Total[1] or average	9,513	30,629	3.22	e11,000	e$37,000	e$3.36
Industrial sand	--	--	--	W	W	17.04
Grand total or average	9,513	30,629	3.22	W	W	W

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Data may not add to totals shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Production of crushed stone declined 8% and 5% in quantity and value, respectively, from that of 1982. The biggest use for crushed stone was for road base and unpaved road surfacing. These uses consumed 59% of the crushed stone produced during the year. The U.S. Forest Service produced 36% of the total crushed stone from a number of quarries for road maintenance on Forest Service lands.

Table 5.—Oregon: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	316	1,053
Filter stone	53	203
Coarse aggregate, graded:		
Concrete aggregate, coarse	109	308
Bituminous aggregate, coarse	470	1,528
Bituminous surface treatment aggregate	302	1,221
Railroad ballast	418	1,469
Fine aggregate (-3/8 inch): Screening, undesignated	19	42

See footnotes at end of table.

Table 5.—Oregon: Crushed stone[1] sold or used by producers in 1983, by use —Continued

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse and fine aggregate:		
Graded road base or subbase	2,383	7,477
Unpaved road surfacing	5,347	15,630
Crusher run or fill or waste	785	2,152
Special:		
Asphalt fillers or extenders	3	10
Other[2]	2,883	8,783
Total	[3]13,089	39,876

[1]Includes limestone, granite, sandstone, traprock, miscellaneous stone, and volcanic cinder and scoria.
[2]Includes stone used for agricultural limestone, poultry grit and mineral food, macadam, stone sand (concrete), terrazzo and exposed aggregate, cement manufacture, sugar refining, stone sand (bituminous mix or seal), fine aggregate, combined coarse and fine aggregate, and uses not specified.
[3]Data do not add to total shown because of independent rounding.

Talc.—Steatite of Southern Oregon Inc. continued to mine and market block soapstone for art carving and other specialty uses from its Jackson County deposit.

METALS

Aluminum.—Reynolds reopened its last idle aluminum potline at Troutdale on December 1, bringing the smelter to full capacity operation for the first time since October 1981. Martin Marietta Aluminum recalled all laid-off workers in August, and at yearend, the company's plant at The Dalles was operating at full capacity. Alumax Pacific Corp., the wholly owned subsidiary of Alumax Inc., announced in late January that it was deferring, perhaps indefinitely, plans to construct a $660 million, 200,000-short-ton-per-year reduction plant at Umatilla in northeastern Oregon. The rate increases for electrical power by Bonneville Power Administration and the uncertainty surrounding future rate increases were blamed for the deferment.

Columbium, Tantalum, Zirconium, Hafnium, and Vanadium.—Teledyne Wah Chang Albany (TWCA) has a 2-million-pound-per-year high-purity columbium pentoxide plant in Albany. However, plant operations were idle for the entire year owing to an oversupply of columbium pentoxide on the open market. Sales of reactor-grade metal and powders improved in 1983, but the aerospace sector demand was very weak. TWCA continued to be the leading producer of zirconium and hafnium in the Nation. The demand was down and so was production. TWCA also was a major domestic source of high-purity vanadium metal, which is used to make vanadium-gallium superconductors and has a variety of other applications in the aerospace, electronic, and nuclear industries.

Copper, Gold, Silver, and Lead.—Lode mine production was limited during the year. Some production of copper, lead, and silver was reported from Baker County. One operator also reported production of gold and silver in Josephine County. Placer mining was reported by two operators, one each in Josephine and Malheur Counties, in which only gold was recovered. It is suspected that production of gold in Oregon is significantly greater than that reported; estimates are that gold mined from the eastern and southwestern Oregon mining districts is perhaps 10 to 50 times greater than what is declared.

Small placer mines continued to supply most of the reported gold produced in the State. Operations on Sucker Creek, Josephine Creek, Coffee Creek, and in the Galice Creek areas, Josephine County, in southwestern Oregon, and on Burnt River, Pine Creek, Elk Creek, and Clarks Creek, Baker County, in northeastern Oregon, were among the most productive.

Several small lode gold and silver mines were intermittently worked during the spring and summer of 1983. The Pyx Mine in Grant County and the Thomason Mine in Baker County continued small-scale operations from 1982. The Sunny Valley Mining and Development Co. shipped a small amount of ore from the Greenback Mine, Josephine County, to the smelter at Tacoma, WA. The property is now being evaluated by Mega Gold Resources Inc. The Lyons Bros. of John Day produced a small amount of silver ore from the old Tempest Mine in Grant County. The mine has been operating on a small scale since 1980. Cash Industries Inc. produced an undisclosed amount of silver ore from the old Bay Horse Mine on the Snake River, Baker County, early in the summer of 1983. This property is a noted

past producer of silver (over 150,000 ounces) and is now being drilled by Silver King Mines Inc.

Nickel.—Hanna reopened its Riddle plant on November 7, after an 18-month closure, but because of the time required for preparation of equipment (about 45 days), production of ferronickel had not resumed by yearend. The plant was reopened under a novel energy-use plan that calls for operating the smelter 13 hours at night Monday through Friday, 15 hours on Saturday, and 24 hours on Sunday, using reduced offpeak power supplied by the Bonneville Power Administration. Hanna is the Nation's only integrated nickel producer. Mining is by open pit from Nickel Mountain, 4 miles west of the town of Riddle.

Titanium.—OREMET in Albany continued production of titanium, but at depressed operating levels. The titanium market had not come out of recession owing to the continuing weakness in the commercial aerospace market. Despite the depressed demand, OREMET constructed a furnace based upon a new and innovative design aimed at increasing the use of recycled scrap.

ALTi announced plans to construct a plant by 1986 that will produce approximately 10 million pounds of titanium sponge annually, and with the attendant capability of producing titanium powder. A new process is to be used, licensed from Occidental Petroleum Co., which reportedly does not employ sodium or magnesium reduction. Construction began during 1983 on a 1-million-pound-per-year pilot plant to test the new process. ALTi expects to begin pilot plant production of titanium powder by late 1984 and titanium sponge a few months later.

[1]State Liaison Officer, Bureau of Mines, Spokane, WA.
[2]Geologist, Oregon Department of Geology and Mineral Industries, Baker Field Office, Baker, OR.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Martin Marietta Aluminum Inc	3313 West 2d St. The Dalles, OR 97058	Smelter	Wasco.
Reynolds Metals Co	5100 NE. Sundial Rd. Troutdale, OR 97060	do	Multnomah.
Cement:			
Oregon Portland Cement Co.,[1] a subsidiary of Ash Grove Cement Co.	111 SE. Madison St. Portland, OR 97214	Plants and quarries.	Baker and Clackamas.
Diatomite:			
Oil-Dri Production Co	Box 191 Christmas Valley, OR 97638	Surface mine and plant.	Lake.
Lime:			
Amalgamated Sugar Co	Box 1766 Nyssa, OR 97913	Plant	Malheur.
Ash Grove Cement Co	8900 Indian Creek Pkwy. Suite 600 Overland Park, KS 66225	do	Multnomah.
Nickel:			
The Hanna Mining Co	Box 85 Riddle, OR 97469	Surface mine and smelter.	Douglas.
Sand and gravel (industrial):			
Ross Island Sand & Gravel Co	4129 SE. McLoughlin Blvd. Portland, OR 97202	Pit and plant	Multnomah.
Stone:			
Baker Rock Crushing Co. Inc	21880 SW. Farmington Rd. Beaverton, OR 97007	Quarry	Washington.
L. H. Cobb Crushed Rock Inc	21305 SW. Koehler Rd. Beaverton, OR 97005	do	Do.
Progress Quarries Inc	14515 Scholls Ferry Rd. Beaverton, OR 97005	do	Do.
Rogers Construction Co	Box 730 Umatilla, OR 97882	Quarries	Umatilla and Washington.
U.S. Forest Service, Region 6	319 SW. Pine St. Portland, OR 97208	do	Various.
Talc:			
Steatite of Southern Oregon Inc	2891 Elk Lane Grants Pass, OR 97526	Surface mine and mill.	Jackson.
Titanium:			
Oregon Metallurgical Corp	Box 580 Albany, OR 97321	Smelter	Linn.
Zirconium:			
Teledyne Wah Chang Albany[2]	1600 NE. Old Salem Rd. Albany, OR 97321	do	Do.

[1]Also clays, pumicite, and stone.
[2]Also columbium, hafnium, tantalum, and vanadium.

The Mineral Industry of Pennsylvania

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources, for collecting information on all nonfuel minerals.

By L. J. Prosser,[1] Arthur A. Socolow,[2] and Robert C. Smith[3]

The value of nonfuel mineral production in Pennsylvania in 1983 was $635.1 million, an increase of $32.5 million over that of 1982. Nationally, the State ranked 10th in value of nonfuel mineral production, accounting for about 3% of the U.S. total value of output.

Cement was again the State's leading nonfuel mineral commodity accounting for about 37% of the value of Pennsylvania's mineral production. Nationally in 1983, the State ranked third in portland cement shipments and fourth in masonry cement shipments.

Output of the State's second leading mineral commodity, crushed stone, increased for the first time in 4 years. Although the State ranked third nationally in output, production has declined nearly 20 million tons since 1979 when 71.4 million tons was produced.

Other commodities produced in Pennsylvania included clays, lime, mica, peat, sand and gravel, and dimension stone.

Table 1.—Nonfuel mineral production in Pennsylvania[1]

Mineral	1982 Quantity	1982 Value (thousands)	1983 Quantity	1983 Value (thousands)
Cement:				
Masonry thousand short tons	256	$14,048	262	$17,095
Portland do	4,800	212,945	5,154	218,539
Clays[2] do	931	5,616	916	4,311
Gem stones	NA	5	NA	5
Lime thousand short tons	1,297	70,902	1,507	81,682
Peat do	27	669	22	628
Sand and gravel:				
Construction do	13,081	55,527	e11,800	e52,000
Industrial do	969	13,589	W	W
Stone:				
Crushed do	e50,400	e200,900	51,523	226,948
Dimension do	e48	e6,354	53	5,799
Zinc (recoverable content of ores, etc.) metric tons	24,762	21,001	16,792	15,322
Combined value of clays (kaolin), mica (scrap), tripoli (1982), and value indicated by symbol W	XX	r1,094	XX	12,812
Total	XX	r602,650	XX	635,141

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes kaolin; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Pennsylvania, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Adams	W	$9,747	Lime, clays, mica.
Allegheny	W	17,377	Cement, clays, sand (industrial).
Armstrong	$1,674	W	Sand and gravel (construction), clays, sand (industrial).
Beaver	W	9,189	Sand and gravel (construction).
Bedford	W	(2)	
Berks	W	W	Cement, clays.
Blair	7,670	(2)	
Bradford	(3)	921	Sand and gravel (construction).
Bucks	W	W	Sand and gravel (construction), clays.
Butler	W	17,140	Lime, cement, sand and gravel (construction).
Cameron	(3)	W	Sand and gravel (construction).
Carbon	W	912	Do.
Centre	W	18,672	Lime.
Chester	W	W	Lime, clays.
Clarion	(2)	--	
Clearfield	336	W	Clays.
Clinton	W	536	Do.
Columbia	W	W	Sand and gravel (construction).
Crawford	(3)	1,094	Do.
Cumberland	4,435	923	Do.
Dauphin	3,174	W	Do.
Delaware	W	(2)	
Elk	103	(2)	
Erie	61	4,096	Sand and gravel (construction), peat.
Fayette	W	--	
Forest	(3)	W	Sand and gravel (construction).
Franklin	W	W	Do.
Fulton	W	W	Do.
Huntingdon	W	W	Sand (industrial).
Jefferson	W	W	Clays, sand and gravel (construction).
Juniata	366	(2)	
Lackawanna	W	W	Peat.
Lancaster	W	973	Clays.
Lawrence	W	24,418	Cement, sand and gravel (construction), clays, peat.
Lebanon	W	W	Lime.
Lehigh	W	W	Cement, zinc.
Luzerne	1,067	W	Sand and gravel (construction), peat, sand (industrial).
Lycoming	W	W	Sand and gravel (construction).
McKean	W	W	Clays.
Mercer	W	2,106	Sand and gravel (construction).
Mifflin	W	W	Sand and gravel (construction), lime.
Monroe	W	1,115	Sand and gravel (construction), clays, peat.
Montgomery	W	W	Lime.
Montour	W	(2)	
Northampton	W	113,301	Cement, sand and gravel (construction), clays.
Northumberland	W	907	Sand and gravel (construction), clays, tripoli.
Perry	W	(2)	
Philadelphia	(3)	--	
Pike	377	101	Sand and gravel (construction).
Potter	W	(2)	
Schuylkill	1,002	W	Sand and gravel (construction).
Snyder	W	(2)	
Somerset	3,207	1,778	Clays.
Susquehanna	1,254	W	Sand and gravel (construction).
Tioga	W	W	Do.
Union	W	65	Clays.
Venango	W	W	Sand and gravel (construction), sand (industrial).
Warren	(3)	2,499	Sand and gravel (construction).
Wayne	671	W	Do.
Westmoreland	9,934	W	Do.
Wyoming	(3)	W	Do.
York	45,848	14,604	Lime, cement, clays, sand and gravel (construction).
Undistributed[4]	496,476	152,924	
Sand and gravel (construction)	e61,100	XX	
Stone:			
Crushed	XX	e200,900	
Dimension	XX	e6,354	
Total[5]	638,756	602,650	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Cambria, Greene, Indiana, Sullivan, and Washington Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Stone, either crushed or dimension, was produced; data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Pennsylvania business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	5,381.2	5,383.5	--
Unemployment	do	760.3	542.3	-28.7
Employment (nonagricultural):				
Mining[1]	do	35.8	39.4	+10.1
Manufacturing	do	1,071.2	1,107.3	+3.4
Contract construction	do	137.7	144.3	+4.8
Transportation and public utilities	do	236.8	243.0	+2.6
Wholesale and retail trade	do	947.7	1,002.8	+5.8
Finance, insurance, real estate	do	237.3	245.1	+3.3
Services	do	1,042.9	1,056.3	+1.3
Government	do	679.9	659.2	-3.0
Total nonagricultural employment[1]	do	4,389.3	4,497.4	+2.5
Personal income:				
Total	millions	$129,956	$136,912	+5.4
Per capita		$10,934	$11,510	+5.3
Construction activity:				
Number of private and public residential units authorized		22,271	34,403	+54.5
Value of nonresidential construction	millions	$1,560.2	$1,685.2	+8.0
Value of State road contract awards	do	$275.0	$298.0	+8.4
Shipments of portland and masonry cement to and within the State	thousand short tons	2,310	2,417	+4.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$602.6	$635.1	+5.4
Value per capita, resident population		$51	$53	+3.9
Value per square mile		$13,292	$14,018	+5.5

[p]Preliminary.
[1]Includes coal (anthracite and bituminous), gas, and oil extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

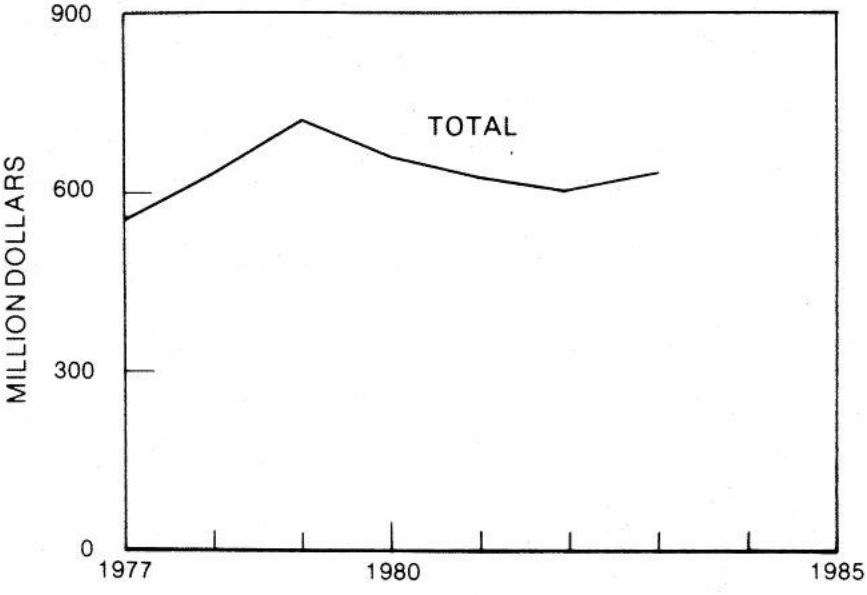

Figure 1.—Total value of nonfuel mineral production in Pennsylvania.

Pennsylvania's last metal mine closed in October, ending a 250-year history of metallic mineral production in the State. New Jersey Zinc Co., a subsidiary of Gulf + Western Industries Inc., shut down its underground zinc mine at Friedensville, Lehigh County, and allowed the mine to flood. Although substantial reserves reportedly remain, the high cost of production and a decline in demand for zinc forced the closure. Late in the year, it was reported that the entire property was sold to a developer.

Trends and Developments.—In 1983, Pennsylvania's nonfuel mineral industry moderately joined in the recovery from the 1981-82 recession. The State's construction sector rebounded in 1983 but at a level below the national average. The value of contract construction awards in Pennsylvania in 1983 surpassed the 1982 mark by 7.7%; nationally, the value increased by 23.4%. Pennsylvania's output of mineral commodities used primarily in construction also lagged behind national rates.

Commodity	Percent change 1982-83	
	United States	Pennsylvania
Cement	+10	+7
Clays	+15	-2
Sand and gravel (construction)	+10	-10
Stone (crushed)	+9	+2

Pennsylvania's manufacturing sector continued to decline in 1983 as average monthly employment in the State's manufacturing industries dropped 6%, while nationally the drop was less than 1% for these industries. The State's primary metals industries accounted for only 2.7% of all nonagricultural employment in 1983, and the average level of employment declined 13.4% compared with that of 1982. The slackened pace of recovery in Pennsylvania's manufacturing sector reflected the State's decline in heavy manufacturing industries, particularly in steel. Prior to 1982, Pennsylvania led the United States in steel production. Since then, both Indiana and Ohio surpassed the State in steel output accounting for 24.2% and 17.5% of the U.S. total, respectively, compared with Pennsylvania's 15.6%.[4] Expected to add to the State's declining position in steel was a December announcement by United States Steel Corp. (USS) that a major restructuring, eliminating about 11,100 jobs in basic steel, was scheduled for April 1984. The announcement listed operations at 6 steel plants in Pennsylvania, affecting about 3,800 workers.

Legislation and Government Programs.—In 1983, the General Assembly of Pennsylvania introduced House bill No. 1176, the Noncoal Surface Mining Conservation and Reclamation Act. The bill would provide a separate law for the State's noncoal mining industry. Since 1972, all mining activities in Pennsylvania were included in a single surface mining law. In 1977, passage of the Federal Surface Mining Law added amendments to the 1972 laws to incorporate mandated Federal requirements. These amendments, according to sponsors of the legislation, imposed requirements, penalties, and economic burdens not appropriate or necessary for the noncoal industry.

Other legislative and regulatory actions under consideration during the year included a bill prohibiting the Department of Environmental Resources (DER) from issuing any permit pertaining to mining, water quality, air quality, solid waste, and other areas unless an on-site inspection is first conducted. In addition, no type of interim or temporary permit could be issued if a project was started without the permission or knowledge of the DER.

Regulatory initiatives under consideration included establishing procedures that allow companies to determine the most effective manner of complying with State air pollution control requirements. The proposed rules would allow Pennsylvania's industries to reduce the cost of complying with air pollution control requirements. Another proposed rule change would limit the water pollution liability for an operator resuming mining at an abandoned minesite. The regulation would limit an operator's liability to meeting the water effluent standards existing at the abandoned site.

Late in the year, the Allegheny County controller filed the first petition under the Pennsylvania Trade Practices Act of 1968 claiming that five foreign countries were engaged in unfair trade practices. The petition, if upheld, would ban the use of steel products from Argentina, Brazil, Mexico, the Republic of Korea, and Spain on government financed or public and private assisted projects in the State. Government agencies in Pennsylvania reportedly purchase an estimated $330 million in steel products per year for highways, bridges, and other construction projects.

The Pennsylvania Topographic and Geologic Survey completed a number of projects including statewide reconnaissance surveys of potential carbonate whiting sources and high-purity silica deposits, reports on white refractory clay deposits and fetid barite

occurrences in Berks County, a summary of the State's slate mining industry, a new "Stratigraphic Correlation Chart of Pennsylvania" for use in understanding nomenclature and in correlating various potential mining intervals, and a publication on the geology and mineralogy of copper-uranium occurrences in the Picture Rocks and Sonestown 7-1/2-minute quadrangles.[5]

Also during the year, The Pennsylvania State University and West Virginia University were jointly named the newest Generic Center for Mineral Technology under the act that established the Mineral Resources Institute Program. The two universities received $1.8 million from the U.S. Bureau of Mines to establish research facilities to investigate black lung disease as well as other respirable dust diseases associated with mining.

Also, in conjunction with the Mineral Resources Institute Program, Penn State completed a handbook outlining procedures for conducting an economic analysis of the effects of proposed new taxes on the mining industry. The publication also provides a summary of State mineral tax laws.[6]

REVIEW BY NONFUEL MINERAL COMMODITIES

In this section, commodities that were mined, processed, or manufactured in Pennsylvania in 1983 are discussed and highlighted. Quantity and value data for mined commodities are given in table 1. Traditionally, cement and lime data are also presented in table 1. The combined value of commodities that were processed or manufactured in Pennsylvania in 1983 was $1.7 billion. These commodities are abrasives, graphite, gypsum, iron and steel slag, perlite, pyrophyllite, sulfur, sulfuric acid, tripoli, vermiculite, ferroalloys, iron oxide pigments, and pig iron. The value of pig iron shipments accounted for 90% of the total. Beryllium and titanium processing operations are also discussed, but no production or value data are available.

NONMETALS

Abrasives.—Three types of abrasive materials—metallic, artificial crude, and tripoli—were produced in Pennsylvania in 1983. Metallic abrasives, steel shot and grit, were manufactured at three plants by three companies in western Pennsylvania. Nationally, the State accounted for 38% of the total metallic abrasives sold or used and was one of only four States that produced this material.

Silicon carbide, classified as a crude artificial abrasive, was manufactured by one firm in southwestern Pennsylvania. The firm was one of only seven that produced silicon carbide in the United States and Canada. Tripoli was purchased by one firm in east-central Pennsylvania and processed for sale as a filler.

Cement.—Pennsylvania's cement industry rebounded in 1983 with a 7% increase in shipments compared with that of 1982. Pennsylvania ranked third nationally in portland cement shipments and fourth in masonry cement shipments. In the past 5 years, the State annually accounted for about 8% of the domestic cement production. Although portland cement production in the State increased in 1983 for the first time in 5 years, shipments remained considerably below the record high of 6.75 million tons shipped in 1978. Grinding capacity also decreased from 9.7 million tons in 1978 to 7.3 million tons in 1983.

Cement data for Pennsylvania is divided into two districts: Eastern Pennsylvania, which is all counties east of the eastern boundaries of Porter, Clinton, Centre, Huntingdon, and Franklin Counties; and western Pennsylvania, which is all other counties in the State. In 1983, the State's eight eastern plants produced 4.1 million tons of portland cement utilizing about 85% of capacity. The State's four western plants produced about 1 million tons of portland cement utilizing about 41% of capacity.

Developments in Pennsylvania's cement industry in 1983 included Keystone Portland Cement Co., Bath, purchasing stone crushing equipment for $1 million for the production of aggregate from low-calcium stone overburden. Previously, overburden at the company's quarry was removed by a contractor. The firm also began marketing cement kiln dust for use in converting aqueous liquid waste into solid waste. As a result, Keystone reported a $200,000 profit from kiln dust sales; previously, disposal of the cement dust cost the firm about $35,000 annually.

Armstrong Cement & Supply Corp., Cabot, formerly Penn-West Cement Co. Inc., began a $3.5 million capital improvement plan. Louisville Cement Co. sold its Bessemer cement plant to SME Bessemer Cement

Co., a subsidiary of Standard Machine & Equipment Co.

Clays.—Production decreased for the fifth consecutive year and was about 1.7 million tons below the 1978 output of 2.6 million tons. In that time period, over one-half of the decline in production resulted from the drop in clays sold or used for face and common brick from about 1.5 million tons to about 771,000 tons. Usage by the clay industry's major consumer, the home construction industry, also declined significantly since 1978 when 54,000 units were started compared with about 22,300 units in 1982 and 34,400 units in 1983.

Table 4.—Pennsylvania: Clays[1] sold or used by producers, by use

(Short tons)

Use	1982	1983
Common brick	33,341	47,002
Face brick	630,530	723,576
Firebrick, block and shapes	115,217	24,373
Flue linings	19,291	22,631
Mortar and cement, refractory	14,493	10,993
Portland and other cements	81,727	51,429
Tile: Drain, quarry, structural	32,034	31,929
Other[2]	4,031	4,031
Exports: Mortar, cement, other refractories	260	260
Total	930,924	916,224

[1]Excludes kaolin.
[2]Includes paint, highway surfacing, and structural concrete.

In 1983, common clay was produced by 20 companies at 37 mines, a decrease of 2 companies and 17 mines, respectively, compared with figures in 1982. Leading production areas included parts of Berks, Jefferson, and York Counties.

Gem Stones.—Mineral specimens and semiprecious gem stones were collected by rockhounds and mineral dealers. Estimated value in Pennsylvania in 1983 was $5,000.

Graphite (Manufactured).—Pennsylvania ranked seventh among the 15 States that manufactured graphite. Production declined about 25% compared with that of 1982. Most of the output was sold as unmachined graphite shapes.

Gypsum (Calcined).—Output in Pennsylvania resumed, reflecting improved conditions primarily in the home repair and rehabilitation markets. Strong demand for wallboard enabled United States Gypsum Co. to reopen its Philadelphia calcining plant during the third quarter of the year. The plant had been closed for more than a year during the recession. The Philadelphia operation was the only gypsum calcining plant active in Pennsylvania during the year.

Lime.—Output in 1983 increased to 1.5 million tons; in 1982, output of about 1.3 million tons was the lowest since 1963. Although demand for lime improved in 1983, production remained well below the levels reported in the late 1970's of more than 2 million tons per year in 1977, 1978, and 1979. The decline in the level of lime production reflects the decreased output of the State's steel industry. In 1983, lime sold or used by Pennsylvania producers and consumed by the steel industry declined more than 500,000 tons compared with 1978 data. Also, of the total lime manufactured in Pennsylvania, 60% was consumed by the steel industry in 1978; steel industry consumption dropped to 50% in 1983.

Most of Pennsylvania's lime was manufactured in the southeastern part of the State in Adams, Chester, Lebanon, Montgomery, and York Counties. Other counties in which lime was produced were Butler in western Pennsylvania and Centre in the central part of the State.

In Centre County, the Domtar Industries Inc.'s underground limestone mine and lime manufacturing plant that were closed in June 1982 were sold to a local investor and renamed Con Lime Inc. Lime production at the 160,000-ton-per-year-capacity plant resumed in May with one of three kilns in operation.

Table 5.—Pennsylvania: Lime sold or used by producers, by use

Use	1982		1983	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, basic oxygen furnace	454,056	$23,207	492,517	$24,350
Steel, electric	178,557	9,068	223,111	11,085
Sewage treatment	153,821	8,248	153,594	8,267
Acid water neutralization (mine or plant)	65,642	3,729	93,681	5,130
Water purification	104,468	5,685	84,576	4,694
Steel, open-hearth	39,462	1,997	39,439	1,955
Mason's lime	49,329	3,716	W	W
Paper and pulp	18,123	880	21,388	1,020
Agriculture	12,837	782	18,907	1,230
Brick, sand-lime	3,517	215	W	W
Petroleum refining	2,481	137	W	W
Metallurgy, other	1,571	80	1,415	W
Other[1]	213,289	13,158	378,130	23,951
Total	1,297,153	70,902	1,506,758	81,682

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes alkalies, glass, oil well drilling, ore concentration, other chemical and industrial uses, paint, petrochemicals (1982), refractories, rubber, silica brick, soil stabilization, sulfur removal from stack gases, tanning, wire drawing, and uses indicated by symbol W.

Mica.—Gross Minerals Corp. mines crude mica (sericite) at an open pit mine in Fairfield about 20 miles from the company's plant in Aspers, Adams County. The deposit is reportedly one of the few in the United States of pure sericite, and ore reserves are estimated at 5 to 7 million short tons. After mining, the material is rotary dried and processed by ball mill and air classification to the micrometer-size range. The material is marketed as a filler and extender.

Peat.—Sales declined more than 5,000 tons in 1983, or nearly 20%, compared with that of 1982. The unit price of peat increased $3.78 to $28.55 per ton with the value of sales declining 6%. Nationally, peat sold for an average price of $25.75 per ton.

Peat mining in Pennsylvania in 1983 was concentrated in two areas. Of the State's seven permitted operations, five were in a three-county area in northeastern Pennsylvania; the other two were on the western border in the northern and central part of the State. The nearest eastern and western peat bogs were separated by about 250 miles. About 75% of the peat was sold in bulk; the other 25% was packaged.

During the year, Anderson Peat Co. in Monroe County was renamed Hyponex Corp. Fehlingers Peat Moss Co., a small producer in 1982 in Luzerne County, was inactive in 1983.

Perlite (Expanded).—Crude perlite mined in New Mexico and shipped to Pennsylvania was expanded by five companies at five plants. Nationally, the State ranked fourth in the quantity of perlite expanded, accounting for about 8% of the U.S. total. In 1983, production declined 7,000 short tons to 31,700 tons valued at about $5 million. U.S. Gypsum discontinued perlite expanding operations at its Philadelphia County plant, although gypsum calcining resumed during the year.

Pyrophyllite.—American Olean Tile Co. imported crude pyrophyllite from its Canadian mine for processing at Lansdale, Montgomery County. The amount of imported ore ground increased nearly 50% compared with that of 1982. The ground pyrophyllite was used in the manufacture of ceramic products including wall and floor tile. The operation employed about 1,300 workers.

Quartz Crystal (Cultured).—Bliley Electric Co., Erie, and Motorola Inc. and P. R. Hoffman Co., Carlisle, were three of the seven companies in the United States that produced cultured quartz crystal in 1983. The firms used lascas, a nonelectronic-grade quartz, as feedstock for growing cultured quartz crystal. Also, a number of Pennsylvania companies consumed cultured quartz to manufacture piezoelectric products, including filters, oscillators, and signal processors, which are used in a variety of military and civilian electronic applications.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

Based on the estimates for 1983 construction sand and gravel, production dropped

for the fourth consecutive year. The 1983 output of 11.8 million tons was about 1.3 million tons lower than that of 1982 and about 7.2 million tons below the 1979 total.

Traditionally, construction sand and gravel is mined in about one-half of the State's 67 counties, primarily northwest and east of the Appalachian Mountains. Leading counties in production in western Pennsylvania are Armstrong, Beaver, and Erie; in the east, Bucks, Columbia, and Lycoming. Little or no sand and gravel is produced in the area of the State's highly populated cities of Pittsburgh and Philadelphia. Environmental constraints have curtailed dredged river sand and gravel production in western Pennsylvania; only two dredging operations remain on the Allegheny River.

Industrial.—Industrial sand output dropped in 1983 reflecting the increased use of plastic containers instead of glass products.

Table 6.—Pennsylvania: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	5,044	$22,989	$4.56	NA	NA	NA
Gravel	7,189	30,402	4.23	NA	NA	NA
Sand and gravel (unprocessed)	849	2,136	2.52	NA	NA	NA
Total or average	[1]13,081	55,527	4.24	[e]11,800	[e]$52,000	[e]$4.41
Industrial sand	969	13,589	14.02	W	W	14.32
Grand total or average	14,050	69,116	4.92	W	W	W

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Slag, Iron and Steel.—Nationally, Pennsylvania ranked first in sales of processed iron and steel slag in 1983. Both the quantity and value of slag sales declined by about 10% compared with those in 1982. Of the 3.9 million short tons of slag produced, 81% was iron slag and 19% was steel slag.

Three types of iron slag were processed by a total of 12 companies: air-cooled, used for asphalt, concrete aggregate, and as a road base material; expanded, used as lightweight aggregate; and granulated, used for road base material. Steel slag, processed at 10 operations, was used primarily for road base material.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Output of the State's second leading mineral commodity, crushed stone, increased for the first time in 4 years. Although the State ranked third nationally in output, production has declined nearly 20 million tons since 1979 when 71.4 million tons was produced. The decreased level of crushed stone production reflects the reduced demand from the State's steel and construction industries.

In 1983, about 80% of the stone mined in Pennsylvania was limestone and dolomite. Other types of stone mined were granite, marble, sandstone, and traprock. About 14% of the stone was used for unpaved road surfacing. The second largest use of crushed rock was for graded road base or subbase at about 13% with the third largest quantity of about 11% used in cement manufacture. Other leading uses listed in decreasing order of quantity included bituminous aggregate (coarse), concrete aggregate (coarse), and fine aggregate.

Of the State's 67 counties, 50 reported production in 1983, and output exceeded 1 million tons in 17 counties. Nearly 70% of the State's crushed stone production was concentrated in a 13-county area in southeastern Pennsylvania. Output from these 13 counties ranged from 1.1 million tons in Cumberland County to 4.6 million tons in Montgomery County. The four other counties with production of more than 1 million tons were Fayette and Westmoreland Counties in southwestern Pennsylvania and Blair and Centre Counties in central Pennsylvania.

The State's top five producers were New

Enterprise Stone & Lime Co. Inc., Koppers Co., Bethlehem Steel Corp., Warner Co., and Stabler Co. Inc., accounting for about one-third of the total output. A total of 9 of the State's 183 quarries produced more than 1 million tons, accounting for 25% of the total crushed stone output.

Developments in the State's crushed stone industry included the opening of a quarry by the Standard Slag Co. in Windber, Somerset County. Previously, the company sold slag obtained from Bethlehem Steel in Johnstown, but increased use of electric furnaces resulted in Standard developing a new source of aggregate material. Late in the year, Silver Ford Inc., a unit of J. M. Brenner Co., announced plans to open a limestone quarry in southeastern Pennsylvania. The company was proceeding in filing development plans with the State's DER.

Two quarry developments were faced with local public opposition and remained pending at yearend. Hempt Bros. Inc. continued to seek township approval to open a limestone quarry with a production capacity of 400,000 tons per year in Cumberland County. Residents opposed the plan claiming the quarry would cause noise problems and blasting damage to their homes. Hempt Bros., which owns the land, sought the approval to replace its existing quarry, which is near depletion. Warner Co., Berks County, also faced local objections to its plan to expand stockpile areas. A decision by the State's DER on variances to extend the stockpiles was expected in 1984.

Table 7.—Pennsylvania: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	302	1,119
Riprap and jetty stone	252	1,133
Filter stone	182	722
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,512	14,527
Bituminous aggregate, coarse	3,607	15,145
Bituminous surface treatment aggregate	1,626	6,509
Railroad ballast	1,152	4,216
Fine aggregate (-3/8 inch):		
Stone sand, concrete	837	3,609
Stone sand, bituminous mix or seal	1,223	6,364
Screening, undesignated	803	3,011
Other fine aggregate	3,380	16,164
Coarse and fine aggregate:		
Graded road base or subbase	6,697	25,241
Unpaved road surfacing	7,004	25,781
Crusher run or fill or waste	1,454	5,296
Other construction materials	49	192
Agricultural:		
Agricultural limestone	1,738	13,649
Poultry grit and mineral food	61	780
Other agricultural uses	30	135
Chemical and metallurgical:		
Cement manufacture	5,880	20,529
Lime manufacture	2,199	12,734
Flux stone	1,450	8,757
Glass manufacture	43	502
Special:		
Mine dusting or acid water treatment	124	2,324
Asphalt fillers or extenders	156	1,663
Other fillers or extenders	348	5,310
Other[2]	7,412	31,538
Total[3]	51,523	226,948

[1]Includes limestone, dolomite, granite, marble, sandstone, traprock, and miscellaneous stone.

[2]Includes terrazzo and exposed aggregate, dead-burned dolomite, chemical stone for alkali works, whiting or whiting substitute, paper manufacture, roofing granules, sulfur oxide removal, coarse aggregate (large), coarse aggregate (graded), combined coarse and fine aggregate, and other uses not specified.

[3]Data do not add to totals shown because of independent rounding.

Dimension.—In 1983, 13 companies produced dimension stone at 16 quarries. Bucks, Chester, and Northampton were the leading counties in production. Of the total output of 53,400 tons (753,000 cubic feet), about two-thirds was sandstone. Other major types of dimension stone quarried were slate and granite (diabase). Leading uses were for irregular-shaped stone, flagging, cut stone, and roofing slate.

Table 8.—Pennsylvania: Dimension stone[1] sold or used by producers in 1983, by use

Use	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Rough blocks for building and construction	8,107	105	$420
Irregular-shaped stone	20,549	251	1,438
Monumental	1,229	12	229
Dressed stone:			
Flagging	5,036	138	346
Flooring slate	117	2	32
Other[2]	18,362	246	3,334
Total	53,400	[3]753	5,799

[1]Includes granite, sandstone, slate, and miscellaneous stone.
[2]Includes ashlars and partially squared pieces, roofing slate, structural and sanitary, blackboards, and uses not specified.
[3]Data do not add to total shown because of independent rounding.

Sulfur (Recovered).—Shipments of recovered elemental sulfur in Pennsylvania amounted to 53,000 metric tons valued at about $4.5 million, a decrease of about 7% in both quantity and value compared with 1982 totals. Sulfur was used in the manufacture of sulfuric acid, for leaching ores, and in chemicals, fibers, paints, and explosives.

In 1983, three petroleum refineries, two in Philadelphia County and one in Delaware County, recovered sulfur from desulfurization of refinery gases and treatment of natural gas. One steel company in Allegheny County recovered byproduct sulfur from coke production.

Vermiculite (Exfoliated).—Two companies—A-Tops Corp./J. P. Austin Associates, Beaver County, and W. R. Grace & Co., Lawrence County—exfoliated vermiculite shipped to Pennsylvania from Montana. The material was packaged and sold for use as a lightweight concrete aggregate, loose-fill insulation, block insulation, and a fireproofing agent.

METALS

Beryllium.—The Cabot Berylco Div. of the Cabot Corp. produced beryllium-copper and beryllium alloys at its plant in Reading. Also in Reading, Brush-Wellman Inc. operated a beryllium-copper strip manufacturing facility. Copper-based beryllium alloys are used primarily by the aircraft, automotive, electronic, and well-drilling industries.

Ferroalloys.—Shipments of ferroalloys in Pennsylvania in 1983 increased to 5,381 short tons from 4,029 tons in 1982; however, value declined from about $29.7 million to about $26.6 million. The decline in value reflected the continuing strong competition from imports. As recently as 1980, shipments totaled about 6,800 tons valued at $92.6 million.

Climax Molybdenum Co., a division of AMAX Inc., suspended operations in January at its Langeloth molybdenum oxide concentrate conversion plant because of continued poor demand. In May, the firm recalled about 25 of the 190 employees in the work force to resume limited production from existing stocks. Limited production continued through yearend at the 140,000-pound-per-day-capacity plant as AMAX's molybdenum mines in Colorado remained closed throughout 1983.

In February, three creditors of The Pesses Co., Pulaski, Lawrence County, filed a petition for involuntary liquidation of the firm under Chapter 7 of the Federal Bankruptcy Code.

Iron Oxide Pigments.—In 1983, finished iron oxide pigment shipments from Pennsylvania producers totaled about 29,000 tons valued at $32.7 million. Shipments of regenerator oxides totaled about 4,900 short tons valued at about $318,000.

Iron and Steel.—Pennsylvania ranked third of 13 States in shipments of pig iron in 1983. Shipments totaled 7.1 million short tons valued at about $1.5 billion. Pig iron shipments increased nearly 30% in 1983 compared with the 1982 level; however, shipments were about 52% below the 1981 total.

Table 9.—Pennsylvania: Pig iron shipments

Year	Pig iron shipments			Rank in United States
	Thousand short tons		Percent	
	Pennsylvania	U.S. total		
1979	19,079	88,781	21.5	1
1980	15,245	69,445	22.0	2
1981	14,804	74,218	20.0	2
1982	5,491	43,449	12.6	3
1983	7,110	49,081	14.5	3

Steel production in Pennsylvania also increased in 1983 to 10.7 million short tons from 9.1 million tons in 1982. Pennsylvania accounted for 15.6% of the total U.S. production in 1983, an increase from 14.9% in 1982 but significantly below the more than 20% share prevailing before the recession.

The decline in the State's steel industry reflects increased foreign competition, which has benefited from declining shipping costs and higher U.S. labor costs. Also, expanding exploration that led to development of raw materials in other parts of the world and changing technologies in steelmaking have resulted in less reliance on Pennsylvania iron ore and coal deposits that initially gave the State a dominant position in the steel industry.[7]

Developments during the year included the announcement by USS, the Nation's leading steel producer, of a major restructuring that eliminates about 11,100 jobs in basic steel, of which 3,800 Pennsylvania workers were affected. The restructuring was scheduled to begin in April 1984. Of the 3,800 Pennsylvania workers affected by the announcement, about 1,200 were working and 2,600 were on layoff. Operations scheduled for permanent closure in Pennsylvania were fabrication plants in Pittsburgh and Ambridge and specialty steel operations in Johnstown. Plants listed for partial closings included the Fairless Works near Philadelphia; the Clairton, Duquesne, Edgar Thomson, Homestead, National, and Irvin-Vandergrift plants, all near Pittsburgh.

In that same announcement, USS canceled previous plans to import steel slabs from the British Steel Corp. for processing at the firm's Fairless Works. USS also suspended plans to build a 1.3-million-ton continuous slab caster at its Edgar Thomson plant. The facility, in the planning stage since 1980, would have supplied steel slabs for conversion into sheet and tin products at the firm's Irvin-Vandergrift plant.

Also in 1983, the Environmental Protection Agency gave USS a 3-year extension for compliance with air pollution control standards. The settlement was based on the Steel Industry Compliance Extension Act of 1981, an amendment to the Clean Air Act. The agreement to extend the deadline for compliance also required a modernization program for the Homestead Works near Pittsburgh.

Bethlehem Steel, the second largest steel producer in the United States, operated three steel plants in Pennsylvania at Bethlehem, Johnstown, and Steelton. In August, Bethlehem Steel restarted electric-furnace steelmaking operations at the Johnstown plant after an 11-month shutdown. Operations at the plant were restructured and, along with the company's remaining Lackawanna, NY, facilities, will be responsible for production of carbon and alloy bars. At yearend, after the reorganization, about 2,100 of 5,300 employees at the Johnstown plant were working.

Late in the year, Bethlehem Steel completed installation of an $85 million continuous bloom caster at its Steelton plant. Blooms from the caster primarily will be rolled into railroad rails and also be used for reinforcing bars and other bar products. The plant has a capacity of 1.3 million tons of steel annually. At yearend, about 2,700 of 3,200 employees at the plant were working.

At the firm's Bethlehem plant, an $80 million modernization plan to improve a 48-inch rolling mill and 40-year-old electric furnaces was under consideration. A new $15 million ingot stripping facility was expected to be operational in the spring of 1984. About 80% of the plant's products are structural shapes used primarily by the construction industry. Average employment at the plant in 1983 was about 6,700 with about 2,100 on layoff; 10 years earlier, about 14,700 workers were employed at the plant.

Also during the year, Bethlehem Steel developed a refractory wear monitoring system designed to determine the rate of

furnace lining wear. The monitoring system, consisting of a single-wire coaxial cable containing crushed refractory material between the outer sheath and the inner wire, is imbedded in the furnace brickwork during relining.

In September, Jones & Laughlin Steel Corp. (J&L), a subsidiary of LTV Corp. and Republic Steel Corp., the Nation's third and fourth largest steelmakers, announced plans to merge. At yearend, the agreement remained subject to shareholder and U.S. Department of Justice approval. J&L's operations in Pennsylvania include plants at Pittsburgh, Aliquippa, and Midland with a total work force of 10,500, of which about 4,800 were on layoff at yearend. Republic's only Pennsylvania facility is its Union Drawn Div. cold finished bar plant in Beaver Falls, which employs about 225 workers. Industry analysts predicted that if the merger is completed, some operations would be consolidated.

Earlier in the year, J&L purchased the Midland plant from Colt Industries Inc. for a $35 million note and assumption of certain liabilities. The plant acquisition included two electric furnaces, an argon-oxygen decarburization finishing vessel, a continuous caster used in stainless steel production, and a finishing mill.[8]

Other activities in Pennsylvania's steel industry in 1983 included Sharon Steel Corp.'s $25 million modernization involving desulfurization equipment for the plant's electric furnace, hot metal mill, and improvements to blast furnaces. In June, Wheeling-Pittsburgh Steel Corp. began operating a continuous bloom caster at its Monessen plant. The facility, designed for an annual capacity of 840,000 tons, supplied blooms for the Monessen plant, blooms and forging-quality billets for the commercial market, and billets for production of seamless tubular products at the firm's other Pennsylvania plant in Allenport. Phoenix Steel Corp. permanently shut down its open-hearth furnace in Phoenixville, which had been idle since August of 1982. Steel ingot for tube and pipe manufacturing facilities at Phoenixville will be supplied by the company's Claymont, DE, plant. At one time, the company employed 450, all of which were on layoff when the closing was announced.

Titanium.—A. Johnson & Co. Inc., a division of Axel Johnson Group of Stockholm, Sweden, began the first commercial production of cast titanium slab in the United States at its electron beam furnace facility at Morgantown. The firm also produced ferrotitanium at its Lionville operations.

Zinc.—The State's last underground metal mine was closed in October. Gulf + Western closed the underground zinc mine and surface plant at Friedensville in the eastern part of the State, citing high production costs and a decline in demand. The underground zinc mine began production in 1958 and at onetime produced as much as 4,000 short tons of zinc per month. In 1966, the operations were sold to Gulf + Western and operated under the name of New Jersey Zinc. Gulf + Western officials stopped pumping water from the underground mine at Friedensville upon closure, although substantial reserves reportedly remain. It is reported that the entire property has been sold to a private developer. In 1983, about 16,800 tons of zinc was produced compared with 24,800 tons in 1982.

St. Joe Resources Co., a unit of Fluor Corp., completed a $5 million expansion project at its Monaca zinc smelter, increasing capacity by 15,000 to 100,000 tons per year. According to a St. Joe official, the smelter will never return to the 225,000-ton-per-year production capacity of the late 1970's primarily because most of the zinc consumed in the United States is imported.

---

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.
[2]State geologist, Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources, Harrisburg, PA.
[3]Economic geologist, Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources, Harrisburg, PA.
[4]Pennsylvania Business Survey. V. 25, No. 2, Feb. 1984, 16 pp.
[5]Additional information may be obtained from Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources, P.O. Box 2357, Harrisburg, PA 17120, telephone 717-787-2169.
[6]Schenck, G. H. K. Handbook of State and Local Taxation of Solid Materials. The Pennsylvania State University, 221 Walker Building, University Park, PA 16802, 1984, 130 pp.
[7]Work cited in footnote 4.
[8]LTV Corp. 1983 Annual Report. P. 43.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Durasteel Abrasives Co	2601 Smallman St. Pittsburgh, PA 15222	Plant	Westmoreland.
Ervin Industries Inc	Box 1168 Ann Arbor, MI 48106	do	Butler.
Satellite Alloy Corp	Satellite Industrial Park Box 171 Springdale, PA 15144	do	Allegheny.
Cement:			
Hercules Cement Co	Center St. Stockertown, PA 18083	do	Northampton.
Lone Star Industries Inc	Wood and Prospect St. Box 270 Nazareth, PA 18064	do	Do.
National Gypsum Co	501 Hokes Mill Rd. York, PA 17404	do	Berks.
Société des Ciments Français	Tour Générale, Quartier Villon Cédex 22 192088 Paris, La Défense France	Plants	Lehigh and Northampton.
Clays:			
Glen-Gery Corp	Box 1542 Reading, PA 19603	Pits	Adams, Berks, Northumberland, Union, York.
Hanley Brick Inc	Box 376 Bradford, PA 16701	Pit	Jefferson.
Harbison-Walker Refractories Co	2 Gateway Center Pittsburgh, PA 15222	Pit	Somerset.
Graphite (manufactured):			
Airco Speer Carbon Co	800 Theresia St. St. Marys, PA 15857	Plant	Elk.
Keystone Carbon Co	1935 State St. St. Marys, PA 15857	do	Elk.
The Stackpole Corp	St. Marys, PA 15857	do	Elk.
Iron oxide pigments:			
Pfizer Inc., Minerals, Pigments, & Metals Div.	640 North 13th St. Box 548 Easton, PA 18042	do	Northampton.
Prince Manufacturing Co	700 Lehigh St. Bowmanstown, PA 18030	do	Carbon.
Reichard-Coulston Inc	15 East 26th St. New York, NY 10010	do	Northampton.
Lime:			
Bethlehem Steel Corp.[1 2]	Martin Tower Bethlehem, PA 18016	Plants	Adams and Lebanon.
Marblehead Lime Co	300 West Washington St. Chicago, IL 60606	Plant	Centre.
Mercer Lime & Stone Co	525 William Penn Dr. Pittsburgh, PA 15219	do	Butler.
Warner Co	Yellow Springs Rd. Devault, PA 19432	do	Centre.
Peat:			
Corry Peat Products Co	515 Turnpike Rd. Corry, PA 16407	Bog	Erie.
Gouldsboro Wayne Peat Co	Box 68 Gouldsboro, PA 18424	Bog	Lackawanna.
Lake Benton Peat Moss	622 South Blakely St. Dunmore, PA 18512	Bog	Do.
Perlite (expanded):			
Allied Block Chemical Co., Therm-O-Rock Div.	Pine St. New Eagle, PA 15067	Plant	Washington.
Pennsylvania Perlite Corp	Box 2002 Lehigh Valley, PA 18001	Plants	Lehigh and York.
Perlite Manufacturing Co	Box 478 Carnegie, PA 15106	Plant	Allegheny.
World Industries Inc	Lancaster, PA 17603	do	Lancaster.
Sand and gravel:			
Construction:			
Davison Sand & Gravel Co	3d Ave. and 4th St. New Kensington, PA 15068	Dredges	Armstrong and Westmoreland.
Dravo Corp	4800 Grand Ave. Pittsburgh, PA 15222	do	Allegheny and Beaver.
Erie Sand Steamship Co	Box 153 Erie, PA 16512	Dredge	Erie.
Shippingport Sand & Gravel Co	355 5th Ave. Pittsburgh, PA 15222	Pit	Beaver.
Warner Co.[1 2 3]	699 Briston Pike Morrisville, PA 19067	Pit	Bucks.
Industrial:			
McCrady Inc	Box 11566 Pittsburgh, PA 15238	Pits	Allegheny.
Pennsylvania Glass Sand Corp	Box 187 Berkeley Springs, WV 25411	do	Huntingdon.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Slag, iron and steel:			
Dunbar Slag Co	Box 666 Sharon, PA 16146	Plant	Mercer.
Standard Slag Co	1200 Stambaugh Bldg. Youngstown, PA 44503	do	Cambria.
Stone:			
Crushed:			
Koppers Co	Box 231 Easton, PA 18042	Quarries	Berks, Bucks, Chester, Clinton, Columbia, Dauphin, Delaware, Lancaster, Luzerne, Montour, Tioga.
New Enterprise Stone & Lime Co. Inc.	R.D. 3 New Enterprise, PA 16664	do	Adams, Bedford, Blair, Cumberland, Franklin, Huntingdon, Lancaster, Somerset.
Stabler Co. Inc., Eastern Industries Inc.	Box 3188 Wescosville, PA 18106	do	Berks, Lehigh, Monroe, Northampton, Susquehanna.
Warner Co	R.D. 3, Box 222H Bellefonte, PA 16823	do	Centre, Chester, Huntingdon, Westmoreland.
Dimension:			
H. Dally & Sons Inc	Railroad Ave., Box 27 Pen Argyl, PA 18072	do	Northampton.
Delaware Quarries	Route 32 Lumberville, PA 18933	Quarry	Bucks.
Media Quarry Co	131 East 2d St. Media, PA 19063	do	Delaware.
Sulfur (recovered):			
Atlantic Richfield Co	3144 Passyunk Ave. Philadelphia, PA 19145	Plant	Philadelphia.
Gulf Oil Corp	Box 7408 Philadelphia, PA 19101	do	Do.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	do	Lawrence.

[1]Also stone.
[2]Also slag.
[3]Also lime.

The Mineral Industry of Puerto Rico, Caribbean and Pacific Island Possessions, and Trust Territories of the Pacific Islands

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Department of Natural Resources, Commonwealth of Puerto Rico, for collecting information on all nonfuel minerals.

By Doss H. White, Jr.[1]

PUERTO RICO

The value of nonfuel mineral production in Puerto Rico in 1983 was $113 million. This figure excludes the value of sand and gravel because production data are not reported to the U.S. Bureau of Mines. Minerals produced in the Commonwealth included cement, clays, crushed and dimension stone, graphite (synthetic), lime, salt (evaporative), sand and gravel, and sulfur (byproduct).

Table 1.—Nonfuel mineral production in Puerto Rico[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement (portland)	thousand short tons	986	$81,822	931	$82,509
Clays	do.	162	298	125	251
Lime	do.	37	1,906	35	3,885
Sand and gravel	do.	NA	NA	NA	NA
Stone:					
Crushed	do.	NA	NA	5,536	26,611
Dimension	do.	NA	NA	W	W
Total[2]		XX	84,026	XX	113,256

NA Not available. W Withheld to avoid disclosing company proprietary data; not included in "Total." XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Total does not include value of items not available.

Table 2.—Value of nonfuel mineral production in Puerto Rico, by district

(Thousands)

District	1981	1982	Minerals produced in 1982 in order of value
Aguadilla	$977	--	
Arecibo	2,196	--	
Guayama	W	--	
Humacao	1,819	--	
Mayaguez	2,221	--	
Ponce	W	W	Cement, lime, clays.
San Juan	W	W	Cement, clays.
Undistributed[1]	200,829	$84,026	
Total	[2]208,041	84,026	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes some stone that cannot be assigned to specific districts and values indicated by symbol W.
[2]Data do not add to total shown because of independent rounding.

Trends and Developments.—Although the recession affecting much of the Western Hemisphere was officially over late in 1982, Puerto Rico's recovery lagged behind that of the mainland United States. While a number of key economic indicators demonstrated signs of recovery in 1983, the island's construction industry, the key market for Puerto Rico's mineral industry, was a notable exception. A spokesperson for the General Contractors Associations of Puerto Rico noted that private housing construction was almost at the point of "total extinction," and as of August 1983, the Rules and Permits Administration of the Planning Board had approved 863 use permits for both public and private housing construction compared with 2,342 for the corresponding period in 1982.[2]

Compounding the construction-mineral industry recovery problem was a backlog of almost $400 million in Government construction projects, primarily highways and aqueducts. At midyear, the Government established an accelerated construction program, and work on some of these programs was underway at yearend. Construction employment in the October-December period of 1983 increased 3,000 over the same period in 1982.[3]

However, a major stumbling block to construction industry resurrection was the possible adoption of restrictive Federal Highway Administration load limits for the island's trucking industry, the prime mover of mineral and construction materials. The Puerto Rico Construction Council, composed of the nine leading island construction associations, projected that the reduction in hauling capacity resulting from the enactment of the proposed weight limits would require an investment of more than $150 million for new equipment.

The council estimated that more than 80% of the cement, aggregate, and hot plant mix asphalt trucks and 95% of the ready-mix concrete trucks would exceed the proposed weight limits if standard loads were hauled. The cost of transporting the 2.1 million cubic yards of ready-mix concrete projected for 1984 sales would be increased by $34.8 million, and the price of an 800-square-foot home requiring between 40 and 50 cubic yards of concrete would increase more than $800. Shipping costs for other building materials such as plaster and terrazzo would also increase.

Other negative effects of implementing the weight limits, cited by the council, include an increase in fuel consumption, traffic congestion, environmental pollution, and traffic accidents.[4]

One highlight in an otherwise dismal year for the island's construction industry was the introduction of a new building material by an architectural engineering firm in San Juan. The material, glass-reinforced composite (GRC), is made by mixing alkali-resistant glass fiber with a slurry of lime, silica, alumina, gypsum, sand, and water. The use of GRC is projected to lower building costs and offer a pliability in a variety of shapes.[5] Adoption of the new material would aid both the construction and mineral industries.

Although shipments of nonmetallic mineral commodities from the U.S. mainland to Puerto Rico increased 2.6% in value to $145.9 million, exports from the island to the United States plummeted 29.4% to $115.4 million.[6]

Legislation and Government Programs.—Work was completed on the drafting of new oil and gas regulations schedul-

ed for presentation to the 1984 Puerto Rican Legislature. The new regulations would replace earlier oil and gas laws enacted in 1955.

The Puerto Rico Department of Natural Resources and the U.S. Bureau of Mines renewed a Memorandum of Understanding that allows the Bureau to share Puerto Rican mineral statistics collected by the Bureau with the Commonwealth.

The Puerto Rican Geological Survey and the U.S. Geological Survey (USGS) continued a reconnaissance geochemical survey to identify favorable areas for detailed mineral investigations. Approximately 70% of the island had been sampled at yearend.

The island's Geological Survey and USGS continued work on mapping the mineral resource potential of the Puerto Rican insular shelf; several maps on the shelf's geology have been published. High-resolution seismic and vibracoring were ongoing at selected sites to evaluate the offshore sand potential.

REVIEW BY NONFUEL MINERAL COMMODITIES

Nonmetals.—Historically, cement, stone, and sand and gravel have been the leading mineral commodities, valuewise, produced in Puerto Rico. However, insufficient response by the island's stone and sand and gravel producers to the U.S. Bureau of Mines voluntary annual canvass resulted in the termination of the collection and publication of output and value data for sand and gravel in 1979 and stone in 1982. However, in 1983 the Bureau sent a revised stone canvass to the island's producers and 76% responded.

Excluding stone, the extractive mineral production of Puerto Rico is by the island's two cement producers, Puerto Rican Cement Co. Inc. in Ponce and San Juan Cement Co. near San Juan. In June, Puerto Rican Cement completed the conversion of three kilns at the Ponce facility from fuel oil to coal. The company anticipated a savings of $6 million per year in fuel costs resulting from the conversions. San Juan Cement began operating a new coal mill during 1983. The company has pioneered the use of waste graphite dust as kiln fuel. Use of the dust, obtained from Union Carbide Corp., has resulted in a $100,000 annual savings.

Table 3.—Puerto Rico: Portland cement salient statistics

(Short tons unless otherwise specified)

	1982	1983
Number of active plants	2	2
Production	985,775	927,314
Shipments from mills:		
Quantity	986,315	931,453
Value	$81,821,822	$82,509,254
Stocks at mills, Dec. 31	35,689	31,550

At yearend, a controversy between the two cement companies and importers of Costa Rican and Spanish cement was unresolved. The island's cement companies charged that foreign cement importers were selling an inferior quality product. Imported cement was sold at a lower price than cement produced on the island. The Puerto Rican Consumer Affairs Department (DACO) conducted hearings on the controversy, and in October, the agency issued a temporary cease-and-desist order against the import companies. However, shortly after the DACO order, the import companies obtained a Superior Court judgment leaving the order without effect.[7]

Both of the island's cement companies mine limestone and clays as raw material for cement production, and Puerto Rican Cement produces a chemical-grade lime at the Ponce facility. The primary market area for lime sales was Puerto Rico and the Virgin Islands.

Mine Safety and Health Administration records indicate that in 1983 crushed stone was produced at 54 quarries located in all of the island's 7 districts. Production and value data for 41 of these quarries were reported to the U.S. Bureau of Mines. Salient statistics on crushed stone production are presented in table 4.

Table 4.—Puerto Rico: Crushed stone in 1983, by type

Type	Number of quarries	Number of districts	Quantity (thousand short tons)	Value (thousand dollars)
Limestone	28	7	3,574	18,373
Traprock	5	3	1,147	4,999
Marble and other types	6	2	496	2,121
Granite	2	1	319	1,118

Table 5.—Puerto Rico: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	123	698
Filter stone	W	W
Coarse aggregate, graded:		
Concrete aggregate, coarse	993	4,152
Bituminous aggregate, coarse	148	655
Bituminous surface treatment aggregate	W	W
Fine aggregate (-3/8 inch): Stone sand:		
Concrete	465	2,023
Bituminous mix or seal	W	W
Coarse and fine aggregate:		
Graded road base or subbase	132	531
Terrazzo and exposed aggregate	W	W
Agricultural: Agricultural limestone	W	W
Chemical and metallurgical:		
Cement manufacture	W	W
Glass manufacture	W	W
Special: Other	3,676	18,552
Total	[2]5,536	26,611

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite, marble, traprock, and miscellaneous stone.
[2]Data do not add to total shown because of independent rounding.

One company in the San Juan District reported the production of dimension traprock in 1983. This stone was used as rubble.

Synthetic graphite was produced from petroleum coke for electrode manufacture at Union Carbide's Yabucoa plant, and elemental sulfur was recovered as a by-product of oil refining at local refineries.

Cabo Rojo Enterprises recovered salt by evaporating seawater in a series of ponds on Puerto Rico's southwest coast. Sales were to pharmaceutical and petrochemical companies, tuna packers, feed and sugar mills, and curing and tanning plants. A second salt operation is located at La Parguera.

Metals.—Puerto Rico has a small but extremely competitive metals industry. During the period between 1978 and 1982, shipments of metal products from the island to the rest of the world increased 269%.[8]

Puerto Rico's primary metal products industry engaged in the smelting and refining of ferrous and nonferrous metals from ore, pig, and scrap; in the rolling, drawing, and alloying of ferrous and nonferrous metals; and in the manufacturing of castings, forgings, and other basic metal products. A summary of the island's metal industry is shown in table 6.

An additional 135 plants were engaged in fabricated metal products production.

Table 6.—Puerto Rico: Metals industry in 1983

Type of facility	Number		
	Operating	Planned	Total
Blast furnaces, steelworks, rolling and finishing mills	8	--	8
Iron and steel foundries	1	--	2
Secondary smelting and refining of nonferrous metals	5	--	5
Rolling, drawing, extruding of nonferrous metals	4	--	4
Nonferrous foundries	1	2	3
Miscellaneous primary metals products	3	1	4

CARIBBEAN ISLAND POSSESSIONS

The United States possessions in the Caribbean, excluding Puerto Rico, consists of the U.S. Virgin Islands; Navassa Island south of Guantanamo, Cuba; the Swan and Corn Islands off the coast of Honduras and Nicaragua; and the Quita Sueno Banks, Roncador Banks, Serrana, and the Serranilla, approximately 250 miles east of the coast of Central America. The U.S. Virgin Islands are the only Caribbean possessions reporting mineral production.

U.S. VIRGIN ISLANDS

The U.S. Virgin Islands consist of St. Croix, St. John, St. Thomas, and a number of smaller islands in the West Indies approximately 1,000 miles south of Miami and 40 to 60 miles east of Puerto Rico. Mineral output is concentrated on St. Croix, which hosts a construction sand operation, two stone quarries, an alumina plant, and the world's largest petroleum refinery. Aggregate producers also have operations on St. Thomas.

The demand for Virgin Island mineral production in 1983 varied with the commodity. Two sizable construction projects provided markets for the aggregate producers while an improving, but soft, aluminum market and reduced demand for residual fuel oil affected demand for alumina and petroleum products.

A $5.7 million expansion of the Harry S. Truman Airport on St. Thomas and a $6.8 million housing project on St. Croix provided markets for stone and sand and gravel producers on the two islands. The two cement companies in Puerto Rico have distribution centers in the U.S. Virgin Islands, and the increased island construction activity buoyed cement sales.

Processing of mineral commodities produced in other parts of the world are a major sector of St. Croix industry. Martin Marietta Aluminum Corp. operated a 700,000-ton-per-year alumina plant on the island's south shore. The company imported bauxite from Guinea as plant feed, and alumina was exported to aluminum producers in the United States, Norway, and indirectly to the U.S.S.R.

Hess Oil Virgin Islands Corp. (HOVIC), a subsidiary of Amerada Hess, operates the world's largest refinery complex on St. Croix. During the first quarter, HOVIC reduced employment by 340 as the refinery reduced production in response to the decline in consumer demand for residual fuel oil and other refined petroleum products. The 700,000-barrel-per-day HOVIC refinery imports crude from Iran, Libya, and Abu Dhabi.

Mineral exports, both fuel and nonfuel, dropped below the 1982 level. In 1983, fuel product imports to the continental United States fell $966 million while aluminum oxide shipments, 753.7 million pounds valued at $84.7 million in 1982, plummeted to 276.8 million pounds valued at $22.3 million in 1983.[9]

PACIFIC ISLAND POSSESSIONS

The islands of American Samoa, Canton, Enderburg, Guam, Jarvis, Johnson, Midway, Palmyra, and Walker comprise the Pacific Island Possessions of the United States. The reasons behind and dates of acquisition vary from island to island, but

most correlate to securing adequate harbors, coaling stations, or seaplane fueling points. American Samoa, at the southern end of the Mariana Island group, and Guam, 1,800 miles north of New Guinea, were the only areas reporting mineral production—volcanic rock and coral crushed for aggregate applications. Cement is imported and the islands' sand resources are mined for concrete output.

TRUST TERRITORY OF THE PACIFIC ISLANDS

The Trust Territory of the Pacific Islands, composed of the Marshall, Caroline, and Mariana Islands, collectively termed Micronesia, became a United Nations trusteeship administered by the United States in 1947.

The trust territory extends over 3 million square miles of the western Pacific Ocean and contains over 2,000 islands. Most islands in the Eastern Carolines and the Marianas are coral. The Western Caroline Islands are part of an undersea volcanic ridge stretching southward from Japan along the western perimeter of the territory. A myriad of mineral commodities have been identified on the islands comprising the territory, and several commodities were mined. Currently, mineral extraction is limited to coral, volcanic rock, and sand for aggregate and concrete applications.

---

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, AL.
[2]Caribbean Business. Feb. 8, 1984, p. 47.
[3]———. Jan. 25, 1984, p. 29.
[4]———. Nov. 2, 1983, p. 1.
[5]Page 55 of work cited in footnote 3.
[6]Caribbean Business. June 27, 1984, p. 15.
[7]———. Nov. 30, 1983, p. 1.
[8]Puerto Rico Economic Development Administration. The Metal Industry in Puerto Rico. Nov. 1982, 34 pp.
[9]Page 30 of work cited in footnote 6.

The Mineral Industry of Rhode Island

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Rhode Island Department of Environmental Management for collecting information on all nonfuel minerals.

By L. J. Prosser, Jr.[1]

The value of nonfuel mineral production in Rhode Island in 1983 was $7.9 million, a $3.1 million increase compared with that of 1982. The increase in 1983 was the first following 3 consecutive years of decline.

Sand and gravel and stone were the only commercial mineral commodities produced in Rhode Island. Expansion in the State's crushed stone industry primarily accounted for the 64% increase in value of mineral production in 1983. Crushed stone output increased a reported 841,000 short tons to about 971,000 tons, surpassing the previous annual production record high of 660,000 tons recorded in 1960.

Legislation and Government Programs.—During 1983, a $250 million plan to revitalize Rhode Island's economy was introduced. Funding for the project would be obtained from increased taxes; local, State, and Federal governments; and business. The plan, termed the "Greenhouse Compact," was designed to encourage economic development and create jobs by fostering new industries and strengthening existing ones. The compact included proposals for developing incentives for industrial expansion and new product development, revitalizing specific industries, creating research institutes called "greenhouses" for education and training programs, and the founding of a Rhode Island Academy of Sciences and Engineering. Approval of the compact will be decided by Rhode Island voters in a June 1984 referendum.

Table 1.—Value of nonfuel mineral production in Rhode Island, by county[1]

(Thousands)

County	1982	1983	Minerals produced in 1983 in order of value
Kent	W	W	Sand and gravel (construction).
Newport	W	W	Stone (crushed), sand and gravel (construction).
Providence	W	W	Sand and gravel (construction), stone (crushed).
Washington	W	W	Stone (dimension).
Undistributed[2]	$4,841	$7,930	
Total	4,841	7,930	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Bristol County is not shown because no nonfuel mineral production was reported.
[2]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

Table 2.—Indicators of Rhode Island business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	471.5	477.2	+1.2
Unemployment	do.	50.2	38.2	-23.9
Employment (nonagricultural):				
Mining	do.	.1	.1	--
Manufacturing	do.	110.8	116.5	+5.1
Contract construction	do.	9.2	11.2	+21.7
Transportation and public utilities	do.	13.1	13.2	+.8
Wholesale and retail trade	do.	78.1	83.0	+6.3
Finance, insurance, real estate	do.	21.2	21.3	+.5
Services	do.	90.1	91.8	+1.9
Government	do.	57.3	57.0	-.5
Total nonagricultural employment	do.	379.9	394.1	+3.7
Personal income:				
Total	millions	$10,254	$10,992	+7.2
Per capita		$10,751	$11,504	+7.0
Construction activity:				
Number of private and public residential units authorized		2,683	3,868	+44.2
Value of nonresidential construction	millions	$75.0	$95.9	+27.9
Value of State road contract awards	do.	$23.6	$63.9	+170.8
Shipments of portland and masonry cement to and within the State	thousand short tons	133	150	+12.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$4.8	$7.9	+64.6
Value per capita, resident population		$5	$8	+60.0
Value per square mile		$3,988	$6,543	+64.1

[p]Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

The Office of the Rhode Island Associate State Geologist, through a Minerals Management Service grant, began an investigation on offshore, heavy-mineral placer deposits. Initial work included identification of potential deposit sites; subsequent plans entail determining if user conflicts exist at the sites, followed by a core drilling program.

A study to determine suitable mining techniques for the Narragansett Basin anthracite-amorphous graphite resources in the Portsmouth area was completed by the U.S. Department of Energy. Open pit mining was identified as the most feasible method because of incompetent roof and floor rock, which essentially precludes underground mining. In the study area, 24 anthracite-amorphous graphite seams ranging in thickness from 2 to 12 feet and averaging 5.6 feet were identified. The material was considered suitable for use as graphite and as fuel with the ash content ranging from 14% to 56%.[2]

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Gem Stones.—Collection of gem stones by hobbyists added a small amount to the State's value of mineral production.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Production of construction sand and gravel declined for the fourth consecutive year; about 15 operations reported a total output of 1 million short tons. Production, value, and unit price data for sand and gravel, 1974-83, were as follows:

Year	Quantity (thousand short tons)	Value (thousands)	Value per ton
1974	2,784	$4,482	$1.61
1975	2,910	4,132	1.42
1976	2,914	4,805	1.65
1977	2,872	5,059	1.76
1978	2,978	6,176	2.07
1979	3,537	6,737	1.90
1980	2,506	4,945	1.97
1981[e]	1,332	3,985	2.99
1982	1,146	3,671	3.20
1983[e]	1,000	2,400	2.40

[e]Estimated.

Table 3.—Rhode Island: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	417	$1,744	$4.18	NA	NA	NA
Gravel	493	1,436	2.91	NA	NA	NA
Sand and gravel (unprocessed)	236	492	2.08	NA	NA	NA
Total or average	1,146	[1]3,671	3.20	[e]1,000	[e]$2,400	[e]$2.40
Industrial sand	5	52	10.00	--	--	--
Grand total or average	1,151	3,723	3.23	1,000	2,400	2.40

[e]Estimated. NA Not available.
[1]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone output increased to a record-high level of 971,000 short tons in 1983. The previous record-high production was 660,000 tons in 1960. The construction contract awards value of $513.6 million was the highest annual total in the State's history in 1983 and compared with that of 1982 increased $263.2 million or more than 105%. Contract awards value by type of construction activity was as follows:

Type of construction activity	Value of contract awards (millions)		Change, percent
	1982	1983	
Residential	$129.6	$209.1	+61.3
Nonresidential	86.6	200.4	+131.4
Public works and utilities	34.2	104.1	+204.4
Total or average	250.4	513.6	+105.1

Source: Rhode Island Department of Economic Development. Mar. 1984.

Table 4.—Rhode Island: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	4	W
Filter stone	89	W
Coarse aggregate, graded:		
Concrete aggregate, coarse	27	W
Bituminous aggregate, coarse	82	W
Railroad ballast	47	W
Fine aggregate (-3/8 inch):		
Stone sand, concrete	14	W
Stone sand, bituminous mix or seal	55	W
Other[2]	652	5,507
Total	[3]971	5,507

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite, and miscellaneous stone.
[2]Includes agricultural limestone, unpaved road surfacing, whiting or whiting substitute, roofing granules, and uses indicated by symbol W.
[3]Data do not add to total shown because of independent rounding.

METALS

Rhode Island Forging Steel Inc., Providence, began production of steel ingot in June at the former facilities of the Washburn Wire Co. The plant is equipped with two 40-ton electric furnaces and has a production capacity of 50,000 tons per year. The firm manufactured the types and sizes of ingots unavailable from larger steelmakers, primarily for the forging industry in the Eastern United States.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.
[2]Skehan, J. W., G. E. Gill, J. D. Raben, N. Schapiro, and D. P. Murray. Exploration of Coal and Anthracitic Carbonaceous Shale Resources, Narragansett Basin, MA and RI. Final Report, Oct. 1, 1979-Apr. 30, 1981. Weston Observatory, MA, May 1981, 81 pp.; NTIS DE 82018223.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Sand and gravel:			
A. Cardi Construction Co. Inc	451 Arnold Rd. Coventry, RI 02816	Pit	Kent.
J. H. Lynch & Sons Inc.[1]	Box 325 Ashton, RI 02864	Pit and mill	Providence.
Material Services Inc	Greenville Rd. North Smithfield, RI 02895	Mine and mill	Do.
River Sand & Gravel Co. Inc	101 Ferris St. Pawtucket, RI 02861	Pit	Do.
J. Santoro Inc	11 Herbert St. Providence, RI 02900	Pit and plant	Do.
South County Sand & Gravel Co. Inc.	North Rd. Peace Dale, RI 02878	Pit	Do.
Stone:			
Forte Bros. Inc	14 Whipple St. Berkley, RI 02864	Quarry	Do.
Tilcon Inc	875 Phoenix Ave. Cranston, RI 02920	____do	Do.

[1]Also stone.

The Mineral Industry of South Carolina

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the South Carolina Geological Survey, State Division of Research and Statistical Services, for collecting information on all nonfuel minerals.

By Doss H. White, Jr.,[1] and Norman K. Olson[2]

South Carolina's extractive nonfuel mineral production, a composite of one metallic and nine nonmetallic mineral commodities in 1983, was valued at $230.6 million, a State record. This was $35.9 million over the value reported by the mineral industry in 1982 and $28.9 million above the previous record high set in 1979.

The dramatic increase in sales, following a 4-year decline in the tonnage of major mineral commodities produced, is attributable to a strong resurgence in construction activity, which was aided by a reduction in inflation and interest rates. The upswing in both residential and commercial construction resulted in a strong demand for those mineral commodities that are the basic raw materials for South Carolina's construction industry—clays, sand and gravel, and stone. The sales of these three construction mineral commodities increased approximately 18% over sales reported in 1982.

Table 1.—Nonfuel mineral production in South Carolina[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement (portland) thousand short tons	1,624	$66,385	W	W
Clays[2] do.	1,535	28,166	1,813	$34,830
Gem stones	NA	10	NA	10
Manganiferous ore thousand short tons	15	W	22	W
Peat do.	r5	rW	W	W
Sand and gravel:				
Construction do.	4,727	13,170	e5,200	e15,000
Industrial do.	720	10,902	842	13,169
Stone:				
Crushed do.	e14,000	e53,000	15,786	61,054
Dimension do.	e14	e904	17	1,165
Combined value of cement (masonry), clays (fuller's earth), mica (scrap), vermiculite, and values indicated by symbol W	XX	r22,181	XX	105,366
Total	XX	r194,718	XX	230,594

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes fuller's earth; value included with "Combined value" figure.

A strong resurgence in the demand for nonconstruction mineral commodities was a key factor in the record-high sales experienced by South Carolina's mineral producers. In 1983, the State ranked second in the Nation in the production and sales of kaolin and vermiculite and ranked in the top 10 in the output of ferroalloys, fuller's earth, and masonry cement. At yearend, South Carolina's extractive mineral industry consisted of 179 mining companies operating 400 mines.

Trends and Developments.—The effects of the recession on South Carolina's economy was traumatic; the composite index of coincident indicators fell 13.3%, total nonfarm employment plummeted by 60,000 jobs, and the dominant manufacturing sector lost 45,000 jobs (75% of the total). Unemployment, well above the national average, soared to a peak of 11.4%, real per capita income dropped 2.4%, and retail sales were down 14.2%. Housing starts, a measure of the health of the mineral industry's construction minerals sector, fell 25.7%.[3]

Table 2.—Value of nonfuel mineral production in South Carolina, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Abbeville	$1,172	W	Sand and gravel (construction).
Aiken	24,493	$24,376	Clays, sand and gravel (construction).
Anderson	W	(2)	
Berkeley	W	(2)	
Charleston	(3)	W	Sand and gravel (construction).
Cherokee	3,054	635	Clays, sand and gravel (construction), manganiferous ore.
Chesterfield	W	1,414	Sand and gravel (construction), clays.
Colleton	(3)	W	Peat, sand and gravel (construction).
Dillon	(3)	--	
Dorchester	52,771	41,072	Cement, sand and gravel (construction), clays.
Edgefield	84	107	Clays.
Fairfield	1,143	(2)	
Florence	(3)	W	Sand and gravel (construction).
Georgetown	W	(2)	
Greenville	W	W	Sand and gravel (construction).
Greenwood	W	W	Clays, sand and gravel (construction).
Horry	W	190	Clays.
Jasper	(3)	W	Sand and gravel (construction).
Kershaw	W	W	Sand (industrial), clays.
Lancaster	W	2,045	Sand and gravel (construction), clays, mica.
Laurens	W	W	Vermiculite.
Lee	--	46	Sand and gravel (construction).
Lexington	W	8,855	Sand (industrial), sand and gravel (construction), clays.
Marion	W	W	Clays.
Marlboro	W	W	Sand and gravel (construction), clays.
Oconee	495	(2)	
Orangeburg	43,715	36,885	Cement, clays, sand and gravel (construction).
Pickens	W	(2)	
Richland	W	1,260	Clays, sand and gravel (construction).
Saluda	W	W	Clays.
Spartanburg	3,206	--	
Sumter	W	W	Clays, sand and gravel (construction).
Union	(3)	--	
York	W	W	Sand and gravel (construction).
Undistributed[4]	62,342	23,929	
Sand and gravel (construction)	e13,240	XX	
Stone:			
Crushed	XX	e53,000	
Dimension	XX	e904	
Total	5205,716	194,718	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Allendale, Bamberg, Barnwell, Beaufort, Calhoun, Chester, Clarendon, Darlington, Hampton, McCormick, Newberry, and Williamsburg. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Stone, either crushed or dimension, was produced; data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of South Carolina business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,463.0	1,451.2	-0.8
Unemployment	do.	182.6	123.7	-32.3
Employment (nonagricultural):				
Mining	do.	1.6	1.7	+6.2
Manufacturing	do.	353.2	370.5	+4.9
Contract construction	do.	61.2	70.4	+15.0
Transportation and public utilities	do.	52.8	54.4	+3.0
Wholesale and retail trade	do.	222.3	236.0	+6.2
Finance, insurance, real estate	do.	48.7	50.9	+4.5
Services	do.	170.0	177.3	+4.3
Government	do.	235.9	234.0	-.8
Total nonagricultural employment	do.	1,145.7	1,195.2	+4.3
Personal income:				
Total	millions	$27,228	$29,224	+7.3
Per capita		$8,475	$8,954	+5.7
Construction activity:				
Number of private and public residential units authorized		18,371	29,819	+62.3
Value of nonresidential construction	millions	$627.2	$535.4	-14.6
Value of State road contract awards	do.	$87.7	$122.0	+39.1
Shipments of portland and masonry cement to and within the State	thousand short tons	836	964	+15.3
Nonfuel mineral production value:				
Total crude mineral value	millions	$194.7	$230.6	+18.4
Value per capita, resident population		$61	$71	+16.4
Value per square mile		$6,262	$7,412	+18.4

[p]Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

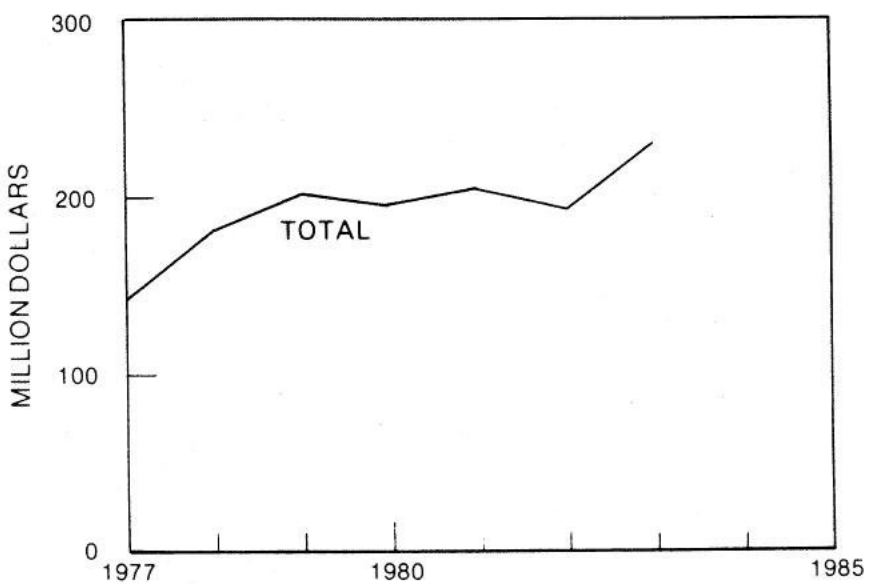

Figure 1.—Total value of nonfuel mineral production in South Carolina.

Fortunately, from a statewide view, the construction industry performed relatively well. Continued interest in the resort and retirement areas along the coast stimulated construction activity and lessened the severity of the recession for the construction minerals producers. Even with this stimulus, the construction minerals sector reported a 4-year trend of annual declines in the tonnage of construction minerals sold.

However, with the end of the recession in the latter part of 1982, the State's economy experienced a surprisingly strong recovery. This also was true for South Carolina's extractive mineral industry, and sales reached a new record high.

A significant sector of South Carolina's mineral industry, but a sector whose sales value is not included in the State's overall mineral value, is the nonextractive metals producers. These producers, processing raw materials purchased from out-of-State and/or country sources, made significant contributions to the local economies where plants are sited and provided thousands of jobs for South Carolina citizens. The strong recovery of the Nation's economy and the accompanying increased demand for durable goods was an important factor in increased orders received by many of the State's metal producers.

Alumax Inc., an aluminum company in Berkeley County, noted a significant increase in billet, slab, and ingot orders. At yearend, Macalloy Corp. in Charleston was awarded a $23 million Government contract to convert stockpiled chrome ore into ferrochrome. The State's three steel companies, Georgetown Steel Corp., Nucor Corp., and Owen Electric Steel Corp., reported substantial increases in orders over those of 1981 and 1982. The demand for ground zircon, produced by M & T Chemicals Inc. in Andrew, rose, reflecting the increased activity in the foundry and construction industries.

AMSELCO, a Denver-based company and wholly owned subsidiary of British Petroleum Co. PLC, has been actively evaluating South Carolina's gold potential for several years. Exploration activity is based in Camden, where the company maintains offices and a sample preparation laboratory. Company geologists were evaluating a potential gold-producing property in Fairfield County, and a decision on whether or not to begin production was expected sometime in 1984.

The Port of Charleston continued as a major transshipment point for raw and semiprocessed mineral commodities and mineral processing equipment. During 1983, mineral imports included alumina, bauxite, colemanite, gypsum, and pumice; exports included clays, vermiculite, and basic steel shapes. In June, a 200,000-pound portable rock crushing facility, fabricated in Iowa, was loaded aboard the MV *Constellation Faros* for shipment to Beirut, Lebanon.

At yearend 1982, Massey Coal Terminals Inc. began shipments through the new $30 million Shipyard River Coal Terminal, the largest of its kind south of Hampton Roads. The facility will handle vessels up to 50,000 deadweight tons and has a 300,000-ton open-storage capacity. Direct rail connections link the terminal with the Appalachian coalfields.

Legislation and Government Programs.—The South Carolina Geological Survey, charged with the responsibility to encourage rational economic development of the mineral and fuel resources of the State through development and interpretation of geoscience data, began the year with a permanent staff of nine aided by six part-time employees. Sweeping budget cuts during the fiscal year (ended June 30) resulted in the loss of several part-time employees and severe reductions in nonpersonnel budget categories.

Despite the monetary and personnel setbacks, the survey provided assistance on several score industry requests, and the increasing number of requests represents a significant upswing in interest in the State's mineral potential.

During the year, mapping was ongoing in approximately 30 quadrangles. Other ongoing work included (1) a mineral resources map of South Carolina, (2) geochemical sampling and analyses in north-central South Carolina, (3) the Computerized Resources Information Bank (CRIB) project, (4) a detailed mineral resources investigation of part of Cherokee County, north-central South Carolina, (5) radiometric age dating of selected crystalline rock masses in the Piedmont and Blue Ridge, (6) seismic zonation of South Carolina, and (7) a magnetometer survey of an old (circa 1900) copper mining area.

During 1983, several new publications were released, including the fifth edition of "Catalog of Geological Publications" (Circular 1), three open-file reports on geochemical investigations within the Inner Piedmont of South Carolina, four U.S. Geological Survey open-file geologic maps, and an

issue of "South Carolina Geology." The Salem geologic quadrangle and text were in press at yearend 1983.

Other manuscripts nearly completed or ready for publication at yearend included a revision of "Catalog of South Carolina Mineral Producers" (Circular 2), "Seismic Zones of South Carolina" (Open-File Report 34A), and "Geologic Map Index of South Carolina" (Circular 3).

The Division of Mining and Reclamation of the South Carolina Land Resources Conservation Commission released a handbook, "Conservation and Reclamation for Mined Lands," which described details of mine land reclamation that are applicable to South Carolina's mining industry.

Various committees of the Mining Association of South Carolina held several meetings during 1983. Association goals include educating the public on the State's mineral resources and the benefits derived from mining. The association was instrumental in aiding the new South Carolina Museum in obtaining samples of minerals and ores from within the State.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetallic minerals comprise the bulk of the mineral commodities mined and/or processed in the State. The principal nonmetallic commodities mined in 1983 in terms of value were cement, stone, and clays, which accounted for over 75% of South Carolina's mineral value.

Cement.—Three companies, Giant Portland & Masonry Cement Co., Gifford-Hill & Co. Inc., and Santee Portland Cement Corp., with plants in Dorchester and Orangeburg Counties, comprised the cement industry in South Carolina. Pertinent data on the three operations is given in table 4.

Table 4.—South Carolina: Cement industry in 1983

Company	Location	Process	Number of kilns	Annual clinker capacity (thousand short tons)	Primary fuel
Giant Portland & Masonry Cement Co	Harleyville	Wet	4	770	Coal.
Gifford-Hill & Co. Inc	do	Dry	1	550	Do.
Santee Portland Cement Corp	Holly Hill	Wet	2	1,060	Do.

All three companies produced portland types I and II, and Giant and Santee produced masonry cement. The three companies mine a Tertiary Age marl and local clays for raw material. Gypsum was imported from Canada and the Caribbean area, and iron materials were obtained from southeastern sources. Sales during 1983 approached the record high established in 1979. Gifford-Hill announced plans to modify the Harleyville plant preheater kiln system to increase capacity by approximately 45,000 tons annually.

Clays.—South Carolina's clay industry, composed of 20 companies operating 36 mines, produced kaolin, fuller's earth, common clay and shale, and fire clay. Output, excluding fuller's earth, exceeded that reported in 1982 by 278,000 tons, while value increased $6.7 million over that reported for the previous year.

Common clay and shale production was reported by 14 companies operating 19 mines in 3 principal areas: (1) in northern South Carolina 4 companies operated 5 mines in 3 counties, (2) in west-central South Carolina 6 companies operated 7 mines in 5 counties; and (3) in the State's coastal plain 5 companies operated 5 mines in 4 counties.

Kaolin was produced by 10 companies operating 17 mines in 6 southwestern counties. Production exceeded that of 1982 by 126,000 tons, reflecting the recovery of the paper and construction industries.

All kaolin production is from surface mines, and the raw kaolin is transported to the processing plant by truck and/or pipeline. At the processing facility, kaolin is processed by either wet or dry beneficiation methods, depending on the end use. Wet-processed kaolin is used as a paper coating, in inks and high-gloss paints, and for other applications. Dry-processed kaolin is used as a paper filler, in ceramics and fiberglass, and by several other industries.

Table 5.—South Carolina: Kaolin sold or used by producers, by kind and use

(Short tons)

Kind and use	1982	1983
Airfloat:[1]		
Adhesives	12,522	17,693
Animal feed and pet waste absorbent	2,193	1,269
Ceramics[2]	27,477	5,453
Fertilizers	7,929	5,540
Fiberglass	76,969	100,099
Paint	410	1,671
Paper coating and filling	2,799	2,980
Pesticides and related products	14,424	15,741
Plastics	11,075	14,804
Rubber	158,819	196,452
Other refractories[3]	4,737	4,157
Other uses[4]	81,708	106,914
Exports[5]	40,632	37,416
Total	441,694	510,189
Unprocessed: Face brick and other unknown uses	174,052	231,989
Grand total	615,746	742,178

[1]Includes waterwashed.
[2]Includes floor and wall tile, pottery, and roofing granules.
[3]Includes refractory grogs and crudes and refractory mortar and cement.
[4]Includes animal oil; catalyst (oil-refining); chemical manufacturing; electrical porcelain; face brick; fire brick, blocks and shapes; high-alumina refractories; ink; medical, pharmaceutical, and cosmetic; roofing tile; sewer pipe; and other unknown uses.
[5]Includes ceramics, adhesives, paper filling, pesticides and related products, and rubber.

The State's fuller's earth, described by the South Carolina Geological Survey as a "nonplastic, opaline-bearing clay," was mined by SCA Services Inc. in Sumter County. After mining by open pit methods, the fuller's earth is dried, crushed, and calcined to produce an absorbent material for oil and grease absorption and pet litter.

One company in Cherokee County mined a fire clay for face brick manufacture.

Colemanite.—Industrial Minerals Inc., Kings Creek, processed colemanite, a calcium borate mineral imported from Turkey through the Port of Charleston. After crushing and grinding, the material was shipped to fiberglass producers in Anderson, SC, and Shelby, NC.

Feldspar.—Spartan Minerals Corp. at Pacolet ground a feldspar-silica concentrate generated during lithium beneficiation at Lithium Corp. of America's flotation facility at Cherryville, NC. Principal sales were to the glass, whiteware, and filler industries.

Mica.—Spartan Minerals dry-ground mica recovered by Lithium Corp. at the Cherryville, NC, spodumene flotation facility. Major ground mica sales were to the joint compound industry.

Mineral Mining Corp. in Lancaster County mined a sericite schist by open pit methods using bulldozers and front-end loaders. The schist was dry ground to produce a product used as a filler by the paint industry, in expansion joint cement, and by the electronics industry.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—The industrial sand industry in South Carolina was comprised of five companies in Lexington and Kershaw Counties in the central and north-cental part of the State. Principal end uses were for mold and core fabrication and in glass container and fiberglass manufacture.

Table 6.—South Carolina: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	2,376	$4,717	$1.99	NA	NA	NA
Gravel	1,522	7,333	4.82	NA	NA	NA
Sand and gravel (unprocessed)	829	1,120	1.35	NA	NA	NA
Total or average	4,727	13,170	2.79	e5,200	e$15,000	e$2.88
Industrial sand	720	10,902	15.14	842	13,169	15.64
Grand total or average	5,447	24,072	4.42	e6,042	e28,169	e4.66

eEstimated. NA Not available.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

In 1983, South Carolina's stone industry consisted of 14 companies operating 27 quarries in 19 of the State's 46 counties. Granite was the leading stone type produced in terms of output and sales; 18 quarries in 13 northern counties produced 9.9 million tons valued at $42 million. Limestone was produced from six quarries in three coastal plain counties, and output, which totaled almost 3 million tons, was valued at $12 million. Limestone production was also reported from Cherokee County in the northern part of the State. Production was from metamorphoric limestones in the Kings Mountain Belt.

Table 7.—South Carolina: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	85	377
Coarse aggregate, graded:		
Concrete aggregate, coarse	2,280	9,865
Bituminous surface treatment aggregate	654	2,797
Railroad ballast	681	3,224
Chemical and metallurgical: Cement manufacture	2,836	6,550
Special: Other[2]	9,251	38,241
Total	[3]15,786	61,054

[1]Includes limestone, granite, and marl.
[2]Includes macadam, bituminous aggregate (coarse), fine aggregate (-3/8 inch), coarse and fine aggregate, agricultural uses, sulfur oxide removal, asphalt fillers or extenders, and uses not specified.
[3]Data do not add to total shown because of independent rounding.

Vermiculite.—South Carolina, Virginia, and Montana are the only States with a vermiculite mining industry. In 1983, W. R. Grace & Co. and Patterson Vermiculite Co. comprised South Carolina's vermiculite producers. Moody Products Co. held mining permits, but State sources indicated that the company did not begin mining in 1983.

Both W. R. Grace and Patterson have facilities in the Enoree district, approximately 70 miles northwest of Columbus. W. R. Grace operated two exfoliation plants, and Patterson operated one. Principal sales by W. R. Grace were for lightweight aggregate, loose fill insulation, and horticultural applications, while Patterson production was used to produce horticultural products sold by the company.

METALS

A significant sector of South Carolina's mineral industry, a sector whose sales are not included in the State's overall mineral value, is the nonextractive metals industry. Metal producers, processing raw materials obtained from out-of-State and/or country, contributed significantly to local economies and provided thousands of jobs for South Carolina's citizens.

The surprising recovery of the Nation's

economy and the increased demand for durable goods were important factors in increased orders received by the State's metals industry.

Aluminum.—Alumax imported alumina from Australia through the Port of Charleston for a direct-reduction facility in Berkeley County. The 181,000-metric-ton-per-year plant houses two potlines and produces billets, ingots, and slabs.

Ferroalloys.—Macalloy in Charleston, the only U.S. company capable of 50% to 55% charge chrome production, filed for protection under chapter 11 in February 1982, and for most of 1982 and 1983 operated only the plant's concentrator and processed low-grade slag. At yearend, Macalloy was awarded a $23 million contract by the Federal Government to convert stockpiled chrome ore into ferrochrome.

Gold.—Limited amounts of gold, silver, and copper were recovered from tailings at the former Old Southern gold mine in Cherokee County.

AMSELCO, a Denver, CO, company which is a wholly owned subsidiary of the British Petroleum Co. PLC, maintained exploration offices and a sample preparation laboratory in Camden. The company was evaluating a property in Fairfield County.

Iron and Steel.—Georgetown Steel, Georgetown; Nucor, Carlington; and Owen Electric, Columbia, comprise South Carolina's steel industry. The three companies operated 11 electric furnaces to produce a variety of metal shapes. Georgetown Steel changed its name from Korf Industries Inc. in October. Prior to the sale, the company was reorganized and a controlling interest was held by Kuwaiti investors.[4] In the latter part of 1983, orders increased significantly over the same period in 1982. In 1983, Nucor sales increased $54 million to $540 million and post tax earnings were $26 million, 25% more than in 1982.[5]

Manganiferous Ore.—Zones with relatively high manganese contents, ranging from 5% to 15% in the Battleground Schist, were mined by three companies in Cherokee County. The manganiferous material was ground, bagged, and sold to South and North Carolina brick manufacturers as a coloring agent.

Zircon.—Crude zircon concentrate, obtained as a byproduct in titanium mineral beneficiation, was imported from Australia and Florida by M & T Chemicals. The concentrate was ground at the company's Andrew plant in Georgetown County and sold to the foundry, wall tile, whiteware, and ceramics industries.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, AL.
[2]State geologist, South Carolina Geological Survey, Columbia, SC.
[3]Ellson, R. W., and R. C. Martin. South Carolina: A Strong Recovery, but Problems Remain. Federal Reserve Bank of Atlanta, Econ. Rev., Feb. 1984, pp. 84-91.
[4]American Metal Market. Aug. 31, 1983.
[5]Inter-mountain (Elkins, WV). Darlington Steel Has Lessons For Other Steel Plants. Mar. 27, 1984.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum smelters:			
Alumax Inc	Box 1000 Goose Creek, SC 29445	Plant	Berkeley.
Cement:			
Giant Portland & Masonry Cement Co	Box 218 Harleyville, SC 29448	do	Dorchester.
Gifford-Hill & Co. Inc	Box 326 Harleyville, SC 29448	do	Do.
Santee Portland Cement Corp	Box 698 Holly Hill, SC 29059	do	Orangeburg.
Clays:			
Common clay and shale:			
Gifford-Hill & Co. Inc	Box 326 Harleyville, SC 29448	Mines	Dorchester.
Palmetto Brick Co.[1]	Box 430 Cheraw, SC 29520	do	Marlboro and Chesterfield.
Richtex Corp.[1]	Box 3307 Columbia, SC 29230	do	Richland and Lexington.
Santee Portland Cement Corp	Box 698 Holly Hill, SC 29059	do	Orangeburg.
Southern Brick Co	Box 208 Ninety Six, SC 29666	do	Greenwood, Newberry, Saluda.
Fuller's earth:			
South Carolina SCA Services Inc.	Route 1, Box 255 Pinewood, SC 29125	Mine and plant	Sumter.
Kaolin:			
Dixie Clay Co	Box B Bath, SC 29816	do	Aiken.
J. M. Huber Corp	Box 306 Langley, SC 29834	do	Do.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Colemanite:			
Industrial Minerals Inc	Box 459 York, SC 29745	Plant	York.
Feldspar:			
Spartan Minerals Corp., a division of Lithium Corp. of America.	Box 520 Pacolet, SC 29372	do	Spartanburg.
Manganiferous ore:			
Ashe Brick Co	Van Wyck, SC 29744	do	Do.
Broad River Brick Co., a division of Boren Clay Products.	Box 368 Pleasant Garden, NC 27313	do	Do.
Fletcher Brick Co., a division of Moland-Drysdale Corp.	Box 2150 Hendersonville, NC 28739	do	Do.
Mica (sericite):			
Mineral Mining Corp	Box 458 Kershaw, SC 29067	Mine and plant	Lancaster.
Sand and gravel (1982):			
Becker Sand and Gravel Co. Inc	Box 848 Cheraw, SC 29520	Pits and plants	Chesterfield, Dorchester, Florence, Marlboro, Sumter.
Brewer Sand Co. Inc	Box 267 Lancaster, SC 29720	Pit and plant	Lancaster.
Foster-Dixiana Sand Co	Box 5447 Columbia, SC 29250	do	Lexington.
Stone:			
Granite (crushed and broken):			
Lone Star Industries Inc	Box 420 Norfolk, VA 23501	Quarry and plant	Fairfield, Greenwood, Richland.
Martin Marietta Aggregates	Box 30013 Raleigh, NC 27612	do	Fairfield, Lexington, Richland, York.
Vulcan Materials Co	Drawer 8834 Greenville, SC 29604	do	Greenville, Laurens, Pickens, Spartanburg.
Granite (dimension):			
Granite Panelwall Co., a division of Florida Crushed Stone.	Box 898 Elberton, GA 30635	Quarry	Kershaw.
Matthews International Corp	Penn Circle East Pittsburgh, PA 15206	do	Do.
Limestone (crushed):			
Martin Marietta Aggregates	Box 30013 Raleigh, NC 27612	Quarry and plant	Berkeley and Georgetown.
Vulcan Materials Co	Drawer 8834 Greenville, SC 29604	do	Cherokee.
Southern Aggregates Co	Box 4510 Augusta, GA 30907	Quarry	Berkeley.
Marl (crushed):			
Giant Portland & Masonry Cement Co.	Box 21969 Columbia, SC 29221	Pit	Dorchester.
Gifford-Hill & Co. Inc	Box 326 Harleyville, SC 29448	Pit	Do.
Santee Portland Cement Corp	Box 698 Holly Hill, SC 29059	Pit	Orangeburg.
Vermiculite:			
W. R. Grace & Co	Route 1 Enoree, SC 29335	Mine and plant	Laurens.
Patterson Vermiculite Co	do	do	Do.

[1]Also kaolin.

The Mineral Industry of South Dakota

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the South Dakota Geological Survey for collecting information on all nonfuel minerals.

By James H. Aase[1]

Nonfuel mineral production in South Dakota during 1983 was valued at $222.3 million, a 64% increase over that of 1982 but $5.6 million below the high set in 1980. The 1983 increase was attributed principally to the propitious advance in gold production and price.

Nine of the fourteen mineral commodities produced during the year had increased outputs, and the same number registered value increases over those of 1982. Nearly three-fifths of the State's total mineral value was derived from gold. Among the nonmetallic minerals, cement led in output value, followed by stone and construction sand and gravel, collectively comprising about 35% of the total value.

Table 1.—Nonfuel mineral production in South Dakota[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	4	$383	4	$359
Portland do	520	27,978	603	37,435
Clays[2] do	128	346	123	353
Feldspar short tons	W	W	7,109	107
Gem stones	NA	70	NA	70
Gold (recoverable content of ores, etc.) troy ounces	185,038	69,558	309,784	131,348
Sand and gravel (construction) thousand short tons	3,816	8,604	e5,190	e11,500
Silver (recoverable content of ores, etc.) thousand troy ounces	26	209	62	713
Stone:				
Crushed thousand short tons	e2,600	e7,400	3,906	12,982
Dimension do	e48	e16,270	43	15,952
Combined value of beryllium, clays (bentonite), gypsum, lime, mica (scrap), and value indicated by symbol W	XX	4,855	XX	11,432
Total	XX	135,673	XX	222,251

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes bentonite; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in South Dakota, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Beadle	(2)	$23	Sand and gravel (construction).
Bon Homme	--	35	Do.
Brookings	(2)	W	Do.
Brown	(2)	182	Do.
Brule	(2)	--	
Butte	W	W	Clays, sand and gravel (construction).
Campbell	(2)	W	Sand and gravel (construction).
Charles Mix	(2)	156	Do.
Clark	(2)	75	Do.
Clay	(2)	30	Do.
Codington	(2)	W	Do.
Corson	(2)	10	Do.
Custer	$647	298	Feldspar, beryllium, mica.
Davison	(2)	W	Sand and gravel (construction).
Day	(2)	89	Do.
Deuel	(2)	204	Do.
Dewey	--	49	Do.
Douglas	(2)	W	Do.
Fall River	470	181	Do.
Faulk	(2)	33	Do.
Grant	17,543	W	Do.
Gregory	(2)	142	Do.
Haakon	--	16	Do.
Hamlin	(2)	40	Do.
Hand	(2)	W	Do.
Hanson	W	3	Do.
Harding	--	40	Do.
Hughes	(2)	9	Do.
Hutchinson	(2)	W	Do.
Hyde	(2)	100	Do.
Jerauld	(2)	31	Do.
Jones	(2)	90	Do.
Kingsbury	(2)	--	
Lake	(2)	317	Sand and gravel (construction).
Lawrence	W	W	Gold, silver, sand and gravel (construction).
Lyman	(2)	--	
McPherson	(2)	W	Sand and gravel (construction).
Marshall	(2)	W	Do.
Meade	15	1,165	Do.
Miner	(2)	W	Do.
Minnehaha	2,995	516	Do.
Moody	(2)	W	Do.
Pennington	32,807	33,404	Cement, lime, sand and gravel (construction), clays, gypsum.
Perkins	(2)	W	Sand and gravel (construction).
Potter	(2)	--	
Roberts	(2)	292	Sand and gravel (construction).
Sanborn	(2)	W	Do.
Spink	(2)	W	Do.
Sully	(2)	509	Do.
Tripp	(2)	--	
Turner	(2)	W	Sand and gravel (construction).
Union	(2)	76	Do.
Walworth	(2)	55	Do.
Yankton	W	203	Do.
Undistributed[3]	130,998	73,626	
Sand and gravel (construction)	e9,224	XX	
Stone:			
Crushed	XX	e7,400	
Dimension	XX	e16,270	
Total[4]	194,698	135,673	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Aurora, Bennett, Buffalo, Edmunds, Jackson, Lincoln, McCook, Mellette, Shannon, Stanley, Todd, and Ziebach. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Includes gem stones and some construction sand and gravel (1982) that cannot be assigned to specific counties and values indicated by symbol W.

[4]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of South Dakota business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	314.4	313.7	-0.2
Unemployment	do	22.7	17.4	-23.4
Employment (nonagricultural):				
Mining[1]	do	2.4	2.5	+4.2
Manufacturing	do	23.8	26.5	+11.3
Contract construction	do	5.8	6.8	+17.2
Transportation and public utilities	do	12.2	12.4	+1.6
Wholesale and retail trade	do	58.8	60.2	+2.4
Finance, insurance, real estate	do	12.0	12.7	+5.8
Services	do	51.3	52.1	+1.6
Government	do	57.0	56.7	-.5
Total nonagricultural employment[1 2]	do	223.4	229.7	+2.8
Personal income:				
Total	millions	$6,676	$6,792	+1.7
Per capita		$9,582	$9,704	+1.3
Construction activity:				
Number of private and public residential units authorized		1,220	2,750	+125.4
Value of nonresidential construction	millions	$77.8	$106.6	+37.0
Value of State road contract awards	do	$78.0	$85.4	+9.5
Shipments of portland and masonry cement to and within the State	thousand short tons	197	278	+41.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$135.7	$222.3	+63.8
Value per capita, resident population		$196	$318	+62.2
Value per square mile		$1,761	$2,882	+63.7

[p]Preliminary.
[1]Includes oil and gas extraction.
[2]Data do not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

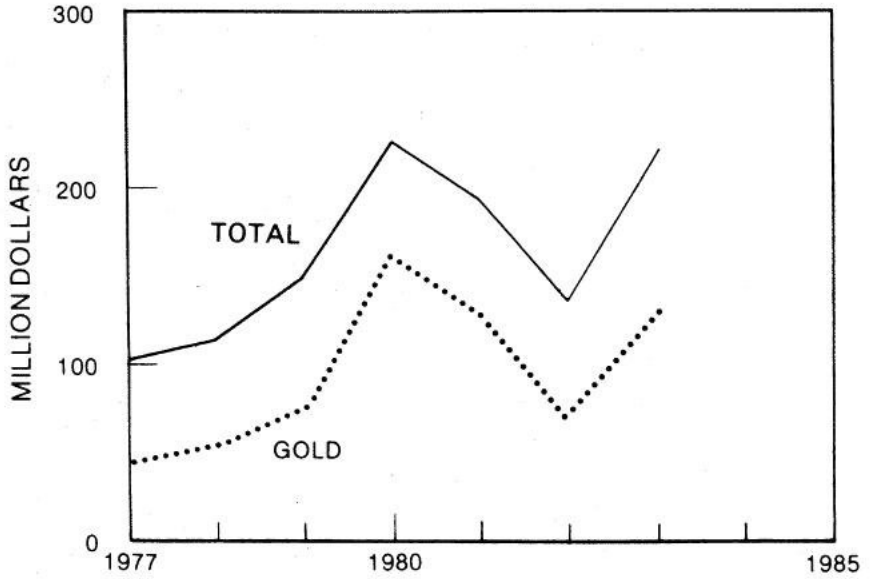

Figure 1.—Value of mine production of gold and total value of nonfuel mineral production in South Dakota.

Nationally, the State ranked 32d in value of nonfuel mineral production, accounting for 1% of the U.S. total. Among the minerals produced during 1983, gold output in South Dakota ranked 2d among 12 States; beryllium, 2d of 3; mica, 2d of 7; feldspar, 6th of 6; silver, 10th of 16; dimension stone, 11th of 39; crude gypsum, 19th of 22; lime, 26th of 39; portland cement, 28th of 40; clays, 29th of 44; masonry cement, 32d of 38; construction sand and gravel, 37th of 50; and crushed stone, 38th of 48.

Employment.—According to the South Dakota Department of Labor, Research and Statistics Division, the average annual employment in the State's mining industry during 1983 was 2,653 workers, about a 15% increase compared with that of 1982. Mining industry workers represented about 1.2% of the State's total nonagricultural work force during the year. During 1983, wages in mining averaged $462 weekly, a 5% increase over those of 1982.

Trends and Developments.—Nonfuel mineral exploration for minerals other than aggregates increased moderately over that of 1982. Twenty exploration permits were issued, mostly for precious metals in Lawrence and Pennington Counties. The State additionally issued 14 mining permits for extracting nonfuel minerals, excluding aggregates. Three of the mining permits were for granite in Grant County; one for gypsum in Meade County; eight for precious metals in Custer, Lawrence, and Pennington Counties; and two for pegmatite minerals in Custer County.

In recognition of its environmental achievements, Homestake Mining Co. received a national award cosponsored by the President's Council on Environmental Quality and the Environmental Industry Council. The award was for Homestake's continuing program to dispose of tailings safely and to remove solid wastes from process water used at its gold mine operations in Lead.

At a site 3-1/2 miles southwest of Lead, Wharf Resources (USA) Inc. advanced from the pilot stage into full production of gold at its Annie Creek Mine project. A former underground mine, the property was converted to an open pit operation. A heap-leaching process recovered the gold from the ore. Ore production was targeted for 500,000 short tons annually, from which 14,000 troy ounces of gold was to be recovered.

At yearend, Homestake was proceeding with development work on reopening its old "Open Cut" gold mine near the surface facilities of its current underground mine on the outskirts of Lead. The project, a 2-year pilot test, will be used to determine the long-range feasibility of continuing the venture. About 4 million tons of waste rock and 500,000 tons of ore were to be removed during the pilot program. The Open Cut reportedly could yield 15 to 20 years of surface mining, producing 7.5 million tons of ore.

Legislation and Government Programs.—The 1983 South Dakota Legislature enacted the following that affected the State's mining industry:

1. HB 1067—Mining Without a Permit. Any person mining without a required permit would be guilty of a Class 2 misdemeanor.

2. HB 1132—Study on State Severance Taxes. The measure required that a legislative committee be appointed to study the State's existing severance taxes on precious metals and to report its findings to the next legislative session for possible action. The pros and cons of a severance tax versus a net profits tax on precious metals was the principal issue to be investigated.

In other action, the legislature granted the State Board of Minerals and Environment authority to approve mining permits for the "life of mine" rather than requiring the operator to renew its permits each year. Life-of-mine permits do not apply to sand and gravel or other aggregate-related material operations.

South Dakota received $1.1 million during fiscal year 1983 from the U.S. Department of the Interior as its share of receipts the Federal Government collected on mineral leasing rents, royalties, and bonuses from Federal lands in the State.

The Mining and Mineral Resources and Research Institute of the South Dakota School of Mines and Technology at Rapid City received a $150,000 grant from the U.S. Bureau of Mines under the provisions of title III of Public Law 95-87. The grant was designed to encourage the training of mining engineers and scientists involved in mineral-related studies. The funds, to be matched with non-Federal funds, can be used by the schools for research projects, demonstrations, fellowships, or other programs.

During 1983, the South Dakota Geological Survey (SDGS) continued its involvement in a variety of activities that provide a better understanding of the State's underlying geology and associated mineral and water

resources. Water resource programs received a major thrust during 1983.

SDGS conducted a total geologic and hydrologic investigation of the entire Big Sioux Basin. This project was to bring together all aspects of research within the basin; the result was to be a computerized ground water model allowing maximum development of water resources through proper management.

SDGS undertook a special water supply study of the entire State for the U.S. Army Corps of Engineers and conducted water-quality studies of selected aquifers in cooperation with the U.S. Environmental Protection Agency. All basic data from these programs were being entered into a computerized data-management system for easy retrieval and for use by interested parties. Near yearend, 5,348 drilling records, 2,336 water-quality records, and over 18,000 water level measurements were in computerized storage.

The following were among the SDGS publications released during 1983:

"Groundwater Studies for the Cities of Fairview and Iroquois"; "Major Aquifers in Miner, Davison, Hanson, and Yankton Counties"; "Sand and Gravel Resources in Davison and Hanson Counties"; and "Geology and Water Resources in McPherson, Edmunds, and Faulk Counties."

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Beryllium.—Bland Mining and Pacer Corp. produced hand-cobbed beryl in Custer County. Total State output for 1983 remained small, falling below the level of 1982.

Gold.—The State ranked second nationally, behind Nevada, in gold production for the year. The bulk of the output came from the underground mine at Lead operated by Homestake, and the remainder came from the open pit mine of Wharf Resources in Lawrence County. Total output rose 67% in quantity and 89% in value over that of 1982. The 1983 production level, the highest since 1976, exceeded the 10-year average by 9%. Gold prices during the year averaged $424 per troy ounce, an advance of $48 per troy ounce over the 1982 price.

Table 4.—South Dakota: Mine production of gold and silver in terms of recoverable metal

Year	Mines producing		Material sold or treated[1] (thousand metric tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Thousand troy ounces	Value (thousands)
1979	1	--	1,297	245,912	$75,618	58	$643
1980	1	1	1,621	267,642	163,947	51	1,058
1981	1	1	1,677	278,162	127,854	56	587
1982	1	--	1,059	185,038	69,558	26	209
1983	2	--	1,771	309,784	131,348	62	713
1876-1983	NA	NA	NA	38,303,555	1,878,017	13,593	15,523

NA Not available.
[1]Excludes placer gravel.

The average recovery grade of the nearly 2 million tons of gold ore mined and processed in the State during 1983 was approximately 0.16 troy ounce per ton of material treated. No placer ore production was reported in 1983.

According to the Homestake Mining Co. 1983 Annual Report, gold ore reserves at the Homestake Mine at Lead were 19,990,000 tons at an average grade of 0.221 ounce per ton. During 1983, the average grade of ore mined increased 7%, tons mined per worker shift increased an average of 1.01 tons or 13%, and the gold recovery rate improved by 2%. The company reported that the average production cost was $301 per ounce and that it paid South Dakota severance taxes amounting to 17% of the Homestake Mine's operating earnings, or $25.46 per ounce of gold sold.

Mining and exploration work continued in the deep level of the Homestake Mine below the 6,800-foot level. The new 7,250-foot level was begun, and exploration to determine ore continuity proceeded on the 8,000-foot level. At the company's tailings disposal site, a 50-foot lift was completed on its Grizzly Gulch dam, and construction began on a waste water treatment plant that will incorporate new technology using bacteria instead of chemicals in its treatment process. The plant startup was scheduled for mid-1984.

Silver.—The State's entire silver production in 1983 was as a coproduct with the gold produced at the Homestake Mine in Lead. Output increased both in quantity and value by 138% and 241%, respectively, over that of 1982. A sharp rebound in silver prices during 1983 resulted in an average advance of $3.49 per troy ounce over that of 1982 for an average price of $11.44 per troy ounce.

NONMETALS

Cement.—Cement manufactured in South Dakota came exclusively from the State-owned plant at Rapid City. The output—consisting of four types of portland cement, an oil-well cement, and a prepared masonry cement—collectively increased 16% in quantity and 33% in value compared with that of 1982. The average unit value of both the portland and masonry cement sold in 1983 reached record highs of $62.03 per short ton and $83.20 per ton, respectively. According to South Dakota Cement Commission officials, cement plant profits during 1983 totaled about $11 million, and about 43% of the 607,000 tons sold during 1983 went to South Dakota customers.

Ready-mixed concrete companies were the largest users of portland cement, consuming 48% of the 1983 shipments, followed by highway contractors, consuming 20%. Approximately 91% of the portland cement shipments were handled by truck and the remainder by rail. Of the total shipments, 96% were made in bulk form. Consumed in manufacturing the 1983 cement output was 910,000 tons of mostly State-produced nonfuel mineral raw materials.

Clays.—American Colloid Co. operated the sole bentonite processing plant in the State during 1983. The crude material processed at the plant came from within the State and from out of State. Output of processed bentonite in 1983 increased nearly sevenfold over that of 1982 to its highest level since 1976. Among the more than a score of uses for which the bentonite was marketed, its use in animal feeds, drilling muds, foundry sand application, and as an iron ore pellet binder were among the leaders.

Common clay from pits operated by the South Dakota Cement Commission for use in manufacturing cement accounted for the total State output during 1983. Although the quantity produced increased slightly over that of 1982, it remained 26% below the 10-year average.

Feldspar.—Pacer ground crude feldspar, purchased from area miners, at its Custer plant. The quantity and value of the crude feldspar processed during 1983 were below the 1982 levels.

The ground feldspar was marketed throughout the United States and abroad for use principally in enamels and pottery.

Gem Stones.—No commercial gem stone mining operations were reported in South Dakota during 1983. No precise value is known for gem material that rockhounds, mineral collectors, and other hobbyists collected. The value for gem stones indicated in table 1 is an estimated amount.

Lime.—The State's entire lime production in 1983 was from the Pete Lien & Sons Inc. plant in Rapid City. Output increased both in quantity and value over that of 1982. Lime consumption in South Dakota, obtained from all domestic sources, was approximately 77,000 short tons in 1983.

Mica.—Mica production during 1983 increased substantially over the 1982 level. During 1983, Pacer accounted for the entire State output, which was processed at the company's grinding mill in Custer.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend. Estimated production in 1983 rose significantly above the level recorded for 1982.

Table 5.—South Dakota: Construction sand and gravel sold or used by producers

	1982			1983[e]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	690	$2,245	$3.26	NA	NA	NA
Gravel	2,844	5,980	2.10	NA	NA	NA
Sand and gravel (unprocessed)	283	378	1.34	NA	NA	NA
Total[1] or average	3,816	8,604	2.25	5,100	$11,500	$2.25

[e]Estimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Granite, limestone, and sandstone-quartzite were all produced in the State during 1983. Stone production increased nearly 50% over the quantity estimated to have been produced in 1982. In 1983, 14 firms quarried stone at 20 locations in 8 counties.

Crushed.—Crushed limestone, exceeding that of any other rock type produced, came from nine quarries in six counties. Among the specified uses of the limestone mined, the largest amount went into cement manufacturing. Pennington County led in crushed stone output.

Three companies produced crushed sandstone or quartzite at three quarries in Hanson and Minnehaha Counties. The largest use for the quartzite produced was as a concrete aggregate.

Approximately two-thirds of South Dakota's crushed stone was from three firms. The range of production from individual quarry operations during the year varied widely, with two quarries producing less than 25,000 short tons; four quarries between 25,000 and 200,000 tons; two quarries between 200,000 and 500,000 tons; and four quarries in excess of 500,000 tons. All crushed stone was shipped by truck in 1983.

Dimension.—Four companies quarried granite at eight sites in Grant County. The granite dimension stone quarried was marketed most extensively as cut stone.

[1]State Liaison Officer, Bureau of Mines, Minneapolis, MN.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Beryllium concentrate:			
Bland Mining	Route 3, Box 18 Custer, SD 57730	Mines	Custer.
Pacer Corp	Box 912 Custer, SD 57730	do	Do.
Cement:			
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Four rotary kilns	Pennington.
Clays:			
American Colloid Co	5100 Suffield Ct. Skokie, IL 60076	Open pit mine and plant	Butte.
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Open pit mine	Pennington.
Feldspar:			
Pacer Corp	Box 912 Custer, SD 57730	Open pit mines and dry-grinding plant	Custer.
Gold:			
Homestake Mining Co	Box 875 Lead, SD 57754	Underground mine, cyanidation mill, refinery.	Lawrence.
Wharf Resources (USA) Inc	Box 897 Lead, SD 57754	Open pit mine and heap leaching.	Do.
Gypsum:			
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Open pit mine	Pennington.
Lime:			
Pete Lien & Sons Inc	Box 440 Rapid City, SD 57709	1 rotary kiln, 1 vertical kiln, continuous-hydrator plant.	Do.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Mica:			
Pacer Corp	Box 912 Custer, SD 57730	Mine and dry-grinding plant	Custer.
Sand and gravel (construction, 1982):			
W. E. Bartholomew & Son Construction Co.	Route 3 Huron, SD 57350	Pits and plants	Various.
Birdsall Sand & Gravel Co. Inc	Box 767 Rapid City, SD 57709	do	Fall River, Pennington, Sully.
Concrete Materials Inc	100 South Dakota Ave. Summit, SD 57266	do	Minnehaha and Roberts.
F. J. McLaughlin Co	Box 13 Watertown, SD 57201	Pit and plant	Codington.
Bernard Mahrer Construction Co.	Rutland, ND 58067	do	Marshall.
W. & D. Morris Construction Co. Inc.	Box 337 Sturgis, SD 57785	Pits and plants	Meade.
Obenauer Construction Co	Box 274 Eureka, SD 57437	Pit and plant	McPherson.
Reynolds Construction Co	Box 689 Sioux Falls, SD 57101	do	Minnehaha.
Silver:			
Homestake Mining Co	Box 875 Lead, SD 57754	See *Gold*	Lawrence.
Stone:			
Crushed:			
Limestone:			
Pete Lien & Sons Inc	Box 440 Rapid City, SD 57709	Quarries and plants	Custer and Pennington.
Northwestern Engineering Co. (Hills Materials Co.).	Box 2320 Rapid City, SD 57709	do	Fall River and Pennington.
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Quarry and plant	Pennington.
Sandstone-quartzite:			
Concrete Materials Co	Box 809 Sioux Falls, SD 57101	do	Minnehaha.
L. G. Everist Inc	313 South Phillips Sioux Falls, SD 57101	do	Do.
Spencer Quarries Inc	Box 25 Spencer, SD 57374	do	Hanson.
Dimension:			
Granite:			
Cold Spring Granite Co	202 South 3d Ave. Cold Spring, MN 56320	Quarries	Grant.
Dakota Granite Co	Box 1351 Milbank, SD 57252	do	Do.

The Mineral Industry of Tennessee

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Tennessee Division of Geology for collecting information on all nonfuel minerals.

By Doss H. White, Jr.,[1] and Robert W. Johnson[2]

In 1983, Tennessee's nonfuel mineral industry produced $407 million worth of mineral commodities. Nonmetallic mineral output was valued at $306.7 million, 75% of the total, while metallic mineral production, principally zinc, added the remaining $100.3 million, or 25%. The nonmetallic mineral value contains the reported value of byproduct copper and silver. Mineral value in 1983 was $28.6 million above that produced in 1982, but fell $14.1 million below the record high set in 1981.

In 1983, the State led the Nation in the output of ball clay, pyrites, and zinc; ranked second in ferroalloy shipments and synthetic graphite production; fourth in phosphate rock production; and fifth in primary aluminum output.

Table 1.—Nonfuel mineral production in Tennessee[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement (portland) thousand short tons	763	$36,689	W	W
Clays do.	766	20,107	1,066	$26,516
Gem stones	NA	5	NA	5
Phosphate rock thousand metric tons	897	11,596	1,193	28,879
Sand and gravel:				
Construction thousand short tons	5,051	15,917	e6,100	e18,700
Industrial do.	468	4,826	483	5,455
Stone:				
Crushed do.	W	W	30,578	111,506
Dimension do.	e10	e1,012	7	1,161
Zinc (recoverable content of ores, etc.) metric tons	121,306	102,882	109,958	100,336
Combined value of barite, cement (masonry), copper, lime, pyrites, silver, and values indicated by symbol W	XX	r185,453	XX	114,493
Total	XX	r378,487	XX	407,051

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Tennessee, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Anderson	W	W	Clays.
Bedford	W	(2)	
Benton	W	W	Sand and gravel (construction), sand and gravel (industrial).
Blount	W	(2)	
Bradley	W	(2)	
Campbell	$4,082	W	Sand and gravel (construction), sand and gravel (industrial).
Cannon	179	(2)	
Carroll	W	W	Sand and gravel (industrial), clays, sand and gravel (construction).
Carter	W	(2)	
Claiborne	W	(2)	
Clay	W	(2)	
Cocke	167	(2)	
Coffee	W	W	Sand and gravel (construction).
Cumberland	5,779	W	Do.
Davidson	W	(2)	
Decatur	2,383	$1,067	Sand and gravel (construction).
DeKalb	W	(2)	
Dickson	W	(2)	
Dyer	(3)	--	
Fayette	(3)	62	Sand and gravel (construction).
Fentress	866	(2)	
Franklin	3,557	(2)	
Gibson	W	W	Clays.
Giles	W	W	Phosphate rock.
Grainger	W	(2)	
Greene	921	W	Sand and gravel (construction).
Hamblen	W	(2)	
Hamilton	19,644	19,432	Cement, sand and gravel (construction), sand and gravel (industrial), clays.
Hardeman	(3)	W	Sand and gravel (construction).
Hardin	W	W	Do.
Hawkins	W	(2)	
Henry	7,475	7,839	Clays, sand and gravel (construction).
Hickman	W	W	Phosphate rock.
Humphreys	327	525	Sand and gravel (construction), sand and gravel (industrial).
Jackson	W	(2)	
Jefferson	75,631	57,608	Zinc.
Johnson	W	(2)	
Knox	47,494	27,367	Zinc, cement, sand and gravel (construction), clays.
Lauderdale	(3)	W	Sand and gravel (construction).
Lawrence	W	12	Do.
Lincoln	1,245	(2)	
Loudon	W	W	Barite.
McMinn	W	W	Lime.
McNairy	(3)	W	Sand and gravel (construction).
Macon	W	(2)	
Madison	(3)	133	Sand and gravel (construction).
Marion	W	W	Cement, sand and gravel (construction).
Marshall	W	(2)	
Maury	W	W	Phosphate rock.
Meigs	W	(2)	
Monroe	1,489	(2)	
Montgomery	W	(2)	
Moore	612	(2)	
Morgan	54	(2)	
Obion	(3)	485	Sand and gravel (construction).
Overton	W	793	Do.
Pickett	71	(2)	
Polk	70,265	57,079	Pyrites, copper, zinc, silver.
Putnam	1,226	(2)	
Rhea	W	(2)	
Roane	W	W	Sand and gravel (construction).
Robertson	W	(2)	
Rutherford	3,346	(2)	
Sequatchie	W	(2)	
Sevier	W	W	Sand and gravel (construction).
Shelby	(3)	3,430	Do.
Smith	W	W	Zinc.
Stewart	W	W	Sand and gravel (construction).
Sullivan	W	W	Cement, clays.
Sumner	W	(2)	
Tipton	(3)	W	Sand and gravel (construction).
Unicoi	W	(2)	

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Tennessee, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Union	W	W	Lime, sand and gravel (construction).
Van Buren	$124	(2)	
Warren	W	(2)	
Washington	W	W	Clays.
Wayne	(3)	W	Sand and gravel (construction).
Weakley	13,500	$10,917	Clays.
White	W	(2)	
Williamson	W	W	Phosphate rock.
Wilson	W	(2)	
Undistributed[4]	136,280	190,725	
Sand and gravel (construction)	e24,130	XX	
Stone:			
Crushed	XX	W	
Dimension	XX	e1,012	
Total[5]	421,149	378,487	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Bledsoe, Cheatham, Chester, Crockett, Grundy, Hancock, Haywood, Henderson, Houston, Lake, Lewis, Perry, Scott, and Trousdale. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Stone, either crushed or dimension, was produced; data not available by county.

[3]Construction sand and gravel was produced; data not available by county.

[4]Includes gem stones and sand and gravel (industrial) that cannot be assigned to specific counties, and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Tennessee business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,145.7	2,200.0	+2.5
Unemployment	do	303.5	244.6	-19.4
Employment (nonagricultural):				
Mining[1]	do	7.6	7.6	--
Manufacturing	do	452.1	481.8	+6.6
Contract construction	do	60.3	71.9	+19.2
Transportation and public utilities	do	80.4	83.0	+3.2
Wholesale and retail trade	do	372.3	394.1	+5.9
Finance, insurance, real estate	do	79.3	81.7	+3.0
Services	do	309.6	323.3	+4.4
Government	do	300.5	302.1	+.5
Total nonagricultural employment[1]	do	[2]1,662.2	1,745.5	+5.0
Personal income:				
Total	millions	$41,406	$43,867	+6.0
Per capita		$8,899	$9,362	+5.2
Construction activity:				
Number of private and public residential units authorized		15,008	30,084	+100.4
Value of nonresidential construction	millions	$792.3	$912.5	+15.2
Value of State road contract awards	do	$229.5	$254.0	+10.7
Shipments of portland and masonry cement to and within the State	thousand short tons	1,154	1,334	+15.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$378.5	$407.1	+7.6
Value per capita, resident population		$81	$87	+7.4
Value per square mile		$8,966	$9,659	+7.7

pPreliminary.

[1]Includes bituminous coal and oil and gas extraction.

[2]Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

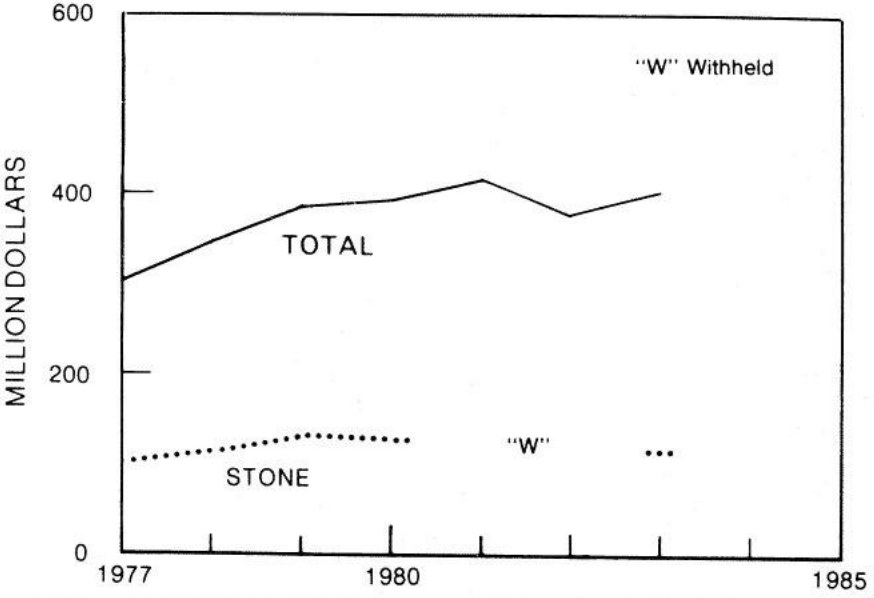

Figure 1.—Value of stone and total value of nonfuel mineral production in Tennessee.

Trends and Developments.—The effects of the nationwide economic downturn, which began in late 1979, were readily apparent, beginning in 1980, on the mineral industries in many Eastern States. Most reported a sales decline from 1980 to 1982. The value of Tennessee's nonfuel mineral output experienced a single-year decrease in 1982 when sales fell $42.3 million. An increase in zinc production and sales buoyed the State's mineral value during 1980 and 1981. However, if the value of Tennessee's major metallic mineral commodity, zinc, is subtracted from the total mineral value for the 1980-82 period, the effects of the recession are readily apparent, as shown in the following:

Year	Nonmetal value (millions)	Metal value[1] (millions)	Total value (millions)
1979	$315.7	$70.0	$385.7
1980	301.6	92.2	393.8
1981	305.5	115.6	421.1
1982	275.8	102.9	378.8
1983	306.7	100.3	407.0

[1]Zinc.

Although 1981 sales of nonmetallics increased $4 million over the value reported in 1980, nonmetallic mineral value experienced a 3-year decline from the record high $315.7 million established in 1979.

However, in 1983, the construction sector of Tennessee's economy experienced a strong rebound from the 3-year slump. Historically, over 40% of the State's nonmetallic mineral output has been used by the construction industry, and the strength of the construction industry's recovery was a major factor in the increased demand and sales experienced by Tennessee's mineral producers.

The Atlanta Federal Reserve Bank reported that the dollar value of construction contracts, on a 12-month rate, had reached $3.6 billion by November, 44% higher than in 1982 and the first significant increase since 1979. Residential construction, which comprised one-half the value of construction expenditures, led the growth; single-family construction doubled in mid-1983 after declining from 1978 to 1982. Single-family permits remained flat through 1982 prior to the meteoric rise noted in 1983. Multifamily permits increased 125% in November, and nonresidential building permits, which did not begin to recover until midyear, were 24% above the 1982 level by November.[3]

Several developments during the year had or promised to have a positive effect on the recovery of the State's mineral industry.

At yearend, work was nearing completion on one of the largest construction projects in the Eastern United States—the Aeropropulsion Systems Test Facility at the Air Force's Arnold Engineering and Development Center at Tullahoma. Upon completion in 1984, the $0.5 billion project, begun in 1977, will be able to test jet engines with up to 75,000 pounds of thrust at simulated altitudes up to 100,000 feet. The test cells, designed to simulate conditions close to Mach 4, can vary temperatures ranging from -150° F to more than 1,000° F. The facility, supported by 630 caissons sunk to bedrock, required 1.2 million cubic yards of excavation and backfill and approximately 67,000 cubic yards of concrete.[4]

A new phosphoric acid production process could have a significant effect on the economically recoverable reserve base of the Tennessee phosphate field. The new process, termed kiln phosphoric acid (KPA), developed by Occidental Chemical Corp. personnel, results in significant savings in operating costs. The savings would allow the processing of lower grade phosphate ores.[5]

The economic recovery in Tennessee and the Southeast had a positive impact on the demand for metal products and shapes produced instate, and a number of Tennessee metal producers that had been operating at a reduced rate of output increased production to fill the escalating demand.

Legislation and Government Programs.—The Tennessee Geological Survey, with headquarters in Nashville and offices in Knoxville and Memphis, officially operates as the Division of Geology of the Tennessee Division of Conservation and also functions as the staff for the State Oil and Gas Board. The State Geologist is the State mineral test hole supervisor and oversees a program requiring exploration permits and bonding, hole location plats, and hole plugging.

During 1983, the Division of Geology completed four 1:24,000 scale geological maps with accompanying mineral resource summaries. Fieldwork was ongoing on mapping the Tri-Cities area of northeastern Tennessee and a coalfield in Morgan County.

The Division of Geology continued its program in research and interagency cooperation in environmental geology. During the year, an environmental geology atlas of Maury County was completed, and work was underway with the U.S. Geological Survey (USGS) on ground water studies relating to deep oil and gas well drilling in east Tennessee. The Division of Geology also continued to cooperate with the Water Resources Division of the USGS on the study of the subsurface stratigraphy and hydrology of the west Tennessee lignite field. Fieldwork was completed, and data analysis and compilation was scheduled for 1984.

The Division of Geology was cooperating with the Environmental Protection Agency and the Tennessee Department of Health and the Environment in drafting and revising new, comprehensive rules and regulations on underground waste fluid injection control.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—Tennessee was one of seven States reporting the production of barite, a barium sulfate used primarily in the manufacture of chemicals and paint and in oil well drilling mud. Production was from the Sweetwater District in Loudon County in eastern Tennessee where barite occurs in weathered residuum from limestones and dolomites of the Knox Group. A. J. Smith Co. continued as the sole producer, and run-of-mine concentrates were shipped out of State for processing.

Cement.—In 1983, Tennessee's cement production was by two companies operating two plants in the eastern part of the State.

Both companies produced portland and masonry cement. In 1982, Dixie Cement Co. Inc., a subsidiary of Moore McCormack Cement Inc., closed plants in Kingsport and Richard City, and at yearend 1983, the latter plant was being dismantled. In 1983, Moore McCormack purchased Ideal Basic Industries Inc.'s cement plant in Knoxville and several terminals in Tennessee and North Carolina; the selling price was reported to be $50 million.

Portland cement production increased less than 1% and value was up almost 3%; masonry cement output increased 4.5% and value increased almost 13%.

Table 4.—Tennessee: Cement plants in 1983

Company	Location	Process	Number of kilns	Annual clinker capacity (thousand short tons)
Dixie Cement Co. Inc	Knoxville	Wet	2	512
Signal Mountain Cement Co	Chattanooga	do	2	442

Clays.—The State's clay industry, 9 companies operating 26 mines in 5 eastern and 4 western counties, reported an increase of $6.4 million in sales over that of 1982. Clay production consisted of common clays and shale in east Tennessee, which were used in the manufacture of brick and cement, and ball clay and fuller's earth mined in the northwestern part of the State, which were used in a variety of applications.

Common clay and/or shale was produced by four companies at nine mines in Anderson-Knox, Sullivan-Washington, and Hamilton Counties in the eastern part of the State and Henry County in western Tennessee. Output and value increased 209,000 tons and $444,000 over production and sales in 1982. Tennessee ranked 23d among 42 States with a clay-shale industry.

Ball clay was produced in four contiguous counties in northwestern Tennessee—Carrol, Gibson, Henry, and Weakley. Tennessee ball clays, composed of fine-grained kaolinite and lesser amounts of illite, smectite, and chlorite, occur in Eocene Age sedimentary deposits along the eastern margin of the Mississippi embayment. Production was by four companies operating several surface mines; processing was essentially identical with all producers. The clay was shredded, dried, and pulverized. Shipments of the shredded clay were made both pre- and post-dried, and two companies shipped pulverized clay in a slurry form. A third company had plans to introduce slurry shipments. Ceramic and refractory clays were produced as well as clays for fillers, conditioning agents, and suspensions.

During 1983, Ranchers Exploration Co. outbid Medusa & Louisville Cement Co. for control of Kentucky-Tennessee Clay Co.

A montmorillonite fuller's earth was produced by Lowes Inc. from an open pit mine in Henry County. The clay was trucked to a processing plant in Paris. Principal processing steps included shredding, sizing, drying, and bagging. The material was marketed as an industrial and pet waste absorbent and as an insecticide and fungicide carrier.

Table 5.—Tennessee: Clays sold or used by producers

Year and type	Quantity (short tons)	Value	
		Total	Average per ton
1982:			
Ball clay	420,557	$13,791,976	$32.79
Common clay and shale	223,842	511,199	2.28
Total	644,399	14,303,175	XX
1983:			
Ball clay	507,744	16,955,610	33.39
Common clay and shale	433,221	955,685	2.20
Total	940,965	17,911,295	XX

XX Not applicable.

Table 6.—Tennessee: Ball clay sold or used by producers, by kind and use

(Short tons)

Use	1982			1983		
	Airfloat	Unprocessed	Total	Airfloat	Unprocessed	Total
Fine china and dinnerware	20,811	W	20,811	W	--	W
Electrical porcelain	9,591	--	9,591	12,349	--	12,349
Floor and wall tile, ceramic	18,095	W	18,095	36,460	W	36,460
Pottery	88,119	W	88,119	117,244	W	117,244
Sanitary ware	32,852	78,050	110,902	W	W	123,743
Other[1]	33,266	77,881	111,147	112,306	168,570	[2]157,133
Exports	35,923	25,969	61,892	37,578	23,237	60,815
Total	238,657	181,900	420,557	315,937	191,807	507,744

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1]Includes data used in animal feed; asphalt emulsion; common brick (1982); catalysts (oil refining, 1982); crockery and other earthenware; firebrick, block and shapes; high-alumina refractories and kiln furniture; mortar and cement; pesticides and related products; roofing granules; rubber; other uses unknown; and data indicated by symbol W.

[2]Incomplete total; remainder included with individual uses.

Table 7.—Tennessee: Common clay sold or used by producers, by use

(Short tons)

Use	1982	1983
Brick	135,538	W
Portland cement	54,760	W
Other	33,544	433,221
Total	223,842	433,221

W Withheld to avoid disclosing company proprietary data; included with "Other."

Fluorspar.—In 1983, United States Borax and Chemical Corp. completed shaft sinking and development drifting on a fluorspar, barite, and zinc ore body near Sweetwater in eastern Tennessee. The company was preparing cost data on deposit development when the recession of the early 1980's reduced the demand for many mineral commodities, including fluorspar, and development studies were discontinued. A limited amount of drilling was completed in 1983. The economic recovery allowed the company to reaccess the deposit, but at yearend, the economics were unfavorable for mine development.

Graphite (Synthetic).—Union Carbide Corp. and Great Lakes Carbon Corp. produced synthetic graphite products at three Tennessee facilities. Union Carbide operated plants at Clarksville in Montgomery County and near Columbia in Maury County; the principal product was electric-furnace electrodes. Great Lakes Carbon produced high-modulus graphite fibers at a plant in Elizabethton in Carter County.

Lime.—The lime industry in Tennessee consists of the Tenn-Luttrell Lime Co. with a plant at Luttrell, near Knoxville, and Bowater Southern Paper Corp. at Calhoun in McMinn County. Principal markets included the paper, steel, and water purification industries; both output and value were higher than that reported in 1982.

Perlite (Expanded).—Crude perlite shipped from New Mexico was expanded by Chemrock Corp. at a plant in Nashville. Principal sales were for horticultural uses, construction applications, and as a filter medium.

Phosphate Rock.—Tennessee continued to rank fourth behind Florida, Idaho, and North Carolina in the production of phosphate rock. Phosphate rock, occurring in residual clays weathered from Ordovician Age limestones, was mined by surface methods in Hickman, Maury, Giles, and Williamson Counties in south-central Tennessee and in Limestone County, AL. A southern extension of the Tennessee phosphate field, the Alabama mine was depleted and closed in 1983.

After beneficiation, the rock was reduced to elemental phosphorus by three companies and subsequently converted into a variety of industrial chemicals. Companies active in the State included Monsanto Co. and Occidental Chemical at Columbia and Stauffer Chemical Co. at Mount Pleasant.

Pyrites.—Tennessee Chemical Co. operated a mining, beneficiation, and chemical processing complex at Copper Hill, Polk County, in the southeastern part of the

State. This is the only operation in the United States mining a massive sulfide ore body for the sulfur rather than the metallic content.

The sulfide deposits are contained within highly folded and metamorphosed Late Precambrian metagraywackes and schists. Nine ore bodies have been identified and contain approximately 60% pyrrhotite, 30% chalcopyrite, 4% sphalerite, 2% magnetite, and traces of silver and gold.

In January 1983, the company was operating two underground mines, the Calloway and Cherokee, and one surface mine. During the spring, a shaft pillar collapse closed the Calloway operation, which necessitated increasing output from the remaining two mines.

Ore was crushed underground, hoisted to the surface, and transported to the nearby London mill where sulfide minerals were recovered by secondary crushing, grinding, and flotation. Magnetite was removed from the tailings by magnetic separators. Copper and iron flotation concentrates were transported by rail to the company's copper smelter and four iron roasters.

Major products from the Tennessee Chemical complex included sulfuric acid and liquid sulfur dioxide; byproducts included blister copper, zinc concentrates, and magnetite. The Copper Hill complex also produces a range of organic and inorganic chemicals based on sulfur, iron, and copper.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Sand and gravel for industrial applications was produced by two companies operating two mines in Campbell and Hamilton Counties in eastern Tennessee, and two companies operating three mines in Benton and Carroll Counties in western Tennessee. Sales were to the glass container industry, for mold and core applications, for roofing granules, and for use in filtration. The end use for approximately 12% of the State's industrial sand and gravel output was not identified. In 1983, output rose 15,000 tons above the 1982 level; sales increased by over $600,000 because of the higher production and a $1.00 increase in unit price.

Table 8.—Tennessee: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	1,345	$4,845	$3.60	NA	NA	NA
Gravel	3,138	9,718	3.10	NA	NA	NA
Sand and gravel (unprocessed)	569	1,355	2.38	NA	NA	NA
Total[1] or average	5,051	15,917	3.15	e6,100	e$18,700	e$3.07
Industrial sand and gravel	468	4,826	10.30	483	5,455	11.30
Grand total[1] or average	5,520	20,743	3.76	e6,583	e24,155	e3.67

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—In 1983, crushed stone production totaled 30.6 million tons valued at $111.5 million or $3.65 per ton. Production was from 115 limestone-dolomite quarries, 1 granite, and 1 marble operation.

Table 9.—Tennessee: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	41	152
Riprap and jetty stone	533	1,903
Filter stone	246	1,022
Other coarse aggregate	59	59
Coarse aggregate, graded:		
Concrete aggregate, coarse	4,347	15,570
Bituminous aggregate, coarse	3,056	11,273
Bituminous surface treatment aggregate	1,438	5,134
Railroad ballast	123	486
Fine aggregate (-3/8 inch):		
Stone sand, concrete	591	2,655
Screening, undesignated	763	2,998
Other fine aggregate	29	110
Coarse and fine aggregate:		
Graded road base or subbase	8,231	28,856
Unpaved road surfacing	1,647	4,957
Crusher run or fill or waste	1,447	4,587
Other coarse and fine aggregate	980	2,721
Agricultural: Agricultural limestone	975	2,790
Special:		
Mine dusting or acid water treatment	3	9
Asphalt fillers or extenders	133	552
Other fillers or extenders	499	2,759
Other[2]	5,439	22,912
Total[3]	30,578	111,506

[1]Includes limestone, dolomite, granite, and marble.
[2]Includes stone sand (bituminous mix or seal), terrazzo and exposed aggregate, poultry grit and mineral food, chemical and metallurgical uses, and uses not specified.
[3]Data do not add to totals shown because of independent rounding.

Dimension.—Dimension sandstone was quarried by several companies and individuals from the Cumberland Plateau area of eastern Tennessee. Output decreased approximately 3,000 tons from that of 1982.

Table 10.—Tennessee: Dimension stone[1] sold or used by producers in 1983, by use

Use	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Irregular-shaped stone[2]	2,569	32	$128
Other rough stone[3]	1,544	16	190
Dressed stone:			
Flagging	735	9	63
Other dressed stone[4]	2,525	31	780
Total	7,373	[5]87	1,161

[1]Includes marble and sandstone.
[2]Includes rubble.
[3]Includes rough blocks for building and construction and flagging.
[4]Includes ashlars and partially squared pieces and slabs and blocks for building and construction.
[5]Data do not add to total shown because of independent rounding.

Vermiculite (Exfoliated).—W. R. Grace & Co.'s Construction Products Div. exfoliated crude vermiculite shipped from South Carolina at a plant in Nashville. Sales, primarily for insulation and aggregate applications, increased significantly over those reported in 1982.

METALS

The recovery experienced by many sectors of the Nation's economy during 1983 resulted in an increase in orders for most of Tennessee's metal producers. By yearend, much of the production that had been

curtailed early in the recession had been regained as new orders and depleted inventories allowed many facilities to operate at or near full capacity.

Aluminum.—The State ranked fifth among 16 States in primary aluminum production; output was from 2 companies with an aggregate capacity of 366,000 short tons. Aluminum Co. of America (Alcoa) operated a 220,000-ton-per-year plant at Alcoa and Consolidated Aluminum Corp. operated a 146,000-ton-per-year plant at New Johnsonville.[6]

During the summer, Consolidated Aluminum reactivated a potline shut down in 1982; at yearend, the company was operating at 44% of capacity, and Alcoa was at 100% of capacity. In November, Alcoa announced plans to spend $250 million to modernize the aluminum rolling facilities at Alcoa.

Copper.—Tennessee Chemical produced blister copper from concentrates recovered during the processing of a massive sulfide ore body mined in the Ducktown area of southeastern Tennessee. The concentrates, recovered by flotation during sulfide mineral beneficiation, were railed to a company smelter as feed for blister copper production. Blister copper, copper sulfate, and copper carbonate accounted for approximately 30% of the company's sales.

Tennessee Chemical is the only operation in the United States mining a massive sulfide ore body for the sulfur rather than the metal content.

Ferroalloys.—The State ranked second in the Nation in shipments of ferroalloys. Producers and products are summarized in table 11.

Six companies shipped about 99,000 short tons of ferroalloys, 11.5% of the U.S. total. Shipments increased 42,600 tons over that reported in 1982 because of the economic recovery and resurgence of the U.S. steel industry.

The Roane plant at Rockwood operated for a short period in January but was closed during the remainder of the year.

Table 11.—Tennessee: Ferroalloy producers

Company	Location	Alloy
Chromium Mining and Smelting Corp	Woodstock	Ferrochromium and ferrochromium-silicon.
International Minerals and Chemical Corp	Kimball	Ferrosilicon and specialty silicon alloys.
Monsanto Co	Columbia	Ferrophosphorus.
Occidental Petroleum Corp	do	Do.
Roane Alloys Div	Rockwood	Ferromanganese, ferrosilicon, silicomanganese.
Stauffer Chemical Co	Mount Pleasant	Ferrophosphorus.

Germanium.—Jersey Minière Zinc Co. recovered germanium residues from zinc ores produced at mines in Gordonsville and Elmwood. The residues were shipped to Métallurgie Hoboken-Overpelt SA, in Belgium, for germanium processing.

Iron and Steel.—Florida Steel Corp. in Jackson, Tennessee Forging Steel Corp. in Harriman, and Knoxville Iron company in Knoxville comprise Tennessee's steel industry. These operations have an annual capacity of 580,000 short tons per year. Output rose substantially as orders increased owing to the improvement in the economy.

Manganese.—Foote Mineral Co. indefinitely closed the New Johnsonville electrolytic manganese metal plant in May 1983. The company planned to convert a portion of the facility for the production of electrolytic manganese dioxide for the alkaline dry cell battery market.

Rare Earths and Thorium.—Australian monazite was processed at a plant in Chattanooga by Davison Chemical Div. of W. R. Grace, which produced rare-earth catalysts and compounds, and also extracted thorium-containing residues, which were not marketed.

Silver.—Tennessee Chemical recovered silver during sulfide beneficiation at the southeastern Tennessee complex.

Titanium Dioxide.—E. I. du Pont de Nemours & Co. Inc. operated the world's largest chloride titanium dioxide TiO_2 pigment process plant at New Johnsonville. The 228,000-ton-per-year-capacity plant processes ilmenite obtained from company mining operations at Starke, FL, and Eneabba, Western Australia. The principal market for TiO_2 output from the New Johnsville facility was the print industry, and with the recovery of the construction sector, demand and output increased over that of 1982. Other markets included paper

and plastics.

Zinc.—Historically, Tennessee has led the Nation in zinc production, and in 1983, zinc output in the State accounted for approximately 39% of the Nation's total. In 1983, Tennessee's zinc industry consisted of four companies operating seven zinc mines in the eastern and central parts of the State, and Tennessee Chemical mining zinc-bearing sulfide ore in the Ducktown-Copper Hill area in southeastern Tennessee. Pertinent data are presented in table 12.

The U.S. Steel mine at Jefferson City, closed during much of the year, was reopened in September. A new contract with the union and the local zinc smelter led to the reopening.

The New Jersey Zinc Co.'s Beaver Creek Mine and Jefferson City mill operated for 1 month in 1983, closing at the end of January because of the depressed zinc market. In July, the mine and mill, along with several other Tennessee properties, were sold to Inspiration Resources Corp. Later in the year, Inspiration announced that the Beaver Creek and Jefferson City facilities would resume operations in January 1984.

Jersey Minière operated an electrolytic zinc refinery at Clarksville. The facility, built in 1978, has a rated capacity of 90,000 short tons per year. Special high-grade zinc is produced by melting cathode sheet for slab, block, and special shape castings. Alloys are also produced and include high-grade, controlled lead, and prime western grade. Pure cadmium, sulfuric acid, and a germanium-bearing residue are a coproduct of the operation.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, AL.
[2]State geologist, Tennessee Division of Geology, Knoxville, TN.
[3]Federal Reserve Bank of Atlanta. Economic Review. Feb. 1984, p. 41.
[4]U.S. Army Corp. of Engineers, Mobile Distict. News. 84-14, Apr. 17, 1984.
[5]Chemical Engineering. Nov. 28, 1983, p. 18.
[6]American Metal Market. Feb. 23, 1984.

Table 12.—Tennessee: Zinc producers

Company	Mine	Mill
ASARCO Incorporated	Coy	Mascot.
Do	Immel	Do.
Do	New Market	New Market.
Do	Young	Mascot.
Jersey Minère Zinc Co	Elmwood and Gordonsville	Elmwood.
The New Jersey Zinc Co., a division of Gulf + Western Industries.	Beaver Creek	Jefferson City.
United States Steel Corp	Jefferson City	Do.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum smelters:			
Aluminum Co. of America	Box 158 Alcoa, TN 37701	Plant	Blount.
Consolidated Aluminum Corp	1102 Richmond St. Jackson, TN 38301	do	Humphreys.
Barite:			
A. J. Smith Co	Route 3 Sweetwater, TN 37874	Open pit mine	Loudon.
Cement:			
Ideal Basic Industries Inc.[1 2]	Box 6238 Knoxville, TN 37238	Plant	Knox.
Moore McCormack Cement Inc.,[1 2] a subsidiary of Moore McCormack Resources Inc.	One Landmark Square Stamford, CT 06901	Plants	Marion and Sullivan.
Clays:			
Cyprus Industrial Minerals Co	Box 111 Gleason, TN 38229	Pits and plants	Carroll and Weakley.
General Shale Products Corp	Box 3547 CRS Johnson City, TN 37601	do	Anderson, Hamilton, Knox, Sullivan, Washington.
Kentucky-Tennessee Clay Co	Box 449 Mayfield, KY 42066	do	Carroll, Gibson, Henry, Weakley.
Lowes Inc	Box 819 Paris, TN 38242	do	Henry.
Old Hickory Clay Co	Box 188 Gleason, TN 38229	do	Henry and Weakley.
H. C. Spinks Clay Co. Inc	Box 820 Paris, TN 38229	do	Carroll, Henry, Weakley.

See footnotes at end of table.

Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Copper:			
Tennessee Chemical Co.[3]	Copperhill, TN 37317	Underground mines, surface mine, plant.	Polk.
Graphite (synthetic):			
Great Lakes Carbon Corp	Box 1031 Elizabethton, TN 37643	Plant	Carter.
Union Carbide Corp	Box 513 Columbia, TN 38401	do	Maury.
Lime:			
Bowater Southern Paper Corp	Calhoun, TN 37309	do	McMinn.
Tenn-Luttrell Lime Co	Box 69 Luttrell, TN 37779	do	Union.
Perlite (expanded):			
Chemrock Corp	Osage St. Nashville, TN 37208	do	Davidson.
Phosphate rock:			
Monsanto Co.[4]	Columbia, TN 38401	do	Do.
Occidental Chemical Corp.[4]	Box 591 Columbia, TN 38401	do	Do.
Stauffer Chemical Co.[4]	Box 89 Mount Pleasant, TN 38474	do	Do.
Sand and gravel (1982):			
Dixie Sand & Gravel Co	515 River St. Chattanooga, TN 37402	Pits	Hamilton.
Memphis Stone & Gravel Co	Box 1683 Memphis, TN 38101	do	Benton, Dyer, Shelby.
Rogers Group Inc. Corp.[2]	Box 25250 Nashville, TN 37202	do	Tipton.
Standard Construction Co. Inc	Box 38289 Germantown, TN 38138	Pit	Shelby.
Stone:			
Limestone:			
American Limestone Co	Box 2389 Knoxville, TN 37901	Quarries	Jefferson, Knox, Sullivan.
Koppers Co. (Stoneman Inc.)	Box 231 Easton, PA 18042	do	Bedford, Hamilton, Rutherford, Warren.
Vulcan Materials Co	Box 7 Knoxville, TN 37901	do	Do.
Marble:			
John J. Craig Co	Box 9300 Knoxville, TN 37920	Quarry	Blount.
Imperial Black Marble Corp	8013 Chesterfield Dr. Knoxville, TN 37919	do	Grainger.
Sandstone:			
Ross L. Brown Cut Stone Co. Inc.	Box 398 Crab Orchard, TN 37723	do	Cumberland.
Crab Orchard Stone Co. Inc.	Drawer J Crossville, TN 38555	do	Do.
Crossville Limestone Co. Inc	Box 485 Crossville, TN 38555	do	Do.
Mountain Stone Co	Box 246 Jamestown, TN 38556	do	Fentress.
Vermiculite (exfoliated):			
W. R. Grace & Co	4061 Powell Ave. Nashville, TN 37204	Plant	Davidson.
Zinc:			
ASARCO Incorporated[2]	Mascot, TN 37806	Underground mines and plant.	Jefferson and Knox.
Jersey Minière Zinc Co	Elmwood, TN 38560	Underground mines, plant, smelter.	Smith.
The New Jersey Zinc Co.	Box 32 Jefferson City, TN 37760	Underground mine and plant.	Jefferson.
United States Steel Corp.[2]	Jefferson City, TN 37760	Underground mine	Do.

[1]Also clays.
[2]Also stone.
[3]Also silver, zinc, and pyrites.
[4]Also ferroalloys.

The Mineral Industry of Texas

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Bureau of Economic Geology, The University of Texas at Austin, for collecting information on all nonfuel minerals.

By Jane P. Ohl[1] and Mary W. McBride[2]

Total value of nonfuel minerals produced in Texas in 1983 was $1.57 billion, a 1.5% increase over that of 1982, and the State ranked second in the Nation. Texas retained its position as one of the leading producers of portland cement, magnesium chloride, construction sand and gravel, crushed stone, Frasch and elemental (recovered) sulfur, and talc.

Table 1.—Nonfuel mineral production in Texas[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	236	$16,440	276	$19,704
Portland do.	9,732	545,679	9,760	534,298
Clays do.	4,193	26,497	3,955	22,575
Gem stones	NA	200	NA	225
Gypsum thousand short tons	1,954	16,681	2,049	16,357
Helium (Grade-A) million cubic feet	458	15,572	524	18,340
Lime thousand short tons	1,125	62,277	1,067	60,193
Salt do.	7,421	82,805	8,028	65,670
Sand and gravel:				
Construction do.	45,527	154,515	e58,500	e208,000
Industrial do.	r2,201	r35,974	1,788	29,637
Stone:				
Crushed do.	e68,000	e205,000	76,453	239,642
Dimension do.	e50	e5,822	50	11,071
Sulfur (Frasch) thousand metric tons	2,360	W	2,468	W
Talc thousand short tons	205	3,024	250	3,933
Combined value of fluorspar, helium (crude), iron ore, magnesium chloride, magnesium compounds, sodium sulfate, and values indicated by symbol W	XX	r374,912	XX	338,912
Total	XX	r1,545,398	XX	1,568,557

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Texas, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Angelina	W	--	
Armstrong	(2)	--	
Atascosa	W	W	Sand and gravel (construction), sand (industrial).
Bandera	W	(3)	
Bastrop	$770	W	Clays, sand and gravel (construction).
Bell	2,753	W	Sand and gravel (construction).
Bexar	W	W	Cement, lime, sand and gravel (construction), clays.
Borden	(2)	W	Sand and gravel (construction).
Bosque	W	W	Lime.
Bowie	(2)	$445	Sand and gravel (construction).
Brazoria	132,855	128,544	Magnesium chloride, salt, magnesium compounds, sand and gravel (construction).
Brazos	(2)	W	Sand and gravel (construction).
Brewster	W	W	Fluorspar.
Brown	W	(3)	
Burleson	288	(3)	
Burnet	12,373	W	Sand and gravel (construction), lime.
Calhoun	W	W	Lime.
Cass	W	W	Iron ore.
Chambers	W	W	Salt, clays.
Cherokee	666	W	Clays, iron ore.
Coke	(2)	W	Sand and gravel (construction).
Coleman	W	W	Clays.
Collin	299	(3)	
Colorado	W	42,725	Sand and gravel (construction), sand (industrial).
Comal	W	W	Cement, lime.
Comanche	28	(3)	
Cooke	W	W	Sand and gravel (construction).
Coryell	W	350	Do.
Crockett	2,486	(3)	
Crosby	--	W	Sand and gravel (construction).
Culberson	W	W	Sulfur, talc.
Dallas	W	W	Cement, sand and gravel (construction), clays.
Deaf Smith	W	W	Lime.
Denton	W	W	Sand and gravel (construction), clays.
Duval	W	W	Sand and gravel (construction), salt.
Eastland	W	W	Clays, sand and gravel (construction).
Ector	W	43,765	Cement, salt, clays.
Ellis	W	W	Cement, sand and gravel (construction), clays.
El Paso	W	W	Cement, sand and gravel (construction).
Fannin	(2)	W	Sand and gravel (construction).
Fayette	W	W	Sand and gravel (construction), clays.
Fisher	W	W	Do.
Fort Bend	W	25,820	Sulfur, salt, sand and gravel (construction), clays, sand (industrial).
Freestone	W	W	Clays.
Gaines	W	W	Sodium sulfate.
Galveston	W	W	Clays.
Gillespie	W	W	Gypsum, sand and gravel (construction).
Gonzales	W	W	Clays.
Grayson	W	(3)	
Gregg	(2)	166	Sand and gravel (construction).
Grimes	(2)	--	
Guadalupe	W	W	Sand and gravel (construction), clays.
Hall	(2)	W	Sand and gravel (construction).
Hansford	W	W	Helium.
Hardeman	W	W	Gypsum.
Hardin	--	W	Sand and gravel (construction).
Harris	132,737	102,899	Cement, salt, lime, sand and gravel (construction), clays, sand (industrial).
Harrison	W	W	Clays, sand and gravel (construction).
Hays	W	W	Cement, sand and gravel (construction).
Henderson	W	W	Sand and gravel (construction), clays.
Hidalgo	2,966	W	Sand and gravel (construction).
Hill	W	W	Lime.
Hood	548	(3)	
Howard	(2)	W	Sand and gravel (construction).
Hudspeth	W	W	Talc, gypsum.
Hutchinson	W	2,492	Sand and gravel (construction).
Jack	W	(3)	
Jasper	399	(3)	
Jefferson	W	W	Salt, sand and gravel (construction).
Jim Wells	W	(3)	

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Texas, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Johnson	W	W	Lime, stone, sand and gravel (construction).
Jones	$38	W	Sand and gravel (construction).
Kaufman	2,316	[3]	
Kerr	[2]	W	Sand and gravel (construction).
Kimble	[2]	W	Gypsum, sand and gravel (construction).
Lamb	W	[3]	
Lampasas	[2]	$82	Sand and gravel (construction).
Liberty	W	W	Sulfur, sand and gravel (construction), sand (industrial).
Limestone	W	W	Sand (industrial), clays.
Lipscomb	84	[3]	
Live Oak	W	W	Sand (industrial).
Llano	549	[3]	
Lubbock	207	[3]	
McCulloch	W	W	Sand (industrial).
McLennan	W	W	Cement, sand and gravel (construction), clays.
McMullen	W	[3]	
Marion	W	W	Clays.
Mason	6	[3]	
Matagorda	W	W	Salt.
Maverick	[2]	--	
Medina	W	W	Sand and gravel (construction), clays.
Midland	941	[3]	
Mitchell	[2]	--	
Montgomery	[2]	4,326	Sand and gravel (construction).
Moore	6,188	12,308	Helium.
Morris	W	W	Iron ore.
Motley	W	162	Sand and gravel (construction).
Nacogdoches	W	W	Clays.
Navarro	W	2,060	Do.
Newton	W	W	Sand (industrial).
Nolan	47,628	44,372	Cement, gypsum, sand and gravel (construction), clays.
Nueces	W	W	Cement, sand and gravel (construction).
Oldham	[2]	2,011	Sand and gravel (construction).
Orange	W	W	Cement, sand and gravel (construction).
Palo Pinto	200	W	Sand and gravel (construction), clays.
Parker	3,115	W	Do.
Pecos	W	W	Sulfur.
Polk	[2]	--	
Potter	W	W	Cement, sand and gravel (construction), clays.
Randall	W	[3]	
Reeves	[2]	W	Sand and gravel (construction).
Runnels	[2]	W	Do.
Rusk	1,633	W	Clays.
San Patricio	W	W	Do.
San Saba	1,711	--	
Smith	W	W	Sand and gravel (construction).
Somervell	[2]	W	Do.
Stonewall	W	W	Gypsum.
Tarrant	W	W	Cement, sand and gravel (construction).
Taylor	W	842	Sand and gravel (construction).
Terry	W	W	Sodium sulfate.
Tom Green	W	[3]	
Travis	W	W	Lime, sand and gravel (construction).
Upshur	[2]	--	
Uvalde	W	545	Sand and gravel (construction).
Val Verde	W	W	Do.
Van Zandt	W	W	Salt, clays.
Victoria	[2]	17,778	Sand and gravel (construction).
Walker	2,164	W	Clays, sand and gravel (construction).
Ward	[2]	W	Sand and gravel (construction).
Washington	166	[3]	
Webb	W	W	Sand and gravel (construction).
Wharton	W	W	Sulfur.
Wichita	[2]	--	
Williamson	28,042	[3]	
Winkler	W	W	Salt.
Wise	W	153	Clays.
Wood	148	W	Clays, sand and gravel (construction).
Yoakum	W	W	Salt.
Young	W	200	Sand and gravel (construction).
Undistributed[4]	1,218,102	902,529	
Sand and gravel (construction)	[e]150,000	XX	

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Texas, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Stone:			
Crushed	XX	[e]$205,000	
Dimension	XX	[e]5,822	
Total[5]	$1,752,410	1,545,398	

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties are not listed because no nonfuel mineral production was reported: Anderson, Andrews, Aransas, Archer, Austin, Bailey, Baylor, Bee, Blanco, Briscoe, Brooks, Caldwell, Callahan, Cameron, Camp, Carson, Castro, Childress, Clay, Cochran, Collingsworth, Concho, Cottle, Crane, Dallam, Dawson, Delta, De Witt, Dickens, Dimmit, Donley, Edwards, Erath, Falls, Floyd, Foard, Franklin, Frio, Garza, Glasscock, Goliad, Gray, Hale, Hamilton, Hartley, Haskell, Hemphill, Hockley, Hopkins, Houston, Hunt, Irion, Jackson, Jeff Davis, Jim Hogg, Karnes, Kendall, Kenedy, Kent, King, Kinney, Kleberg, Knox, Lamar, La Salle, Lavaca, Lee, Leon, Loving, Lynn, Madison, Martin, Menard, Milam, Mills, Montague, Ochiltree, Panola, Parmer, Presidio, Rains, Reagan, Real, Red River, Refugio, Roberts, Robertson, Rockwall, Sabine, San Augustine, San Jacinto, Schleicher, Scurry, Shackelford, Shelby, Sherman, Starr, Stephens, Sterling, Sutton, Swisher, Terrell, Throckmorton, Titus, Trinity, Tyler, Upton, Waller, Wheeler, Wilbarger, Willacy, Wilson, Zapata, and Zavala. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specified counties and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Texas business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	7,551.9	7,634.7	+1.1
Unemployment	do	666.5	555.8	-16.6
Employment (nonagricultural):				
Mining[1]	do	267.7	265.1	-1.0
Manufacturing	do	959.5	965.8	+.7
Contract construction	do	409.3	405.2	-1.0
Transportation and public utilities	do	367.5	373.7	+1.7
Wholesale and retail trade	do	1,513.6	1,572.4	+3.9
Finance, insurance, real estate	do	381.4	396.3	+3.9
Services	do	1,157.1	1,190.6	+2.9
Government	do	1,051.6	1,055.8	+.4
Total nonagricultural employment[1]	do	6,107.7	6,224.9	+1.9
Personal income:				
Total	millions	$174,528	$184,003	+5.4
Per capita		$11,423	$11,702	+2.4
Construction activity:				
Number of private and public residential units authorized		201,313	273,452	+35.8
Value of nonresidential construction	millions	$6,878.0	$6,274.5	-8.8
Value of State road contract awards	do	$895.4	$867.1	-3.2
Shipments of portland and masonry cement to and within the State	thousand short tons	9,428	10,359	+9.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,545.4	$1,568.6	+1.5
Value per capita, resident population		$102	$100	-2.0
Value per square mile		$5,814	$5,879	+1.1

[p]Preliminary.

[1]Includes oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

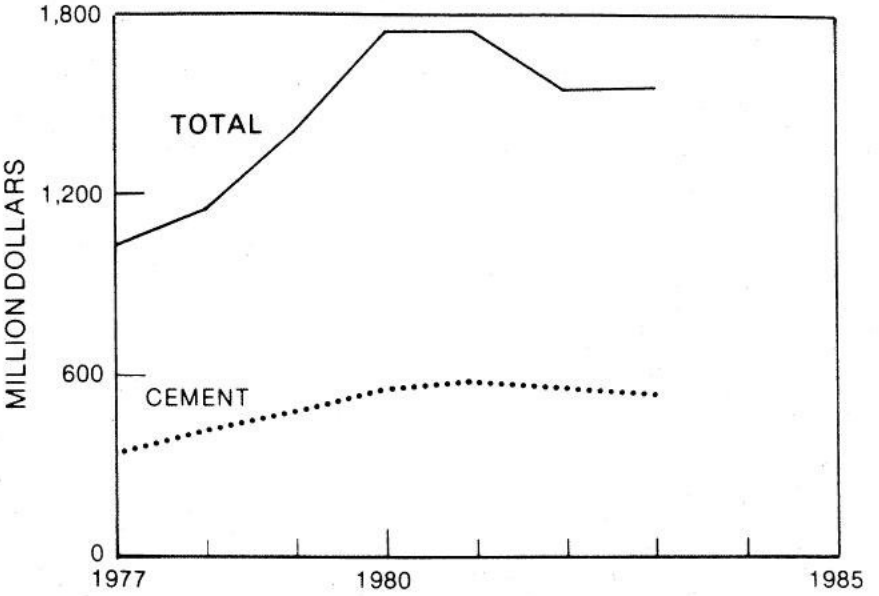

Figure 1.—Value of cement and total value of nonfuel mineral production in Texas.

Trends and Developments.—Although improving slightly, the mining industry was still in the doldrums at yearend. Industry executives cited several factors that affected the continuing shrinkage of the domestic mining industry: foreign competition, large inventories, a strong dollar hurting U.S. exports, and relatively high interest rates. Prices for precious and light metals such as gold and aluminum climbed in 1983; however, prices for such base metals as copper, lead, and molybdenum and for such industrial minerals as barite were still depressed at yearend.

Nonfuel mineral production value per capita declined from $102 in 1982 to $100 in 1983.

Each of Texas' six economic regions fared differently, because of their diversified economies. Some regions, dependent on the oil and gas industry which uses bentonite, were hard hit by declining oil prices; the Border area, dependent on trade with Mexico, had a severe drop in retail trade, caused by recent devaluations of the Mexican peso and a severe drought in west Texas; and two regions—the Metroplex and the Central Corridor—performed well because of their diversified economies.[3]

Nationwide economic recovery reversed the 1981-82 production downtrend for such chemical raw materials as lime and sulfur (Frasch and recovered elemental); in Texas, however, lime production fell in 1983, whereas salt and sulfur production rose over the 1982 levels.

Kaiser Cement Co., Gifford-Hill & Co. Inc., and the United Cement, Lime, Gypsum and Allied Workers' Union (UCLGAW) joined to petition the U.S. Department of Commerce to impose countervailing duties on Mexican cement and clinker imports to the United States equal to the direct and indirect subsidies the Mexican producers are said to receive from their Government. Mexican cement enters the United States through several States, including Texas.[4]

Late in the year, work continued on the Houston Ship Channel cement terminal of Falcon Cement Co., owned by Saudi Arabia's Saudi Research and Development Corp. (Redec). In July, constructors Voss International Corp. placed 6,000 cubic yards of concrete in a 10-hour pour for the 50,000-metric-ton-capacity terminals' foundation. Its six silos will be 171 feet high and 50 feet in diameter. The terminal will be able to offload cement from ships at 600 to 800

metric tons per hour.[5]

International Minerals & Chemical Corp. announced plans to build a dry bulk marine terminal at Texas City for petroleum coke, potash, soda ash, and other domestically produced materials; the operation also is to handle imported materials from overseas. The multimillion dollar facility, which will be constructed on a 93-acre leased site on the Texas City Industrial Canal, is expected to be operational late in 1984. Five railroads serve the location: the Atcheson, Topeka, and Santa Fe; the Burlington Northern; the Missouri-Kansas-Texas; the Missouri-Pacific; and the Southern Pacific.

More and more surface and underground mine operators began relying on electronics and computer technology to make their operations economic by providing precise control of various functions, including the elimination of unscheduled downtime. (See "Stone, *Crushed*" section.) Other companies began or upgraded employee retraining programs. (See "Sulfur" section.)

The Texas Bureau of Economic Geology, supported by the Texas Mining and Mineral Resources Research Institute, published two volumes of interest: One on nonpetroleum mineral producers in the State, and the other, an annotated bibliography of mineral deposits in Trans-Pecos Texas.[6]

Current mineral industry research programs at the Bureau of Economic Geology were continued in the base and precious metals and industrial minerals categories: on areas of metallic mineralization in igneous or volcanic environments; on unusual silver-copper-lead deposits in sandstones; and on the geologic and resource aspects of cement materials and barite. Also, Wilcox Group lignites of east and east-central Texas were being studied to identify areas of high potential for deep recovery of lignite, probably by in situ gasification.

Employment.—Employees on mining payrolls (includes oil and gas extraction) declined 3.6% during the year, from 273,000 in January 1983 to 263,600 in December 1983.[7]

Lone Star Steel Co., a subsidiary of Northwest Industries Inc., signed a labor agreement, effective September 11, 1983, and expiring in October 1986, that reduced wages for 4,000 Texas employees represented by the United Steelworkers of America. Lone Star Steel reduced wages $2.80 per hour across the board, to an average hourly wage ranging from $10 to $11 for various steelworking jobs. Union members said the concessions hurt the 1,500 workers at Lone Star Steel's Morris County plant; however, the agreement gave additional unemployment benefits and a chance of being recalled to the 2,500 workers who had been laid off. Moreover, the contract gradually reinstated 68 cents of the hourly reduction over the next 3 years.

Environment.—A lawsuit filed by the Natural Resources Defense Council led to a settlement July 26, 1983, with the Environmental Protection Agency (EPA). The settlement, covering lead emission problems in 28 States, included problems allegedly attributable to the ASARCO Incorporated smelter in El Paso. Monitors set up in the El Paso area measured lead levels at more than twice the national ambient air standard, and the suspected source was the Asarco smelter. By July 1, 1984, an EPA-approved plan is to be in force in Texas that would require Asarco to cut its lead emissions by one-half.

In early December 1983, the lowest bid the Railroad Commission of Texas received for filling 59 abandoned mercury mines was $35,354, offered by Stockton Contractors Inc. Work was expected to start on filling the mines near Terlingua in late December or early 1984. The abandoned shafts, in the vicinity of Big Bend National Park, were thought to endanger tourists in that part of Brewster County. Under a separate contract, another 11 shafts were to be sealed at the surface.

Exploration Activities.—Gold Fields Mining Corp., which had begun exploration work at its Shafter Mines 20 miles north of Presidio in Presidio County in 1977, completed a feasibility study in June 1983 and determined that the property could not be developed if the price of silver remained at its 1983 level.[8]

Wold Minerals Exploration Co. announced a major talc discovery in west Texas; size of the discovery was not reported. The company claims more than 20,000 acres of land, through State prospecting permits or patented mining claims. Talc has been produced in the district since the mid-1950's, recently at about 300,000 tons per year.

Legislation and Government Programs.—On May 18, 1983, the Texas Legislature enacted S.B. 1018, requiring permits for certain drilled or mined shafts. The measure gives the Railroad Commission of Texas, the Texas Water Commission, the Texas Water Development Board, and the

Permit Division of the Texas Department of Water Resources certain powers and duties related to these permits or to procedures for inspecting these shafts. Public hearings on rules for issuing permits were ongoing at yearend 1983; granting permits would begin in late 1984.

On June 8, 1983, in the case (No. B-9735) of Margaret Lyne Moser, et al, versus United States Steel Corp., the Texas Supreme Court upheld lower court opinions and ruled that a uranium deposit within 200 feet of the surface belonged to the mineral estate, not to the surface estate. On June 20, the petitioner filed for a rehearing, and by yearend, the case was still pending. Previously, a mineral deposit within 200 feet of the surface was held to be "near surface" as a matter of law, and as such was included with the surface estate. In Texas, the mineral estate may be separated from the surface estate by deed, lease, or conveyance; therefore, this recent ruling seemed to overturn a long-held Texas understanding. The ruling held that all mineral contracts, leases, and deeds, executed between February 10, 1971, and June 8, 1983, must be controlled by the law in effect at the time of execution. In the past, Texas courts have held that such commodities as caliche, sand and gravel, shale, stone, and water were a part of the surface estate.

The 1983 Texas Legislature amended the State's 1979 Surface Mining and Reclamation Act to extend coverage to iron ore and "iron ore gravels" (H.B. 593, SEC. 19, sec. 4 (b)). The Surface Mining and Reclamation Division of the Railroad Commission of Texas claimed sole jurisdiction over such operations on land tracts larger than 5 acres and begun after September 1, 1983. Public hearings on the yet incompletely written regulations were scheduled for early 1984; they were to parallel closely the State's uranium regulations.

The Surface Transportation Assistance Act (Public Law 97-424), passed by Congress on January 6, 1983, initiated a 5-cent-per-gallon user fee and other fees highway users pay, effective April 1, 1983. States are to provide matching funds for interstate highway work, and some projects were started in the first half of 1983. Public Law 97-424 extended the Federal Highway Trust Fund to September 30, 1988. The funding levels established in the act are the highest ever for highways and mass transportation, and the highest in constant dollars since the early 1970's. The passage of this act was called a very important step toward achieving a strong recovery in the U.S. economy, in general, and was expected to significantly increase crushed stone demand, particularly that of Texas, the Nation's largest producer of crushed stone.

On August 14, the United States and Mexico signed "Agreement on the Environment of the Border Area," which includes a strip of land 100 kilometers wide on either side of the inland and maritime borders shared by the State of Texas and Mexico. In response to U.S. complaints about pollution from the Cananea copper smelter, Cía. Minera de Cananea asserted that Mexico suffers, in turn, from air pollution generated by Asarco's smelter at El Paso. Asarco announced plans to spend some part of $4.4 million to meet new EPA standards for reducing fugitive emissions of inorganic arsenic at El Paso, although the smelter uses low-arsenic-content ore and is not as great a risk to the environment as smelters that use high-arsenic-content ore.[9]

On September 21, Gulf Chemical & Metallurgical Corp. was awarded a contract to supply the General Services Administration with 362,000 pounds of vanadium pentoxide (V_2O_5). Gulf Chemical, a division of Associated Metals & Minerals Corp., operated a plant at Freeport that reportedly could recover more than 1,500 short tons of vanadium pentoxide per year from spent catalysts.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Portland cement production increased less than 1%, but masonry cement production increased more than 17% in 1983, reflecting increased construction activity and improvement of the State and national economy. Portland cement was produced at 19 plants, and masonry cement, at 12 plants during the year, 1 less plant than in 1982. The average value of portland cement shipped in 1983 was $61.14 per short ton in the State's northern district and $47.79 in the southern district. The southern district comprises, from west to east, Jeff Davis, Pecos, Crockett, Schleicher, Menard, Mason, Llano, Burnet, Williamson, Milam, Robertson, Brazos, Madison, Walker, San Jacinto, Polk, Tyler, Jasper, and Newton Counties and all other counties south of these counties. The average value of masonry cement shipped was $72.37 in

the northern district and $69 in the southern district.

Ready-mixed concrete companies used 61.7% of the finished portland cement produced, followed, in decreasing order of amount used, by contractors, concrete product manufacturers, building material dealers, highway contractors, miscellaneous customers, and government agencies.

During the year, the industry operated 33 kilns having a total clinker production capacity of 29,105 tons of cement per 24 hours. Eighteen kilns were the wet-process type and 15 were the dry process.

The industry consumed 8.8 million tons of limestone and smaller amounts of anhydrite, cement rock, clays, clinker, fly ash, gypsum, iron ore, marl, mill scale, sand, sandstone, shale, and various acids, oils, and resins.

Natural gas was the major fuel used to heat kilns; 2,406,266 thousand cubic feet of this fuel was consumed during the year. Other fuels used were fuel oil, bituminous coal, and petroleum. Fiberglass baghouses and electric precipitators were used for air pollution control.

Alamo Cement Co. at San Antonio converted a second F. L. Smidth raw mill to a finish mill in June. The firm planned to build additional grinding, storage, and shipping facilities.[10]

Capitol Aggregates Inc. added a 500,000-ton-per-year, dry-process line to its cement plant at San Antonio in 1983.[11]

Dal-Tex Cement Corp. began constructing a 1-million-ton-per-year cement plant near Midlothian; construction was delayed while Dal-Tex sought a new contractor.

At its Midlothian plant, Gifford-Hill successfully used petroleum coke as part of its kiln fuel. The fuel was being evaluated for use at other Gifford-Hill facilities.[12]

Lone Star Industries Inc. sold its ready-mixed concrete operations in north Texas to Pioneer Concrete of Texas Inc. Completed in late 1983, the transaction was still subject to regulatory approval as of January 1984. Pioneer Concrete also took an option to purchase some north Texas aggregate properties belonging to Lone Star Industries. To consolidate its grip on regions in which it was strongest, Lone Star Industries was cutting costs in the wake of an ambitious expansion program during a period of slow sales and soft prices.[13]

Texas Cement Co., a subsidiary of Centex Corp., Dallas, completed construction in May 1983, doubling the annual capacity of its Buda plant to 6 million barrels, or 1.1 million tons. The new equipment includes a 165-metric-ton-per-hour Loesche raw mill, a Fuller flash furnace, a grate cooler, and a 3,500-horsepower finish mill.[14]

Table 4.—Texas: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1982	1983
Number of active plants	13	12
Production	217,829	281,585
Shipments from mills:		
Quantity	235,524	276,197
Value	$16,439,773	$19,704,492
Stocks at mills, Dec. 31	22,254	27,005

Table 5.—Texas: Portland cement salient statistics

(Short tons unless otherwise specified)

	1982	1983
Number of active plants	20	19
Production	9,448,176	9,652,005
Shipments from mills:		
Quantity	9,731,972	9,760,372
Value	$545,678,788	$534,298,379
Stocks at mills, Dec. 31	656,443	555,593

Clays.—Although clays sold or used in the State decreased 5.7% in tonnage and 14.8% in value, Texas retained its position as the second ranking producer in the Nation. Quantities of fire clay, produced from two mines, fuller's earth from one mine, and kaolin from one mine, increased; but quantities of ball clay (2 mines), bentonite (11 mines), and common clay and shale (70 mines) decreased.

Fire clay output increased 16%, and average value increased from $6.16 to $6.55 per short ton. The average value per ton of fuller's earth fell 22%, from $38.59 to $30.00; production, however, rose 7%. Kaolin output increased 24% and average value increased 27.5%, compared with that of 1982.

Texas ranked 4th of 6 States that produced ball clay and 7th of 15 States that produced bentonite—commonly the calcium, or low-swelling, type. Although Texas was the major producing State of common clay and shale, output declined 5.7%, and value, 10.2%.

Only those changes in bentonite, fuller's earth, and kaolin output followed nationwide trends.

Major producers included Southern Clay

Products Inc., a subsidiary of English China Clays America, which mined ball clay and ball airfloat from the Troup pit in Cherokee County and nonswelling and swelling bentonite in Gonzales County, and Milwhite Co. Inc., which mined swelling bentonite from the Flatonia Mine in Fayette County and from the Riverside Mine in Walker County. Elgin-Butler Brick Co., Henderson Clay Products Co., and United States Gypsum Co.-A. P. Green Refractories Co. mined fire clay in Bastrop, Cherokee, and Wood Counties, respectively. Balcones Minerals Corp. mined attapulgite-type fuller's earth from Fayette County, and Justin Industries Inc., Acme Brick Co., mined montmorillonite-type fuller's earth from Guadalupe County. Texas Industrial Minerals Co. mined kaolin from Limestone County. Twenty-five companies produced common clay and shale in 26 of Texas' 254 counties.

Southern Clay Products began a $2 million expansion of an organoclay production operation in Gonzales County. When completed, the Gonzales plant will have double its former capacity. Organoclay viscosifiers are used as rheological control additives in water-based systems, such as in paints, and in oil-based drilling muds.

Castone Brick Corp. opened its latest facility near Houston early in 1983. The new plant has a daily production rate of 250,000 high-density, water-resistant brick during two 12-hour shifts. The process takes 48 hours, including the 24-hour self-curing process at all temperatures, and requires lower energy costs because no artificial heat is used.[15]

Table 6.—Texas: Clays sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Year	Ball clay, fuller's earth, kaolin		Bentonite		Fire clay		Common clay and shale		Total[1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1979	137	6,019	66	3,242	58	725	3,610	11,548	3,871	21,533
1980	123	5,953	109	7,061	57	743	3,475	13,265	3,763	27,022
1981	112	5,251	116	8,265	42	259	3,902	15,359	4,172	29,135
1982	114	5,036	100	5,161	38	234	3,940	16,067	4,193	26,497
1983	123	4,985	75	2,876	44	288	3,714	14,427	3,955	22,575

[1]Data may not add to totals shown because of independent rounding.

Fluorspar.—Texas was one of only three States to ship fluorspar during 1983. Chemical manufacturers in Texas significantly increased fluorspar consumption in 1983. D & F Minerals Inc. shipped metallurgical-grade fluorspar from its stockpile. D & F mined the ore in earlier years at its Paisano Mines, south of Alpine, Brewster County. E. I. du Pont de Nemours & Co. Inc. announced construction to increase capacity for manufacturing fluorocarbon precursors at its Corpus Christi plant by 1985.

Gem Stones.—The value of gem stones produced during the year increased 12.5% over that of 1982.

Gypsum.—In descending order of crude gypsum output, producing counties were Nolan, Hardeman, Stonewall, Gillespie, Kimble, and Hudspeth. A small improvement in the housing industry and among other gypsum users in 1983 accounted for a 4.9% rise in the quantity of gypsum mined, compared with that of 1982. Gypsum was calcined by Genstar Building Products Materials Co. at Sweetwater, Nolan County; Georgia Pacific Corp. at Quanah, Hardeman County; National Gypsum Co. at Rotan, Fisher County; United States Gypsum at Galena Park, Harris County, and at Sweetwater, Nolan County; and, by a new producer, Windsor Gypsum Co., at McQueeney, Guadalupe County. Windsor started up in May 1983 and uses gypsum from its quarry in Gillespie County, near Fredericksburg. The value per ton of calcined gypsum rose 16% from $15.32 in 1982 to $17.80 in 1983, and quantity rose 13.8% from that of 1982. Texas companies produced 10% of the Nation's calcined gypsum.

Helium.—Separating and recovering crude helium from natural gas continued in the Texas Panhandle and was nearly 95% more than the amount produced in 1982. Grade-A helium production increased just slightly more than 14% over that of 1982, when production nearly doubled that of 1981. Phillips Petroleum Co. built a new crude helium plant at Dumas, Moore County, north of Amarillo.

Iron Ore.—Texas ranked 7th of 12 States that shipped usable iron ore in 1983.

Lime.—Lime production in Texas fell 5%

below that of 1982; nevertheless, the State ranked fifth in output and accounted for more than 7% of the Nation's quicklime and hydrated lime production. Quicklime production was 54.5% of total output and hydrated lime was 45.5% of the total. The number of lime plants fell from 10 in 1982 to 9 in 1983. Average value of Texas lime increased $1.05, from $55.36 to $56.41 per short ton. Texas ranked fourth among lime consuming States—more than 1 million tons during 1983. Texas also consumed 515,000 tons of hydrated lime production, leading all other States. The State ranked second in producing lime for water purification and fourth in output of lime for electric-furnace steel production.

Chemical Lime Co. Inc. opened a new facility in July at Marble Falls, Burnet County. The facility used a Maerz-Warwick vertical shaft, parallel-flow kiln, rated at about 600 tons per day, and produced a dolomitic lime, principally for use in producing magnesium from seawater. The kiln at Marble Falls was the only new kiln in the Texas lime industry in 1983.

At its quarry near Clifton, Bosque County, Chemical Lime installed a new in-pit crushing system to reduce costs and improve output. Crushed material drops onto the 1,402-foot-long conveyor for transport to one of the kilns, eliminating haul truck runs of as long as a mile from the face to a primary crusher. Diesel fuel costs were reduced about 50%, limestone output more than tripled, and truck maintenance was reduced to a minimum. The quarry rock averaged 97% calcium carbonate, with minor amounts of magnesium.[16]

United States Gypsum produced dolomitic lime for the construction industry for the first time in the Southwestern United States in 1983 when it expanded its New Braunfels plant capacity to 1,100 tons per day. The dolomitic lime production was added by converting an existing rotary kiln. High-calcium lime capacity at the plant doubled with the addition of a new 600-ton-per-day kiln. The new No. 3 coal-fired rotary kiln at the New Braunfels plant is a 13.5-by 175-foot unit with a counterflow polygon preheater and an 18-foot-diameter contact cooler. The No. 3 kiln brought fuel usage full circle; since 1908, fuel for firing the kilns has been switched successively from coal to lignite to fuel oil to natural gas and, recently, back to coal. Major markets for United States Gypsum's lime included soil stabilization, water and sewage treatment, and mortar and stucco plaster for construction uses, and for producing aluminum, paper, steel, and sugar.[17]

Armco Inc., a steelmaker in Houston, Harris County, closed down its Azbe vertical lime kiln in late 1982, let it lie dormant during 1983, and withdrew from producing quicklime after yearend.

Although the State's lime production decreased in value and quantity, compared with the 1982 figures, producers in Bosque, Comal, Hill, and Travis Counties did not follow the same downward trend and showed increases in both value and output. Statewide, quicklime averaged $52.39 per short ton; hydrated lime, $61.29.

Table 7.—Texas: Lime sold or used by producers, by use

Use	1982		1983	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Road stabilization	325,420	$17,484	366,177	$21,605
Soil stabilization	150,164	9,430	127,768	6,865
Paper and pulp	138,405	7,175	W	W
Steel, electric	117,509	6,374	106,528	5,275
Water purification	113,723	6,328	W	W
Aluminum and bauxite	89,829	4,966	W	W
Sewage treatment	27,704	1,385	W	W
Oil-well drilling	14,755	1,067	W	W
Mason's lime	11,695	811	W	W
Food, animal, human	3,028	160	1,532	83
Other[1]	132,657	7,097	464,555	26,365
Total	1,124,889	62,277	1,066,560	60,193

W Withheld to avoid disclosing company proprietary data, included with "Other."
[1]Includes acid water neutralization, basic oxygen furnace steel, finishing lime, glass, magnesium, open-hearth steel, other chemical and industrial uses, petrochemicals (1983), petroleum refining, sugar refining, and uses indicated by symbol W.

Magnesium Compounds.—Magnesium compounds produced in Texas during 1983 increased nearly 5% in quantity but increased less than 1% in value from that of 1982. The Dow Chemical Co. produced caustic-calcined magnesium and magnesium hydroxide from its seawater magnesium operation at Freeport in Brazoria County. Production capacity at the Freeport facility is 75,000 short tons of MgO equivalent per year.

Perlite (Expanded).—Seven plants expanded perlite in Texas, which ranked 6th of 33 producing States. The plants were in Bexar, Comal, Dallas, Harris (two plants), Nolan, and Tarrant Counties. Quantity sold and used fell more than 7% in 1983. Filter Media Co. and Perlite Houston Inc. were the two leading expanded perlite producers. Expanded perlite was used in cavity fill, insulation, concrete aggregate, filter aid, formed products, horticultural aggregate, low-temperature insulation, and plaster aggregate.

Salt.—Texas ranked 2d among 15 States in quantity of salt sold or used, accounting for 23.2% of the Nation's 34.6 million tons. Total value of the sold or used salt decreased 20.7% from that of 1982; the average value per short ton fell 26.7% from $11.16 in 1982 to $8.18 in 1983. Eight companies recovered salt at 11 operations in 10 counties. One company sold more than 1 million tons.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Compared with actual figures for 1982, construction sand and gravel production in 1983 increased 28.5% in estimated output and 34.6% in estimated total value. Value per short ton rose from $3.39 in 1982 to an estimated $3.56 in 1983.

Industrial.—Industrial sand production in 1983 decreased 18.8% in output and 17.6% in total value; none of the 17 industrial sand pits operated by 10 firms in 10 counties produced more than 400,000 short tons. Combined output from three firms in McCulloch County accounted for 38.9% of the State's total industrial sand product. Reported average value was $16.58 per short ton, up 24 cents from that of 1982. In order of decreasing amounts, industrial sand was used in hydraulic fracturing, for blasting, in containers, ground fiberglass, flat glass, and other uses. More than 81% of industrial sand was shipped by truck; the remainder, by railroad.

Texas Mining Co., a subsidiary of Oglebay Norton Co., the State's largest source of industrial sand, produced blasting, fracturing, and filtering sand from its plant at Brady, McCulloch County. In late 1983, the 20-40 mesh fracturing sand sold for $16 per ton, compared with $24 in October 1982 and $30 just a month earlier. Texas Mining also is the only producer in McCulloch County of pulverized sand, used in pipe products.

Unimin Corp. purchased the Industrial Sand Div. of Martin Marietta Corp. for $27 million and became the largest U.S. producer of industrial sand. Of the 10 plants involved nationwide, 1 is at Cleburne, Johnson County.[18]

The Pennsylvania Glass Sand Corp. San Saba plant at Voca, McCulloch County, produced industrial sand from the Hickory Sandstone Member of the Riley Formation,

Table 8.—Texas: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	18,669	$58,510	$3.13	NA	NA	NA
Gravel	22,674	88,374	3.90	NA	NA	NA
Sand and gravel (unprocessed)	4,184	7,631	1.82	NA	NA	NA
Total or average	45,527	154,515	3.39	e58,500	e$208,000	e$3.56
Industrial sand	r2,201	r35,974	r16.34	1,788	29,637	16.58
Grand total or average	r47,728	r190,489	r3.99	e60,288	e237,637	e3.94

eEstimated. rRevised. NA Not available.

the oldest Cambrian rocks in Texas.[19] About 75% of the total production is hydraulic fracturing sand—the largest such operation in the Nation—and the remainder is foundry sand and abrasives. The recent decrease in the price of foreign oil reduced the rate of oil extraction in the United States and, therefore, the demand for hydraulic fracturing sand. In August 1983, the company began to recover from the June 1982 slowdown when production was 50% of normal. One-half the plant's output was shipped by rail from nearby Brady; however, because rail prices rose sharply, shipping by truck, usually cheaper and more convenient, was becoming the predominant transportation method.

In March 1983, Vulcan Materials Co., at Voca, began producing fracturing sand from the Hickory Sandstone.

Sodium Sulfate.—Texas ranked second of three sodium sulfate-producing States. During 1983, Ozark-Mahoning Co., a subsidiary of Pennwalt Corp., continued to produce at 1982 capacity and to sell sodium sulfate from its S. H. Davis plant near Seagraves in Gaines County and from its Brownfield plant in adjacent Terry County. Although proposed capacity increases were not achieved, the average value per short ton rose nearly 9%. The major end uses of sodium sulfate were pulp and paper, detergents, glass, and miscellaneous.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Almost 29% of the counties—73 of 254—produced crushed stone during the year. Most production came from 153 limestone quarries, but dolomite, granite, marble, marl, sandstone, traprock, and other crushed stone also were extracted. The combined output of crushed limestone and crushed dolomite was 74.5 million short tons, valued at $230.3 million. The unit values of all crushed stone ranged from $1 to $40 and averaged $3.13 per short ton. In order of increasing unit value, the more highly priced uses of crushed stone were for poultry grit, asphalt filler, terrazzo, and exposed aggregate, bituminous aggregates, roofing granules, and other fillers.

Of the total crushed stone shipped, 81.9% was transported by truck and 10.6% by railroad; the remainder was transported by unspecified methods.

Texas Crushed Stone Co. was again the Nation's leading producer of crushed stone, followed, in Texas, by 110 other firms, including Gifford-Hill, Texas Industries Inc., and General Portland Inc. Together, these four top producers accounted for 29% of the total tonnage and 24% of total value during 1983.

Texas Architectural Aggregates Inc. and Cactus Canyon Quarries of Texas Inc. produced marble from their quarries in Burnet County. Crushed marble value was $26.43 per short ton.

Many companies maintained a competitive edge and improved efficiency by computerizing their operations. Texas Crushed Stone, at Georgetown, Williamson County, for one, used computers to track routine maintenance requirements of nearly 200 pieces of equipment, including downhole drills, dozers, 50- and 100-ton end-dump trucks, graders, 100-ton loaders, scrapers, shovels, and tractors. The company estimated that it had saved $100,000 since it began using a computer program in combination with an older oil-analysis program.[20]

Lone Star Industries sold its aggregate operations in north Texas to Pioneer Concrete in late 1983. The sale was to be completed in July 1984.

Replacing an all truck-haulage transportation system with an 800- to 950-short-ton-per-hour in-pit crushing system and a 1,402-foot-long overland conveyor for material transport out of the pit at Chemical Lime's limestone quarry in Clifton, Bosque County, reduced diesel fuel costs about 50%, more than tripled limestone output, and reduced truck maintenance to a minimum.[21]

Dimension.—Although output of all types of dimension stone Texas producers sold or used during 1983 did not change from that of 1982, its total value rose more than 90%, from $5.8 million to $11.1 million. The State ranked 9th among 39 States that cut dimension stone, down from 7th in 1982. The value of granite dimension stone was $266.62 per short ton; the value of limestone dimension stone was $38.85 per short ton.

Dimension stone, cut in thin slabs or panels and used for building facades, is making a comeback and replacing glass in some new constructions. Stone veneer deflects heat rays better than glass does and requires less air conditioning, thereby reducing energy costs.

Seven companies quarried rock from nine sites in Burnet, El Paso, Gillespie, Jones, Llano, and Williamson Counties; no one

operation produced more than 25,000 short tons. Texas Granite Co. at Marble Falls, a subsidiary of Cold Spring Granite Co., led the State in dimension stone output. The largest limestone producer, Featherlite Pre-Cast Corp., planned to change its name to Featherlite Precast Corp. (doing business as) Texas Quarries, a subsidiary of Justin Industries.

Table 9.—Texas: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	137	604
Filter stone	157	636
Coarse aggregate, graded:		
Concrete aggregate, coarse	11,579	40,100
Bituminous aggregate, coarse	2,404	9,178
Bituminous surface treatment aggregate	956	4,750
Railroad ballast	680	2,231
Fine aggregate (-3/8 inch):		
Stone sand, concrete	1,582	5,744
Stone sand, bituminous mix or seal	1,293	4,371
Screening, undesignated	1,148	3,355
Coarse and fine aggregate:		
Graded road base or subbase	23,357	56,557
Unpaved road surfacing	1,290	3,861
Terrazzo and exposed aggregate	87	437
Crusher run or fill or waste	1,641	4,170
Combined coarse and fine aggregate	W	1,231
Agricultural:		
Agricultural limestone	253	578
Poultry grit and mineral food	113	W
Chemical and metallurgical:		
Cement manufacture	9,530	19,917
Lime manufacture	1,183	6,596
Sulfur oxide removal	617	1,379
Special:		
Other fillers or extenders	584	13,566
Roofing granules	14	219
Other[2]	17,848	60,163
Total	76,453	[3]239,642

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."

[1]Includes limestone, dolomite, granite, marble, marl, sandstone, traprock, and miscellaneous stone.

[2]Includes macadam, dead-burned dolomite, flux stone, asphalt fillers or extenders, whiting or whiting substitute, uses not specified, and use indiciated by symbol W.

[3]Data do not add to total shown because of independent rounding.

Sulfur.—*Frasch.*—Frasch sulfur production in Texas increased nearly 5% from that of 1982, yet the State accounted for 60% of the Nation's 1983 output; Louisiana was the only other producing State. Texasgulf Inc. temporarily suspended production of Frasch sulfur from the Comanche Creek Mine, Pecos County, in west Texas on December 1, 1983. The company stated that it had sufficient stocks of sulfur and production capacity at its Boling Dome Mine, Wharton County, to supply its internal needs and to meet contractural obligations. Future market conditions would determine the length of shutdown.

At yearend, the Frasch mines in Pecos County at Fort Stockton (Farmland Industries Inc.) and in Culberson County (Duval Corp., a wholly owned subsidiary of Pennzoil Co.), as well as Boling Dome, were operating at an estimated 50% of capacity.

Duval sold primarily to phosphate industry customers for use in manufacturing phosphate fertilizer materials. The product also was sold to the general chemicals industry and other industrial customers for use in manufacturing a variety of products, including fibers and paints. Most of Duval's primary sulfur production was transported in liquid form by unit train to Duval's primary sulfur terminal facilities in Galveston. The remainder was shipped by rail directly from the mine to customers.

Through a program called Resource Management, Duval saved $2 million between November 1982 and March 1983 in a cost-savings project at its Pecos sulfur plant. Realizing the need to compete, Duval asked employees to attend seminars and classes to improve productivity in their own work areas: "Employees do the work, they know what's going on, and they have ideas on how to improve it and cut down cost."

As reported in its form 10k, Duval's

Culberson County facilities have a design capacity of 2.5 million long tons of sulfur per year. During 1983, 1982, and 1981, the facilities were operated at approximately 50%, 70%, and 86%, respectively, of design capacity. Proven ore reserves at yearend amounted to 38 million long tons; production in 1983 was 1.25 million long tons, 28.3% and 43.6% less, respectively, than in 1982 and 1981.[22]

Recovered.—Texas led in producing recovered elemental sulfur; shipments from the State accounted for almost 28% of total shipments nationwide. Elemental sulfur was recovered during petroleum refining in 30 counties. Most came from Harris, Henderson, and Jefferson Counties, in eastern Texas—sites of plants owned by Atlantic Richfield Co., Charter International Oil Co., Crown Central Petroleum Corp., Exxon USA, Du Pont, Mobil Oil Corp., Shell Oil Co., Smackover Shell Ltd., and Union Oil Co. of California.

Table 10.—Texas: Sulfur produced and shipped from Frasch mines

(Thousand metric tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1979	3,897	4,649	W
1980	4,081	4,810	W
1981	3,908	3,674	W
1982	2,898	2,360	W
1983	1,915	2,468	W

W Withheld to avoid disclosing company proprietary data.

Sulfuric Acid.—Sulfuric acid was a byproduct from copper and lead smelting, but not from zinc smelting or roasting as in previous years. Nevertheless, byproduct sulfuric acid produced in Texas increased 4% from that of 1982 but its value decreased 12.8%. Asarco recovered sulfuric acid from its Corpus Christi and El Paso facilities.

Talc.—In 1983, Texas talc production and value rose 22% and 30%, respectively, countering the lower output and value of talc nationally. Producing more than 25% of the Nation's output, Texas ranked 1st among 11 producing States. Five producers quarried talc worth an average of $15.70 per ton. Southern Clay Products Inc. and Dal-Til (Texas Talc Co.) were leading producers in Hudspeth County; Westex Minerals Inc., was the sole producer in Culberson County. A significant talc discovery was made in west Texas. (See "Exploration Activities" section.)

Vermiculite (Exfoliated).—W. R. Grace & Co. continued operating two exfoliation plants at San Antonio in Bexar County and at Dallas in Dallas County; Vermiculite Products Inc. produced exfoliated vermiculite at its Houston plant in Harris County. Both companies used crude vermiculite from out-of-State sources. Total production and sales declined less than 9% from those of 1982; the average price increased about 3%. In decreasing order of quantity, the product was sold for use as fireproofing, aggregates (concrete and plaster), agriculture (horticulture and soil conditioning), and insulation (block and loose fill).

METALS

Smelters and Refineries.—Asarco planned to reopen the 207,000-metric-ton-capacity Corpus Christi zinc refinery in February 1984 and expected to commence shipping zinc in May (annual slab zinc capacity of the primary zinc plant at Corpus Christi was 104,000 metric tons). The plant had not operated since October 1982. Asarco also operated a copper and silver refinery at Amarillo and a copper and lead smelter and zinc slag-fuming plant at El Paso.

Asarco's Amarillo electrolytic copper refinery operated at approximately 75% of capacity for the first 7 months of 1983 and then cut back to 55% of capacity for the remainder of the year. The Amarillo refinery can produce 420,000 tons of copper cathode annually, making it one of the world's largest electrolytic refineries. Asarco completed installing a new $6 million acid cleaning system for continuous-cast copper rod at the Amarillo refinery in 1983. In the new system, the rod is submerged in a tank of sulfuric acid, washed, and then coated to prevent reoxidation; the system permits uninterrupted production of continuous-cast 5/16-inch copper rod. Amarillo also is the Nation's largest producer of refined silver; the refinery has a 60-million-troy-ounce-per-year capacity and is the only domestic producer of tellurium.

Gold, nickel, palladium, platinum, and selenium also are produced at the refinery.

Also in 1983, Asarco produced 410,900 ounces of refined gold, a record high for the Amarillo refinery; 46,157,000 ounces of silver; and 274,800 tons of copper.

Asarco's El Paso 115,000-ton-per-year-capacity smelter produced 85,000 tons of blister copper (an intermediate product containing approximately 98% copper) and 46,200 tons of lead bullion.

After contract talks broke off, Phelps Dodge Refining Corp. workers struck the company's 445,000-short-ton-per-year copper refinery at El Paso on July 1. The primary issue was the firm's discontinuation of cost-of-living adjustments (COLA) pegged to the Consumer Price Index rather than to the price of copper. When the strike began, supervisory personnel and nonstriking employees operated the refinery at reduced levels; by September, however, enough workers, including replacement workers, had been hired to bring the refinery to near capacity.[23]

Late in 1983, Phelps Dodge's El Paso refinery began receiving material formerly sent to the old electrolytic copper refinery at Laurel Hill, Long Island, NY. El Paso operated at 75% of its 420,000-ton-per-year electrolytic copper capacity, according to the firm's 1983 annual report.

The El Paso smelter was one of the Nation's seven copper sulfate producers in 1983.

Aluminum.—Potline two of the eight at the Aluminum Co. of America's (Alcoa) Rockdale alumina reduction plant was returned to full operation in December, bringing Rockdale to full capacity for the first time since June 1981. The Rockdale operation in Milam County survived as the only aluminum smelter in Texas because fuel for the plant was provided by Alcoa's nearby Sandow lignite properties in Milam and Lee Counties; other operations, mainly powered by natural gas, could not operate as economically. Alcoa's Point Comfort smelter, on Lavaca Bay in Calhoun County, which had used natural gas, was closed permanently in May 1982, although the alumina plant there remained in operation. Alcoa's Palestine plant, Anderson County, which closed indefinitely in July the same year, used lignite fuel but was an Alcoa experimental process pilot plant and had a primary aluminum production capacity of only 15,000 metric tons at yearend 1983.

Reynolds Metals Co.'s San Patricio smelter at Corpus Christi was closed indefinitely in May 1981; it was expected to reopen in 1984.

Kaiser Aluminum & Chemical Corp. owned an extrusion operation in Sherman, but sold its can body plant in Houston.

Iron Ore.—Lone Star Steel, Mathis & Mathis Mining & Exploration Co., and Hudson Bros. Mining Co. Inc. mined iron ore from surface pits in Cass, Cherokee, and Morris Counties, northeast Texas. Hudson Bros.' Rusk Mine in Cherokee County was the largest producer. Lone Star Steel's mines and blast furnace in Morris County, had been idle since August 1982. The blast furnace was one of only two operating west of the Mississippi River at yearend. Armco prepared to close its Houston steel mill in early January 1984, reducing its total annual raw steel capacity from 6.8 million short tons to 5.3 million tons. The company had lowered production costs at the plant by closing its blast furnaces and an older electric-furnace shop in January 1983, but the plant remained unprofitable because of the recession and competition from imports. The mill, which employed about 4,500 workers in the late 1970's, employed about 1,400 in November 1983.

Magnesium.—At Freeport, Dow Chemical processed seawater to provide feed material for the production of pure magnesium metal. Annual capacity at Freeport is estimated at 230 to 250 million pounds. Dow Chemical had been operating the electrolytic plant at 50% capacity for some time. The move to increase production was designed to replenish Dow's inventories and to meet part of the rising demand for magnesium. Dow's first quarter 1983 business rose 5% compared with that of fourth quarter 1982. Magnesium demand continued to run ahead of the first quarter level by the end of the second quarter 1983.

Selenium.—Although amounting to 12% less than 1982 Texas production, primary selenium was recovered from anode slimes generated in the electrolytic refining of copper by Asarco at its Amarillo plant. Phelps Dodge reportedly was stockpiling crude selenium materials at the recently installed selenium refining facilities at El Paso; however, owing to strike activity and low selenium prices during 1983, startup of the selenium refinery was replanned for early 1984.

Silver.—Asarco recovered silver at its Amarillo plant from copper, silver, and lead-zinc ores mined outside Texas and

smelted by Asarco and others. Silver also was recovered from precious metals scrap. Production of refined silver was higher in 1983 than in 1982 owing to increased availability of raw materials. The average price of silver in 1983 was $11.44 per troy ounce.[24]

Tellurium.—Asarco recovered commercial-grade tellurium metal from copper anode slimes, a byproduct of electrolytic copper refining. The Asarco smelter at Amarillo was the Nation's only domestic source of tellurium. Tellurium is used primarily as an alloying material in producing free-machining steels.

Vanadium.—Gulf Chemical, a division of Associated Metals & Minerals Corp., produced vanadium pentoxide at its spent catalyst processing facility at Freeport.

---

[1]State Liaison Officer, Bureau of Mines, Denver, CO.

[2]Geologist, Bureau of Economic Geology, The University of Texas at Austin, TX.

[3]Fiscal Notes. The Texas Economy and Regional Strengths and Weaknesses. No. 83:11, Oct. 1983, p. 1.

[4]Kuennen, T. Rock Newscope. Rock Prod., v. 86, No. 4, Apr. 1983, p. 13.

[5]Rock Products. Industry News. V. 86, No. 11, Nov. 1983, p. 18.

Rich, R. Cement Exports are Vital Part of Producer Sales; Exporters are Here To Stay, Says Major Saudi Trader. Rock Prod., v. 86, No. 4, Apr. 1983, p. 44.

[6]McBride, M. W., and A. L. Dobbs. Nonpetroleum Mineral Producers in Texas—1983. Univ. Tex. Austin, Bur. of Econ. Geol., MRC 74, 1983, 94 pp.

Price, J. G., C. D. Henry, and A. R. Standen. Annotated Bibliography of Mineral Deposits in Trans-Pecos Texas. Univ. Tex. Austin, Bur. of Econ. Geol., MRC 73, 1983, 108 pp.

[7]U.S. Department of Labor. Employment and Earnings, Mar. 1984. Table B-8, p. 76.

[8]New Mexico Pay Dirt. No. 77, Oct. 1983, p. 8A.

[9]American Mining Congress Journal. V. 69, No. 14, July 20, 1983, p. 3.

[10]Rock Products. V. 86, No. 12, Dec. 1983, p. 36.

[11]Grancher, R. A. Cement. Min. Eng., v. 36, No. 5, May 1984, pp. 509-510.

[12]Page 39 of work cited in footnote 10.

[13]Rock Products. Rock Newscope. V. 87, No. 2, Feb. 1984, p. 7.

[14]Page 41 of work cited in footnote 10.

[15]Brick & Clay Record. Unique Brickmaking Process Fully Automated. V. 183, No. 5, Nov. 1983, pp. 28-29.

[16]Sassos, M. E&MJ Operating Ideas. Eng. and Min. J., v. 185, No. 5, May 1984, p. 65.

[17]Levine, S. U.S.G. Expands Texas Lime Plant to Meet Southwest Needs. Pit and Quarry, v. 76, No. 6, Dec. 1983, pp. 28-32.

[18]Pit and Quarry. V. 76, No. 5, Nov. 1983, p. 20.

[19]Barnes, V. E. Geologic Atlas of Texas, Brownwood Sheet. Univ. Tex. Austin, Bur. of Econ. Geol., 1976, Scale: 1:250,000.

[20]Pit and Quarry. Oil Analysis Program Identifies Engine Oil Contaminants. V. 76, No. 4, Oct. 1983, pp. 48-51.

[21]Engineering and Mining Journal. E&MJ Operating Ideas. New In-Pit Crushing System Reduces Costs, Improves Output. V. 185, No. 5, May 1984, p. 65.

[22]Duval Corp. 1983 10K Annual Report.

[23]Engineering and Mining Journal. PD Strike Looks Like a Flop. V. 184, No. 8, Aug. 1983, p. 25.

———. Phelps Dodge-Union Controversy Escalates Into the Courts. V. 184, No. 10, Oct. 1983, p. 25.

Dillard, G. Phelps Dodge at 100 Percent of Capacity; Company Expects Full Work Force by Mid-September. New Mexico Pay Dirt, No. 76, Sept. 1983, p. 3A.

[24]ASARCO Incorporated. Annual Report 1983, p. 5.

Table 11.—Texas: Primary smelters, refineries, and reduction plants

Product, company, plant	Location (county)	Material treated
Aluminum:		
Aluminum Co. of America:		
Rockdale (reduction)	Milam	Alumina.
Palestine (reduction)	Anderson	Do.
Point Comfort (alumina)	Calhoun	Bauxite.
Reynolds Metals Co.:		
San Patricio (reduction)	San Patricio	Alumina.
Sherwin plant (alumina)	do	Bauxite.
Antimony:		
ASARCO Incorporated:		
El Paso smelter	El Paso	Ore.
Anzon American Inc.:		
Laredo smelter	Webb	Ore.
Cadmium:		
ASARCO Incorporated:		
Corpus Christi electrolytic	Nueces	Ore.
Copper:		
ASARCO Incorporated:		
Amarillo refinery[1]	Potter	Blister and anode.
El Paso smelter	El Paso	Ore and concentrate.
Phelps Dodge Refining Corp.:		
Nichols refinery[2]	do	Blister and anode.
Iron:		
Armco Inc.:		
Houston plant	Harris	Ore and scrap.
Lone Star Steel Co.:		
Daingerfield plant	Morris	Do.
Tex-Iron Inc.:		
Larue operations	Henderson	Ore.
United States Steel Corp.:		
Baytown plant	Chambers	Ore and scrap.
Lead:		
ASARCO Incorporated:		
El Paso smelter	El Paso	Ore and concentrate.

See footnotes at end of table.

Table 11.—Texas: Primary smelters, refineries, and reduction plants —Continued

Product, company, plant	Location (county)	Material treated
Magnesium:		
Dow Chemical U.S.A., a division of The Dow Chemical Co.:		
Freeport plants, electrolytic	Brazoria	Seawater.
Manganese:		
Tenn-Tex Alloy Corp	Harris	Ore.
Sodium:		
Ethyl Corp	do	Salt.
Tin:		
Gulf Chemical & Metallurgical Corp.:		
Texas City smelter	Galveston	Ore, slag, scrap, residue.
Zinc:		
ASARCO Incorporated:		
Corpus Christi electrolytic[3]	Nueces	Ore and concentrate.
El Paso fuming plant	El Paso	Dusts and residues.

[1]Asarco's Amarillo refinery also produced gold, nickel sulfate, palladium, platinum, selenium, silver, and tellurium.
[2]Phelps Dodge's El Paso (Nichols) refinery also produced copper sulfate, gold, palladium, platinum, selenium, and silver.
[3]Asarco's Corpus Christi refinery also produced sulfuric acid and cadmium.

Table 12.—Texas: Secondary metal recovery plants

County and company	Material	Product
Austin:		
Schindler Bros. Steel Co	Steel scrap	Reinforced steel bars.
Bexar:		
Newell Salvage Co. of San Antonio	Scrap metal	Smelter and refined scrap metals.
Brazoria:		
Texas Reduction Corp	Aluminum scrap	Alloyed aluminum ingot.
Collin:		
Electro Extraction Inc	Aluminum and copper scrap	Aluminum ingots, copper bars.
GNB Batteries Inc	Lead scrap	Battery lead oxide, pig lead.
Dallas:		
ABASCO Inc	Aluminum scrap	Aluminum ingots and dioxidizing bars and shot.
Dixie Metals Co	Lead scrap	Lead pigs, alloys, chemicals.
Laclede Steel Corp	Steel scrap	Reinforcing steel.
Murdock Lead Co., a division of RSR Corp.	Lead scrap	Lead shot, solders, lead pipe.
El Paso:		
Border Steel Mills Inc	Steel scrap	Reinforcing bars, bar shapes, steel grinding balls.
Proler International Corp	do	Precipitation iron.
SEC Corp	Nickel-copper waste solution	Nickel.
Ellis:		
Chaparral Steel Co	Steel scrap	Steel reinforcing bars and shapes.
Industrial Metals Co	Scrap metal	Metal shapes and ingots.
Galveston:		
Gulf Chemical & Metallurgical Corp	Various metal scrap	Tin.
Gregg:		
Marathon-LeTourneau Co	Steel scrap	Steel castings and shapes.
Southwest Steel Castings Co	do	Steel castings.
Guadalupe:		
Structural Metals Inc	do	Structural steel reinforcing bars.
Harris:		
A & B Metal Manufacturing Co. Inc	Scrap metal	Tungsten carbide.
Federated Metals Corp	Various metals	Lead ingot, solder, copper tubing, bearing metals, sheet lead, lead pipe.
Gulf Reduction Corp	Aluminum zinc scrap	Aluminum and zinc ingots, alloys.
Houston Lead Co	Lead scrap	Lead pigs, ingots, alloys.
Lead Products Co. Inc	do	Do.
Newell Metals Inc	Zinc scrap	Zinc dust.
Proler International Corp	Various metals	Zinc slab, aluminum alloys, precipitation iron.
Redgate Virgil Co	do	Recovery of gold, silver, platinum, rhodium, copper, nickel, cadmium, aluminum.
Jefferson:		
Georgetown Texas Steel Corp	Steel scrap	Steel rods and shapes.
Laclede Steel Corp	do	Reinforcing steel.
Leon:		
Nucor Steel Co	do	Steel rods and shapes.
San Antonio:		
Standard Industries	Lead scrap, soft lead, drosses.	Battery metals, grids and oxides.
Smith:		
Bloch Metals Inc	Aluminum scrap	Aluminum ingots.
Tyler Pipe Industries Inc	Steel scrap	Pipe and pipe fittings.
Tarrant:		
Texas Steel Co	do	Carbon and alloy steel bars and shapes, reinforcing bars.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt (native):			
Uvalde Rock Asphalt Co	Box 531 San Antonio, TX 78206	Quarry and plant	Uvalde.
White's Mines Inc	Box 499 San Antonio, TX 78206	do	Do.
Barite:			
Dresser Industries Inc	Box 6504 Houston, TX 77002	Grinding plants	Cameron and Galveston.
Milwhite Co. Inc.[1]	5801 Lyons Ave. Houston, TX 77020	do	Cameron and Harris.
NL Industries Inc	Box 1675 Houston, TX 77001	do	Nueces.
Cement:			
Alamo Cement Co	Box 6925 San Antonio, TX 78209	Quarry and plant	Bexar.
Centex Corp	4600 Republic Bank Tower Dallas, TX 75201	Quarries and plants	Hays and Nueces.
General Portland Inc	12700 Park Central Pl. Dallas, TX 75251	do	Bexar, Dallas, Tarrant.
Gifford-Hill & Co. Inc	Box 520 Midlothian, TX 76065	Quarry and plant	Ellis.
Lone Star Industries Inc.[2]	Box 47327 Dallas, TX 75247	do	Nolan.
Southwestern Portland Cement Co.	Box 392 El Paso, TX 79943	Quarries and plants	Ector, El Paso, Potter.
Texas Industries Inc	8100 Carpenter Freeway Dallas, TX 75247	do	Comal and Ellis.
Clays:			
Acme Brick Co., a division of Justin Industries Inc.	Box 425 Fort Worth, TX 76101	Pits and plants	Denton, Guadalupe, Nacogdoches, Parker, Van Zandt, Wise.
Balcones Minerals Corp	Box B Flatonia, TX 78941	Pit and plant	Fayette.
Elgin-Butler Brick Co	Box 1947 Austin, TX 78767	do	Bastrop.
Featherlite Precast Corp	Box 141 Ranger, TX 76470	do	Eastland.
Henderson Clay Products Co	Box 490 Lindale, TX 75771	Pits and plants	Cherokee, Harrison, Rusk.
Milwhite Co. Inc	5801 Lyons Ave. Houston, TX 77020	do	Fayette and Walker.
Southern Clay Products Inc	Box 44 Gonzales, TX 78629	do	Cherokee and Gonzales.
Texas Clay Industries Inc	Box 469 Malakoff, TX 75148	Pit and plant	Henderson.
Texas Industries Inc	8100 Carpenter Freeway Dallas, TX 75247	Pits and plants	Ellis, Fort Bend, Guadalupe, Henderson, Navarro.
Gypsum:			
Genstar Building Products Materials Co.	Box 2580 Irving, TX 75061	Quarry and calcining plant.	Nolan.
Georgia Pacific Corp	133 Peachtree St., NE. Atlanta, GA 30303	do	Hardeman.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	do	Fisher.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Harris and Nolan.
Windsor Gypsum Co	McQueeney, TX 78123	Quarry and plant	Gillespie and Guadalupe.
Iron ore:			
Lone Star Steel Co	Box 35888 Dallas, TX 75235	Mines	Cass and Morris.
Mathis & Mathis Mining & Exploration Co.	1101 Santa Rita Box 2577 Silver City, NM 88062	Mine	Cass.
Lime:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Calhoun.
Austin White Lime Co	Box 9556 Austin, TX 78766	do	Travis.
Chemical Lime Co. Inc	Box 427 Clifton, TX 76634	Plants	Bosque and Burnet.
Holly Sugar Corp	Drawer 1778 Hereford, TX 79045	Plant	Deaf Smith.
McDonough Bros. Inc	Route 2, Box 222 San Antonio, TX 78229	do	Bexar.
Round Rock Lime Co., a subsidiary of Dravo Lime Co.	Box 38 Blum, TX 76627	do	Hill.
Texas Lime Co., a subsidiary of Rangaire Corp.	Box 851 Cleburne, TX 70631	do	Johnson.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Comal.

See footnotes at end of table.

Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Salt:			
Diamond Shamrock Corp	717 North Harwood Dallas, TX 75201	Plant	Chambers.
Dow Chemical U.S.A., a division of The Dow Chemical Co.[3]	2020 Dow Center Midland, MI 48640	Brine	Brazoria.
Morton Salt Co	110 North Wacker Dr. Chicago, IL 60606	Underground mine and brine.	Van Zandt.
Texas Brine Corp	2000 West Loop South Houston, TX 77027	Brines	Harris, Jefferson, Matagorda.
Sand and gravel:			
Capitol Aggregates Inc	Drawer 33240 San Antonio, TX 78233	Stationary plants	Guadalupe, Travis, Val Verde.
Dresser Industries Inc	Kosse, TX 76653	Stationary plant	Limestone.
The Fordyce Co	Box 1981 San Antonio, TX 78297	Stationary plants	Hidalgo and Victoria.
Fort Worth Sand & Gravel Co	Box 400 Arlington, TX 76010	do	Dallas, Denton, Tarrant.
Gifford-Hill & Co. Inc	Box 47127 Dallas, TX 75247	do	Brazos, Clay, Dallas, McLennan, Tarrant.
R. E. Janes Gravel Co	Box 2155 Austin, TX 78768	Pits and plant	Borden, Crosby, Lubbock, Taylor.
Lone Star Industries Inc	Box 47327 Dallas, TX 75247	do	Colorado and Denton.
Oglebay Norton Co., Texas Mining Co.	2104 East Randol Mill Rd. Suite 101 Arlington, TX 76011	do	McCulloch.
Parker Bros. & Co. Inc	Box 107 Houston, TX 77001	Stationary plants and dredges.	Colorado, Harris, Victoria.
Pennsylvania Glass Sand Corp	Box 187 Berkeley Springs, WV 25411	Pit	McCulloch.
Thorstenberg Materials Corp	1333 West Loop South Suite 1028 Houston, TX 77002	Pits	Colorado and Fayette.
Unimin Corp	50 Locust Ave. New Canaan, CT 06840	Plant	Johnson.
Sodium (metallic):			
Ethyl Corp	Box 472 Pasadena, TX 77502	Plant	Harris.
Sodium sulfate (natural):			
Ozark-Mahoning Co	1870 South Boulder Tulsa, OK 74119	Plants	Gaines and Terry.
Stone:			
General Portland Inc	2800 Republic Bank Tower Dallas, TX 75201	Quarries	Dallas, Tarrant, Wise.
Gifford-Hill & Co. Inc.[4]	Box 47127 Dallas, TX 75247	do	Comal, Ellis, Hudspeth, Wise.
Lone Star Industries Inc	Box 47327 Dallas, TX 75247	do	Burnet, Nolan, Wise.
Parker Bros. & Co. Inc	Box 107 Houston, TX 77001	Quarry	Comal.
Texas Crushed Stone Co	Box 9345 Austin, TX 78717	Quarries	Williamson.
Texas Industries Inc	Box 146 Midlothian, TX 76065	Quarries	Comal, Ellis, Jack, Wise.
Vulcan Materials Co.[5]	Box 13010 San Antonio, TX 78213	do	Bexar, Grayson, Wise.
White's Mines Inc	Box 499 San Antonio, TX 78206	do	Brown, Parker, Taylor, Uvalde.
Shell:			
Parker Bros. & Co. Inc	5303 Navigation Bldg. Box 107 Houston, TX 77001	Dredge	Calhoun.
Sulfur:			
Byproduct:			
Amoco Production Co	Box 591 Tulsa, OK 74102	Secondary recovery	Andrews, Ector, Hockley, Van Zandt, Wood.
Getty Oil Co	Box 8 Scroggins, TX 75480	do	Franklin and Freestone.
Gulf Oil Co	Box 701 Port Arthur, TX 77640	do	Crane, Hopkins, Jefferson, Karnes.
Phillips Petroleum Co	Bartlesville, OK 74003	do	Andrews, Brazoria, Hutchinson.
Warren Petroleum Corp	Box 1589 Tulsa, OK 74101	do	Crane, Hopkins, Karnes.
Native:			
Duval Corp	1906 First City National Bank Houston, TX 77002	Frasch mine	Culberson.
Farmland Industries Inc	Box 850 Fort Stockton, TX 79735	do	Pecos.

See footnotes at end of table.

Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sulfur —Continued			
Native —Continued			
Jefferson Lake Sulfur Co	Box 1185 Houston, TX 77001	Frasch mine	Fort Bend.
Texasgulf Inc	200 Park Ave. New York, NY 10017	Frasch mines	Pecos and Wharton.
Talc:			
Pioneer Talc Co. Inc	Chatsworth, GA 30705	Mine and plant	Hudspeth.
Southern Clay Products Inc	Box 44 Gonzales, TX 78629	Mine	Do.
Texas Talc Co	Box 866 Van Horn, TX 79855	do	Do.
Westex Minerals Inc	Box 15038 Houston, TX 77020	Mine and plant	Culberson and Hudspeth.
Vermiculite (exfoliated):			
W. R. Grace & Co	2651 Manila Rd. Dallas, TX 75200	Exfoliating plants	Bexar and Dallas.
Vermiculite Products Inc	Box 7327 Houston, TX 77008	Exfoliating plant	Harris.

[1]Also clay and shale, Fayette and Walker Counties.
[2]Also industrial sand, Liberty County.
[3]Also magnesium compounds, Brazoria County.
[4]Also clays, Ellis County.
[5]Also industrial sand, McCulloch County.

The Mineral Industry of Utah

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Utah Geological and Mineral Survey for collecting information on all nonfuel minerals.

By Lorraine B. Burgin[1]

The value of nonfuel mineral production rose from $616 million in 1982 to $657 million in 1983. The increase was partly attributed to a new gold mine brought on-stream during the year, a new silver operation that attained full production, and an improved construction industry.

In order of value of output, Utah's principal commodities were copper, gold, silver, portland cement, potassium salts, salt, phosphate rock, construction sand and gravel, native asphalt (gilsonite), and lime. Among the States, Utah ranked first in gilsonite and beryllium hydroxide production; second in copper, potash, and vanadium; third in gold; and fourth in silver and molybdenum.

Table 1.—Nonfuel mineral production in Utah[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2]	thousand short tons	183	$994	227	$1,569
Copper (recoverable content of ores, etc.)	metric tons	189,090	r303,483	169,751	286,403
Gem stones		NA	80	NA	80
Gold (recoverable content of ores, etc.)	troy ounces	174,940	65,762	238,459	101,107
Gypsum	thousand short tons	231	2,363	305	2,736
Lime	do.	286	15,121	315	16,771
Salt	do.	1,227	23,210	936	23,184
Sand and gravel:					
Construction	do.	7,579	14,920	e9,800	e19,800
Industrial	do.	W	W	24	W
Silver (recoverable content of ores, etc.)	thousand troy ounces	4,342	34,522	4,567	52,242
Stone:					
Crushed	thousand short tons	e2,500	e9,800	4,407	14,636
Dimension	do.	e3	e280	W	W
Combined value of asphalt (native), beryllium concentrate, cement, clays (fuller's earth), iron ore (usable), lead (1982), magnesium compounds, molybdenum, perlite (1983), phosphate rock, potassium salts, sodium sulfate, vanadium, and values indicated by symbol W		XX	145,669	XX	138,051
Total		XX	r616,204	XX	656,579

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes fuller's earth; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Utah, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Beaver	(2)	$132	Sand and gravel (construction).
Box Elder	$1,132	W	Sand and gravel (construction), salt.
Cache	1,213	W	Sand and gravel (construction).
Carbon	56	W	Do.
Davis	(2)	2,126	Do.
Duchesne	(2)	528	Do.
Emery	--	352	Do.
Garfield	--	W	Sand and gravel (construction), vanadium.
Grand	W	W	Potassium salts, salt.
Iron	10,032	19,284	Silver, iron ore, sand and gravel (construction), gold.
Juab	494	8,858	Cement, silver, clays, sand and gravel (construction), gold, gypsum.
Kane	(2)	W	Sand and gravel (construction).
Millard	4,405	5,135	Lime, gypsum, sand and gravel (construction), beryllium.
Morgan	W	W	Cement, sand and gravel (construction).
Salt Lake	553,778	425,137	Copper, gold, silver, molybdenum, cement, salt, sand and gravel (construction), lime.
San Juan	(2)	W	Vanadium.
Sanpete	W	W	Sand and gravel (construction), gypsum, clays.
Sevier	W	2,326	Gypsum, salt, clays, sand and gravel (construction).
Summit	W	W	Sand and gravel (construction), clays.
Tooele	54,843	19,259	Lime, salt, potassium salts, magnesium compounds, sand and gravel (construction), clays.
Uintah	W	24,934	Asphalt, phosphate rock, sand and gravel (construction).
Utah	9,962	5,575	Silver, gold, sand and gravel (construction), copper, clays, sand (industrial), lead.
Wasatch	(2)	368	Sand and gravel (construction).
Washington	(2)	778	Do.
Weber	10,370	42,966	Potassium salts, salt, asphalt, magnesium compounds, sodium sulfate, sand and gravel (construction).
Undistributed[3]	119,045	48,362	
Sand and gravel (construction)	e54,550	XX	
Stone:			
Crushed	XX	e9,800	
Dimension	XX	e280	
Total[4]	819,882	616,204	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Daggett, Piute, and Wayne Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Includes gem stones and perlite that cannot be assigned to specific counties and values indicated by symbol W.

[4]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Utah business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	677.9	700.6	+3.4
Unemployment	do	75.8	59.9	-21.0
Employment (nonagricultural):				
Mining[1]	do	14.1	14.2	+.7
Manufacturing	do	80.5	89.4	+11.1
Contract construction	do	22.6	27.4	+21.2
Transportation and public utilities	do	35.0	36.2	+3.4
Wholesale and retail trade	do	128.6	135.3	+5.2
Finance, insurance, real estate	do	27.3	29.0	+6.2
Services	do	111.7	115.9	+3.8
Government	do	129.8	130.2	+.3
Total nonagricultural employment[1 2]	do	549.5	577.7	+5.1

See footnotes at end of table.

Table 3.—Indicators of Utah business activity —Continued

		1982	1983[p]	Change, percent
Personal income:				
Total	millions	$13,790	$14,618	+6.0
Per capita		$8,820	$9,031	+2.4
Construction activity:				
Number of private and public residential units authorized		7,667	14,013	+82.8
Value of nonresidential construction	millions	$436.4	$465.2	+6.6
Value of State road contract awards	do.	$85.0	$179.0	+110.6
Shipments of portland and masonry cement to and within the State	thousand short tons	599	793	+32.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$616.2	$656.6	+6.6
Value per capita, resident population		$401	$406	+1.2
Value per square mile		$7,331	$7,734	+5.5

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.
[2]Data do not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

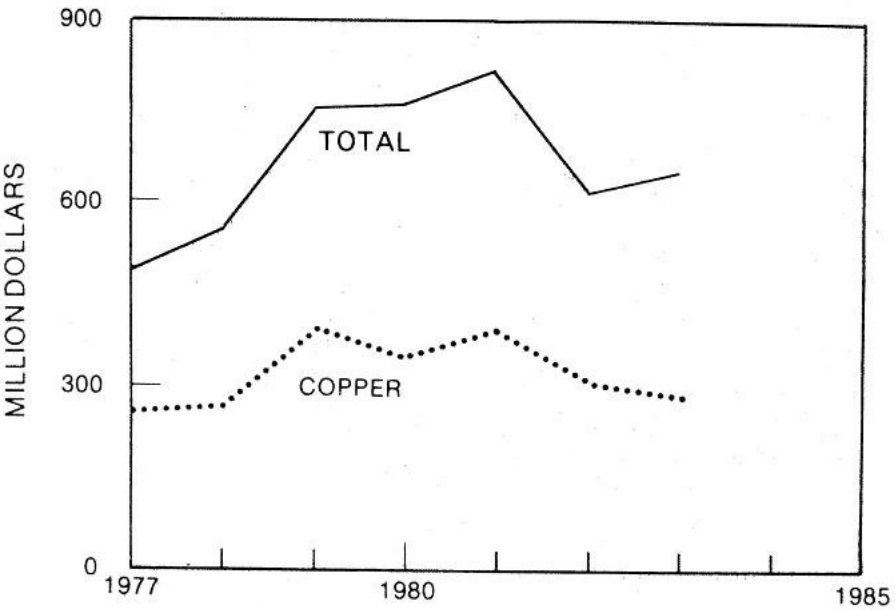

Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Utah.

As a percentage of total nonfuel production, Utah's metals output declined slightly from about 71% in 1982 to less than 70% in 1983. Copper, the most important commodity, comprised nearly 63% of the metals recovered in the State and less than 44% of the total value of nonfuel minerals. Although copper output declined, the State produced 16.4% of the Nation's copper, with Kennecott's Utah Copper Div. the principal producer. Gold, silver, and molybdenum continued as important byproducts from the Utah Copper Div. operation at Bingham. Ranchers Exploration and Development Corp.'s Escalante silver mine and Getty Oil Co.'s Mercur gold mine raised Utah's precious metals output; the State produced almost 12.2% of the Nation's gold and 10.5% of its silver. Declines were noted in molybdenum, as the Utah Copper Div. cut back its molybdenum circuit, in iron ore as United States Steel Corp. shipped only from stockpiles, and in byproduct vanadium as uranium companies slashed production. Lead production ceased in 1982, and no zinc had been produced since 1981.

In the nonmetals group, production increased as the construction industry improved. The leading commodities in value were portland cement and potassium salts; followed by salt, phosphate rock, construction sand and gravel, gilsonite, lime, and crushed stone. Output of potassium salts, gilsonite, dimension stone, and salt declined.

Trends and Developments.—Mining continued in the doldrums as coal, copper, and uranium failed to recover from the 1982 recession. The biggest declines in value of nonfuel production were in iron ore, followed by vanadium, molybdenum, dimension stone, and potassium salts. The copper industry, however, sustained the heaviest loss in value of the nonfuels, more than $17 million in 1983. Also in declining order, the industries dropping in production value included potassium salts, vanadium, molybdenum, iron ore, dimension stone, magnesium compounds, salt, and masonry cement. Factors affecting Utah's copper industry included the depressed market and prices, competition with imported copper, and the need for modernizing to increase productivity at the Nation's largest copper operation. The State's only integrated steel plant was operated at one-half capacity, partly because of competition with Japanese imports on the west coast. The Iron County iron mines were permanently closed as more cost-effective taconite pellets were shipped in from the steel company's Minnesota properties. Recovered in Utah as a byproduct of uranium production, vanadium suffered both from a depressed steel industry and from severe cutbacks in Colorado Plateau uranium operations. With the continued slump in steel, molybdenum markets and prices failed to recover significantly.

Heavy precipitation, flooding, and the accompanying rise in the level of Great Salt Lake affected the magnesium, potash, and salt industries on the shores of the lake, and output from the potash and salt industries was cut almost one-fourth.

Improvement in the construction industry brought increases in production of the industrial commodities of portland cement, gypsum, lime, sand and gravel, and crushed stone. Total permit-authorized construction climbed to $1,115.2 million, a 15% increase. Lower interest rates encouraged residential construction, and building increased 89%. Nonresidential construction declined 21%, its lowest level since 1976.[2]

Exploration Activities.—Exploration was dominated by the search for gold and silver. A few such projects included the following: Freeport Minerals Co. explored for gold and silver on the Horn Silver Mines Inc. and Tintic Mineral Resources Inc. properties in Beaver County; Toledo Mining Co. and Horn Silver Mines entered a joint agreement to prospect holdings in the Frisco, Beaver Lake, Rocky, and Star mining districts in Beaver County; Magnum Resources Inc. and ASARCO Incorporated prospected a silver property in Millard County; Axtel Oil Co. leased gold claims east of Wendover and acquired American Gold Minerals Co.; Western Strategic Minerals Inc. explored for gold and silver on the Thomas Caldera properties in Juab County; Nevada Resources Inc. drilled for gold at its Yellow Cat claims in Millard County; Cash Industries Inc. tested placer properties on the Colorado River north of Moab; and Musto Exploration Ltd. of Vancouver explored the old Apex copper-lead-zinc-silver mine in Washington County for germanium and gallium.

Legislation and Government Programs.—The Governor signed the following bills related to mining passed by the 1983 general session of the 45th Legislature meeting from January 10 to March 10: H.B. 6 authorized the Industrial Commission to approve a workday in excess of 8 hours in smelters and underground mines; H.B. 359 revised certification procedures for "fore-

men, fire bosses, shot firers, and mine electricians"; H.B. 297 established the Utah Geological and Mineral Survey as a repository for geologic information and provided procedures for handling confidential information; and H.B. 102 excluded the common varieties of sand, gravel, and cinder from its definition of minerals. In June 1983, however, the U.S. Supreme Court ruled that sand and gravel were minerals and, therefore, subject to reservation by the Federal Government.

The U.S. Bureau of Mines awarded $861,000 to the University of Utah, Department of Metallurgy and Metallurgical Engineering, for organizing and operating the Generic Mineral Technology Center for Communition. The Utah center had received $2.1 million, including the award, as part of the Mining and Minerals Research Institute program the Bureau of Mines funded. The research centered on determining a means of reducing the cost of pulverizing ores to recover valuable minerals efficiently.

When Utah became a State in 1896, Congress designated sections 2, 16, 32, and 36 in each township of Federal land as State land to be used for the benefit of schools. Many of the 5,000 parcels of land involved had been transferred to the State; however, approximately 226,000 acres of "in lieu land" was still due the State. In lieu lands were equivalent sections granted to the States in place of designated sections already legally occupied or disposed of in some manner by the Federal Government. On August 12, 1983, the Secretary of the Interior transferred 93,803 acres of school lands to the State, approximately one-half of the amount still due. These areas contained some valuable mineral lands with reserves of coal, oil shale, tar sands, and other minerals.

Much of the original 7.2 million acres of land turned over to the State had been sold or otherwise disposed of; however, more than 3.6 million acres remained under State ownership scattered throughout the State. To make more productive use of the lands, State officials proposed "Project Bold," which would return most of the land to the Federal Government in exchange for about 30 large manageable blocks of land presently in Federal ownership. Although the State hoped to obtain additional royalties from lands containing coal, oil shale, tar sands, and other minerals, hard-rock mining companies operating under the Mining Law of 1872 were concerned that title to mining claims on the exchanged land might be jeopardized and that proposed royalties would pose an insurmountable obstacle to mining enterprises.

A special session of the Utah Legislature in July narrowly defeated a proposed $3.35 million appropriation to breach the Southern Pacific Railroad causeway across the north arm of Great Salt Lake. The action was designed to alleviate flooding on the south shore of the lake and prevent further damage to salt and magnesium industries by equalizing the water levels of north and south areas.

The U.S. Department of Energy planned to investigate further two sites in Utah for nuclear waste disposal; Davis Canyon, 1 mile east of Canyonland National Park, San Juan County, and Lavender Canyon adjacent to Davis Canyon. Concern was expressed that drilling an exploratory shaft in the Gibson salt dome area would violate air-quality standards in the Canyonlands, and the salt stored at or transported from the site would pollute the Colorado River.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Beryllium.—Beryllium ore production increased in quantity and value in 1983. According to its 1983 annual report, Brush Wellman Inc., the principal producer of beryllium ore in the United States, obtained 458,000 pounds of beryllium from 116,000 short tons of bertrandite ore milled at Delta in 1983, compared with 359,000 pounds recovered from 91,000 tons of ore in 1982. As of December 31, 1983, the company estimated proven bertrandite ore reserves of 4,946,000 tons averaging 0.22% beryllium.

Brush Wellman trucked the bertrandite ore containing beryllium from the Topaz-Spor Mountain area in Juab County to its mill at Delta, Millard County, where the ore and imported beryl ores were processed into a beryllium hydroxide concentrate. The product was then shipped to Elmore, OH, for conversion to beryllium alloys, beryllia ceramic, and metallic beryllium. The company's mining properties contained the Nation's only known commercial deposits of bertrandite. Annual capacity of the mill in 1980 was 112,000 tons of ore. In the third quarter of 1983, a separate circuit for treat-

ing the beryl ores closed for repairs and was expected to resume operation in 1984.

Copper.—As the copper market failed to recover from the recession, copper production declined yet another year, more than 10% in quantity and 5% in value. The average copper cathode price increased from $0.728 per pound in 1982 to $0.7653 in 1983, accounting for the smaller drop in production value.

Utah's principal copper producer was Kennecott, a subsidiary of Kennecott Corp. acquired in 1981 by Standard Oil Co. of Ohio (Sohio). Sohio was 50% owned by British Petroleum Co. The Utah Copper Div. at Bingham Canyon, 25 miles southwest of Salt Lake City, included one of the world's largest open pit copper mines and a precipitate plant. Sixteen miles to the north were the company's Bonneville crushing and grinding concentrator and the Magna and Arthur flotation concentrators capable of treating 108,000 tons of ore per day; a smelter with an annual production capacity of 280,000 tons of copper anode; and a refinery with an annual capacity of 192,000 tons of copper cathode. The North Ore Shoot underground mine at Bingham was still being developed; production from this ore body was not expected before 1985 at the earliest.

The Sohio 1983 10K Annual Report to the Securities and Exchange Commission showed the Utah Copper Div. mined and processed 33,310,000 short tons of ore yielding 200,842 tons of copper, compared with 36,878,000 short tons of ore yielding 199,518 tons of copper in 1982. The average grade of ore mined was increased from 0.625% in 1982 to 0.626% in 1983. Byproduct gold, molybdenum, silver, and selenium were also recovered. Kennecott's total operating losses from all its properties dropped from $187 million in 1982 to $91 million in 1983.

A detailed engineering study of the method and timing of modernizing the Utah Copper Div. facilities was underway and was planned to be completed in 1984. Kennecott announced productivity would be improved by replacing railroad and truck haulage with a system of in-pit ore and waste-crushing facilities and conveyor haulage. Also, the Magna and Arthur concentrators would be updated or replaced with a new concentrator. As a preliminary step in the project, large haulage trucks replaced trains for in-pit ore haulage to achieve an immediate cost reduction.[3] In September, the company announced that tax relief from the Utah Legislature would be needed before the $400 million modernization program could begin.

Kennecott initiated a 5-year, $1 million study of possible ground water contamination below the Bingham Mine and evaporation ponds east of Copperton. Pollution may have occurred naturally as water percolated through the ore bodies and from leaching of overburden and waste terraces. Wells providing water for culinary and irrigation purposes in western Salt Lake County showed no signs of contamination. In U.S. Circuit Court, the company challenged existing regulations governing sulfur dioxide and particulate emissions at all its smelters. If the regulations were not modified, the Utah smelter would require substantial additional capital to meet air-quality standards.

By yearend, employment at Kennecott's headquarters office and Utah Copper Div. had fallen from 7,400 in 1981 to approximately 5,064 in 1983. The first half of 1983, about 156 salaried workers were laid off, and in September, another 120 workers were idled when the pit was converted from rail to truck haulage.

Kennecott and representatives of 13 international labor unions signed a new 3-year labor contract effective July 1. Calling for a wage freeze and benefit reductions, the agreement, however, maintained the cost-of-living allowance and added flexibility for changes in technology and work methods to improve productivity. This agreement was the first time in 30 years that a labor contract had been reached without a strike.

In January 1983, the U.S. Department of Labor certified 1,300 unemployed Utah Copper Div. workers eligible for Federal assistance. This high rate of unemployment was attributed to a sharp decline in refined copper production and sales in 1982 that were the result of depressed prices and the availability of imported copper.

Although Anaconda Minerals Co.'s Carr Fork Mine, Tooele County, remained idle in 1983, about 45 workers continued to maintain the operation and pump the underground workings. Anaconda Minerals was a subsidiary of Atlantic Richfield Co.

Other copper producers in the State included the Midvale tailings project of Sharon Steel Corp. and the Yellow Hammer Mine of American Consolidated Mining Co., Tooele County.

Table 4.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Lode mines producing	Material sold or treated (metric tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
1981, total	9	36,858,359	227,706	$104,662,786	2,882,671	$30,320,999
1982, total	6	33,764,573	174,940	65,761,695	4,342,333	34,521,547
1983:						
Box Elder	1	W	--	--	W	W
Iron	1	258,679	353	149,672	2,352,768	26,915,666
Salt Lake	1	W	W	W	W	W
Tooele	2	628,010	37,644	15,961,056	1,202	13,751
Utah	1	W	W	W	W	W
Total	6	31,152,258	238,459	101,106,616	4,566,610	52,242,019

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1981, total	211,276	$396,471,474	1,662	$1,338,141	1,576	$1,547,808	$534,341,208
1982, total	189,090	r303,483,112	W	W	--	--	W
1983:							
Box Elder	--	--	--	--	--	--	W
Iron	--	--	--	--	--	--	27,065,338
Salt Lake	W	W	--	--	--	--	W
Tooele	W	W	--	--	--	--	W
Utah	--	--	--	--	--	--	W
Total	169,751	286,403,329	--	--	--	--	439,751,964

rRevised. W Withheld to avoid disclosing company proprietary data; included in "Total."

Table 5.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Gold	2	W	W	1,202	W	--	--
Gold-silver	1	W	W	W	--	--	--
Silver	2	258,693	353	2,358,975	--	--	--
Copper	1	30,218,514	W	W	151,881	--	--
Total	6	W	W	W	151,881	--	--
Other lode material:							
Gold-silver tailings	--	W	W	W	W	--	--
Copper precipitates	1	25,828	--	--	17,809	--	--
Grand total	6	[2]31,152,258	[2]238,459	[2]4,566,610	[2]169,751	--	--

W Withheld to avoid disclosing company proprietary data.
[1]Detail may not add to total because some mines produce more than one class of material. An operation from which gold, silver, and copper were recovered from tailings is not counted as a producing mine.
[2]Includes items indicated by symbol W.

Table 6.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1983, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Cyanidation	37,996	2,353,964	--	--	--
Smelting of concentrates	198,876	2,162,283	151,881	--	--
Direct smelting of:					
Ore	W	W	W	--	--
Tailings	W	W	W	--	--
Precipitates	--	--	17,809	--	--
Total	238,459	4,566,610	169,751	--	--

W Withheld to avoid disclosing company proprietary data; included in "Total."

Gold.—Gold output increased 36% as Getty Oil's Mercur operation came on-stream, and the yield of byproduct gold increased at the Utah Copper Div.'s Bingham Canyon Mine. The 54% rise in the gold production value was partly attributed to the increase in the price of the metal from an average $375.91 per troy ounce in 1982 to $424.00 in 1983. Other gold producers, in descending order of output, included the following: the Midvale tailings project of Sharon Steel, the Escalante Mine of Ranchers, the Trixie Mine of Sunshine Mining Co., and a small amount from the Yellow Hammer Mine of American Consolidated.

On April 21, 1983, Getty Mining Co., a subsidiary of Getty Oil, poured its first doré bar at its Mercur gold mine in the Camp Floyd (Mercur) mining district, Tooele County. Located 65 miles south of Salt Lake City and 30 miles southeast of Tooele, the property consisted of 9,200 acres held under lease and mining claims in 1983. Gold was mined at Mercur from the 1890's to 1942 by underground methods.

Getty Mining owned and operated the project; Gold Standard Inc. of Salt Lake City, which had acquired 3,000 acres and negotiated the original agreement in 1973, held a 15% net-profit interest in 1983. Davy McKee Corp. was awarded the contract for engineering, procurement, and construction management in July 1981; initial stripping for the open pit mine began in March 1982, and construction of the mill in June 1982. Completed within 21 months of the contract award, the $90 million project included the mine, a 3,000-ton-per-day carbon-in-pulp gold plant, access and haulage roads, tailings-disposal dam, offices, laboratory, shops, warehouse, two water wells, and an 8-mile water supply line. Approximately 375 were employed during peak construction; after production began, the operation employed about 230 in 1983. By yearend, production was to reach 32,000 ounces of gold and thereafter to average about 80,000 ounces annually for 14 years. Getty Mining was also developing methods to test and prepare the lower grade material for heap leaching.

Reserves were an estimated 15 million tons of ore averaging 0.1 ounce of gold per ton and 3 million tons of old mill tailings averaging 0.06 ounce per ton to be processed near the end of mining. The micrometer-size gold particles were deposited in Mississippian Age carbonate host rock by hydrothermal solutions in a hot spring environment and found in the sulfide and oxide zone. The associated minerals included pyrite, marcasite, orpiment, realgar, barite, and remobilized carbon.[4]

In early January, Johnson Matthey Refining Inc., a subsidiary of Johnson Matthey Investments Inc. (holding company for Johnson Matthey & Co. Ltd. of London), completed constructing its refinery on a 20-acre site at Salt Lake City. Production of gold and silver bars began a few weeks later. The $10 million custom refinery had an initial capacity of 1 million ounces of gold and 4 million ounces of silver annually. Concentrates of doré bars of at least 25% gold or 85% silver were accepted for refining, and the final product was sold by the customer or purchased by the company for sale on the open market. About 40 people were employed at the plant.[5]

Iron Ore and Steel.—Iron ore shipments in Utah continued to drop. The 68% decline in tonnage and nearly 69% fall in value were attributed to suspension of mining in the Iron Springs mining district 10 to 20 miles west of Cedar City. The small amount of iron ore shipped in 1983 came from direct-shipping ore stockpiled at the Desert Mound Mine. The CF&I Steel Corp.'s Comstock Mine was idled in January 1981, and U.S. Steel shut down its Mountain Lion Mine and its Desert Mound Mine by mid-1982. In December 1983, U.S. Steel announced the permanent closure of both mines in Utah and the Atlantic City Mine in Wyoming, the principal iron ore suppliers for its Geneva Works near Provo. At the same time, the company permanently shut down its eastern Carbon County Columbia coal mine, which had been closed for more than 1 year, and its Geneva Works foundry that made casting for internal use.

With the shutdown of the Wyoming and Utah mines, the Geneva plant was supplied with taconite ore pellets from Minnesota. Geneva Works, the only integrated domestic steel mill operating in the West, operated at 50% capacity, primarily for the Western market. Employment by yearend had dropped to 2,700, compared with a peak of 4,500 in 1981. The shutdown of the foundry released 68 workers; the Desert Mound operation employed a maintenance crew of 12; and the Columbia coal mine dropped from 400 to a crew of 7.

Under the Trade Act of 1974, 1,250 workers laid off at the Geneva Works in 1982 were certified for up to 26 weeks of addition-

al unemployment assistance. Imported carbon steel plate, carbon steel pipes, and tubes displaced the workers making similar products at the Utah steel plant.

At the Geneva plant, the $3.5 million federally mandated water-quality program was more than 40% complete by yearend. The standards called for reducing levels of ammonia, oil, grease, and suspended particles discharged into Utah Lake. The water recycling system will be improved and new water systems installed to treat more than 200 million gallons of water daily. Existing evaporation ponds were to be lined to prevent seepage, and a new pond was to be constructed.

U.S. Steel reported that its 1983 losses in the steel industry totaled $634 million, compared with $852 million in 1982.

Nucor Steel Co., a division of Nucor Corp., continued to operate its 400,000-short-ton-per-year ministeel mill at Plymouth, Box Elder County. Steel scrap was melted in two electric arc furnaces and continuous cast into billets for feed into the rolling mill. Products manufactured included reinforcing bars, angles, rounds, channels, and flats. New equipment was being installed for the production of coiled rounds, beginning in the first quarter 1984. The 1983 Nucor annual report stated that its minimills have high productivity resulting in employment costs that are only 20% of the sales dollar and lower than employment costs of the integrated steel mills producing comparable products. Production employees at the Utah plant worked under group incentives, which provided increased earnings for high productivity. Nucor's Vulcraft Div. at Brigham City used steel products from the Plymouth operation for the manufacture of joists and girders and steel grinding balls for the mining industry. In 1983, Nucor was constructing a plant at Brigham City to produce cold finish bars; the 50,000-ton-per-year facility was to be completed in the first quarter of 1984.

Magnesium.—AMAX Magnesium Corp., a subsidiary of AMAX Inc., operated the Nation's second largest magnesium plant at Rowley, Tooele County. Magnesium was recovered from Great Salt Lake brines concentrated in 40,000 acres of solar evaporation ponds, processed into magnesium chloride, and electrolytically separated into magnesium metal and chlorine. By yearend 1983, production reached an annual rate of 32,000 short tons. According to AMAX, increased demand and lower unit costs effected an upswing in its production during the second half of 1983 and substantially reduced inventories. Several million dollars were spent in 1983 to repair and replace dikes damaged by the rising Great Salt Lake.

Molybdenum.—Utah Copper Div., the only molybdenum producer in the State, continued to ship molybdenum concentrate recovered as a byproduct of its copper production. Molybdenum output declined, and shipments dropped more than 36% in quantity and about 45% in value as the average producers' price dropped from about $4.45 in 1982 to about $3.65 in 1983.

Exploration at the Pine Grove molybdenum deposit in the central Wah Wah Mountains, western Beaver County, ceased in December 1982. The Pine Grove Associates project was a joint venture of Phelps Dodge Corp., discoverer of the deposit, and Getty Oil, manager of exploration and development; however, Getty Oil dropped its option to purchase the deposit in 1982. Under the agreement, Getty retained the right to earn 52% interest in the property by spending $45 million; $18.8 million had been paid out by yearend 1983.

Silver.—Utah's principal silver producer was Ranchers' Escalante Mine, Iron County, followed by Kennecott's Bingham Canyon Mine, Salt Lake County; Sharon Steel's Midvale tailings project, Salt Lake County; Getty Mining's Mercur Mine, Tooele County; Sunshine's Trixie Mine, Utah County; and American Consolidated's Yellow Hammer Mine, Tooele County. Silver production increased about 5% in quantity and more than 51% in value as the price of the metal rose from an average $7.95 per troy ounce in 1982 to $11.44 in 1983.

In its fiscal year ending June 30, 1983, Ranchers reported producing 2,265,923 troy ounces of silver, compared with 1,100,000 troy ounces in fiscal year 1982. Approximately 350,000 tons of ore was mined and 279,205 tons milled in fiscal year 1983. Sales of refined silver were more than 2.1 million troy ounces for an average price of $9.85 per ounce, increasing revenues by $13.5 million to $21.7 million in 1983.

Located about 42 miles west of Cedar City, the property, originally known as the Holt silver mine, was staked in 1873. Microcrystalline argentite and jalpaite were the dominant silver minerals followed by acanthite, embolite, and native silver. The hydrothermal quartz-calcite vein was deposited as crustiform banding and open space filling in a hot spring occurrence in

Tertiary Rhyolite volcanics. The vein width ranged from 5 to 47 feet and averaged 19 feet; in some places, it was more than 800 feet deep. As of May 1, 1983, proven reserves were 1.63 million tons with an average grade of 10.37 ounces per ton. In the oxide zone, the silver minerals were associated with galena and cerussite. Ores are mined using the end-slicing mining method adapted from the vertical crater retreat method initially tested at the mine. In fiscal 1983, 1,000 to 1,200 tons per day of 10-ounce-per-ton silver ore and 350 tons per day of development waste were mined; silver was produced at a cash cost of $4.69 per troy ounce, including mining, milling, power, royalties, refining, and administration. Nine wells were dewatering the mine with 250- to 1,000-horsepower pumps moving less than 23,000 gallons per minute. Originally designed for 500 tons per day, the mill could process ore at a daily average of 800 tons, with an 81.4% recovery rate.[6]

Ranchers continued to lease the mine from Escalante Silver Mines Co.; rights to the lease were purchased in 1975 and will extend to 1992 with rights for three 10-year extensions. In November 1983, Ranchers acquired the interest of Escalante Silver Mines in its Escalante Mine.

In April 1983, the HMC Mining Co. of Silver City, NM, purchased Kennecott's interest in the Trixie property, East Tintic mining district, Utah County. On May 25, 1983, Sunshine purchased from HMC all Kennecott's assets in the district, including the Trixie Mine and mineral leases covering 8,000 acres. Kennecott had used the Trixie silver-gold-copper ores as a fluxing agent for its Garfield smelter; however, the mine had been shut down since December 1982. During the latter half of 1983 when production was resumed, ore was shipped to the Garfield smelter. Sunshine's 1983 annual report stated estimated reserves at the Trixie Mine to be 64,040 tons of ore containing 503,938 ounces of silver, 6,545 ounces of gold, and 1,736,700 pounds of copper. The literature detailed geologic mapping and sampling programs used to compile data base for developing mining reserves at the Trixie Mine.[7] In late 1983, Sunshine's Apex No. 2 shaft was deepened 168 feet; the goal was to reach 300 feet and the 1,300-foot level by early 1984 to explore and develop its Burgin Mine. Indicated reserves at the Burgin Mine were estimated to be 1.7 million tons of ore containing 22.3 million ounces of silver, 281,000 tons of lead, and 119,000 tons of zinc. In October, Sunshine acquired an option to lease underground mining rights to 2,013 acres comprising Chief Consolidated Mining Co.'s Homansville Fault property in the East Tintic District.

Vanadium.—Vanadium recovered from uranium-vanadium ores mined on the Colorado Plateau was shipped to Atlas Corp.'s mill near Moab, Grand County, and, in the month of January, to the Energy Fuels Nuclear Inc. mill at Blanding. Utah ranked second of three States producing vanadium in the Nation; however, 1983 production continued to decline, plunging 45% in tonnage and nearly 50% in value because of depressed vanadium prices. Output came from the milling companies' own properties and from independent operators in Emery, Garfield, Grand, and San Juan Counties.

The Atlas Minerals Div. of Atlas Corp. had mines in the Big Indian District, Green River District, San Juan Canyon, Uravan Mineral Belt, Red Canyon, and White Canyon areas of Utah and Colorado, and a uranium-vanadium processing mill approximately 4 miles from Moab. The mill was supplied with ores from the company's Pandora, Velvet, and Rim Columbus Mines in San Juan County; the Snow and Probe Mines in Emery County were on standby. According to the company, in its fiscal year ending June 30, 1983, Atlas Minerals Div. sold 1,386,000 pounds of U_3O_8 in concentrate and 1,407,000 pounds of vanadium pentoxide; however, no uranium was sold after March 1983 and no vanadium after October 1982. The corporation reported a net income of $19.4 million in 1983, compared with $27.1 million in 1982.

In December, Atlas Minerals Div. was studying the feasibility of developing the Edward R. Farley, Jr. uranium deposit 10 miles north of Ticaboo, Garfield County. Exploration had been underway since the Bullfrog claims were acquired from Exxon Corp. in 1982. If the feasibility study proved out and mining permits granted, mine construction could begin in late 1984. The claims were contiguous to those of Plateau Resources Ltd., where Plateau was developing its uranium mine at Ticaboo and testing its 750-short-ton-per-day mill.

Energy Fuels idled its White Mesa uranium-vanadium mill at Blanding, and laid off more than 100 employees in January 1983 because of low product demand. The $40 million mill was brought under joint ownership with Union Carbide Corp.

in February and remained closed the rest of the year.

The Hecla Mining Co. and Union Carbide uranium-vanadium mine near Moab remained on standby, pending uranium price recovery.

Rio Algom, a unit of Rio Algom Ltd., reopened the MiVida underground uranium-vanadium mine, San Juan County, which had been leased from Minerals West Inc. of Monticello. Ore was trucked 15 miles to the Rio Algom Lisbon mill near La Sal, where only uranium was extracted because the mill lacked a vanadium recovery circuit.

Disposal of tailings from the Old Vitro uranium-vanadium plant in Salt Lake County remained the center of vigorous controversy. The cost of preventing dispersal of radioactive particles in the air and water in the valley during tailings removal was the principal concern. In October, the U.S. Department of Energy agreed to move the tailings to Tooele County instead of stabilizing them at its South Salt Lake location as originally proposed.

Zirconium.—Western Zirconium Inc. continued to produce zirconium and zirconium alloys from imported Australian sands. A small amount of titanium was also recovered.

Western Electric Corp. of Pittsburgh, PA, and Mitsubishi Metal Corp. of Tokyo, Japan, abandoned plans to produce titanium sponge at the Western Zirconium plant near Ogden; weakened markets contributed to the companies' decision.

NONMETALS

Asphalt (Native) and Other Bitumens.—Gilsonite production increased about 11% in quantity and 15% in value. The principal producer, American Gilsonite Co., a subsidiary of Standard Oil Co. of California, mined hydrocarbon material from veins near Bonanza, Uintah County, where the company owned 5,000 acres of land and leased 20,000 acres from the State and Federal Governments. Located about 45 miles southeast of Vernal, the operation comprised 11 mines, offices, a processing plant, and 5 concrete silos with a combined storage capacity of 7,500 short tons. Ores mined on a 45° angle were airlifted to the surface through a 14-inch-diameter pipe. According to the company, gilsonite sales ranged from 60,000 to 100,000 tons per year, and depending on the grade, the product was marketed at $150 to $375 per ton for automobile body sealer and radiator paint, inks, oil well-drilling fluids, cement for sand molds in the foundry industry, and many other uses.[8]

Cement.—Portland cement producers, listed in descending order of 1983 output, included the Ideal Basic Industries Inc. 350,000-short-ton-per-year capacity wet-process plant at Devils Slide, Morgan County; the Martin Marietta Corp. 650,000-ton-per-year dry-process plant at Leamington, Millard County; and the Lone Star Industries Inc. 420,000-ton-per-year wet-process plant at Salt Lake City. At midyear, the Martin Marietta plant was for sale. Finished portland cement output increased 30%; sales increased more than 40% in quantity and nearly 20% in value. The increase was attributed to construction of the Intermountain Power Project near Lynndyl, Millard County; to a gain in interstate and State highway work; and to office and hotel buildings being erected in downtown Salt Lake City. Masonry cement declined in production and the quantity and value of sales. Principal materials consumed in making cement were limestone, cement rock, sandstone, gypsum, shale, iron ore, and clays. Natural gas was the chief energy source for the plants, followed by bituminous coal and a small amount of fuel oil. Pollution-control equipment at the plants included baghouses and electrical precipitators.

Clays.—The principal common clay and shale producer was Utelite Corp., Summit County, followed by Interpace Corp., Utah County; Interstate Brick Co. at its Five-Mile pit, Tooele County, and Jim Gay pit, Utah County; Martin Marietta at its Hank Allen pit, Juab County; and Redmond Clay and Salt Co. at its Sanpete County pit. Western Clay Co. mined swelling bentonite at its Redmond pit and fuller's earth at its Aurora pit, both in Sevier County. R. D. Wadley Clay Co. mined fire clay at its Wadley pit, Utah County. The common clays were used mainly for face brick and for concrete block, followed by portland cement, structural concrete, terra cotta, floor and wall ceramics, adhesives, and animal feed. Swelling bentonite was used for animal feed, drilling mud, and waterproof sealant. Fire clay was used for foundry purposes and fuller's earth for mineral oil preparation.

Clay and shale increased in quantity and value; the average unit value increased from $5.71 in 1982 to $7.14 in 1983.

Graphite.—Synthetic graphite production increased 62% and its value rose 35%. Because of its light weight, stiffness, and good coefficient of thermal expansion, the

commodity was used for aerospace equipment, golf club shafts, and tennis rackets. Hercules Inc., Aerospace Div., at its Bacchus Works, principal producer of the commodity, employed about 3,000 workers.

Gypsum.—Georgia-Pacific Corp. and United States Gypsum Co. continued producing crude and calcined gypsum at Sigurd, Sevier County. Wallboard was the principal product shipped from the Sigurd plants. Crude gypsum was also mined by Cox Enterprises Inc. near Levan, Sanpete County; Thomas J. Peck & Sons Inc. near Nephi, Juab County; and White Mountain Gypsum Co. near Fillmore, Millard County.

Lime.—Leading quicklime producers included Continental Lime Co., a subsidiary of Steel Bros. Canada Ltd., Millard County; Utah Marblehead Lime Co., a subsidiary of General Dynamics Corp., Tooele County; Utah Copper Div. of Kennecott, Salt Lake County; and Genstar Lime Co., a subsidiary of Genstar Corp., Toronto, Canada, Tooele County. Lime production increased as the construction industry picked up. Utah Marblehead, 35 miles northwest of Grantsville, with a 230,000-ton-annual-capacity plant, produced a dead-burned dolomite chiefly for refractory use in the steel industry in California and Utah. About 60% of its production was shipped to the Kaiser Steel Corp. steel plant at Fontana, CA, and with the shutdown of the Kaiser plant in October 1983, 14 of 27 employees at the Utah Marblehead lime plant were laid off.

Magnesium Compounds.—Great Salt Lake Minerals & Chemicals Corp., a division of Gulf Resources & Chemicals Corp., with an annual capacity of 100,000 short tons of magnesium oxide equivalent, obtained magnesium chloride and other products from the brines of Great Salt Lake west of Ogden, Weber County. Kaiser Aluminum & Chemical Corp., with an annual capacity of 50,000 tons of MgO equivalent, recovered magnesium compounds from the brines of Great Salt Lake at its Bonneville plant near Wendover, Tooele County. Magnesium compounds sales were essentially the same in volume as those of 1982; however, their value declined slightly.

Perlite.—Holly Corp. mined perlite in Millard County. Perlite was expanded at the Georgia-Pacific plant in Sigurd, Sevier County, and was brought in from out of State for expanding at the Pax Co. plant in Salt Lake County. The expanded perlite was used in horticulture, plaster aggregate, and other uses. Production of the treated product increased 19% in quantity and about 7% in value.

Phosphate Rock.—Chevron Resources Co. mined phosphate rock from the Upper Permian Age Park City Formation 12 miles north of Vernal, Uintah County. Expansion of the Vernal Mine remained in abeyance; however, a contract was awarded to construct a 98.2-mile-long slurry pipeline from the open pit mine at Vernal to a proposed $350 million, 1,200-short-ton-per-day fertilizer plant at Rock Springs, WY. At the Vernal Mine, phosphate rock reserves were estimated to be 700 million short tons of ore; Chevron reported spending $150 million in acquiring reserves and conducting preliminary activities before beginning construction. Construction startup was deferred to 1985.[9]

The U.S. Bureau of Mines published summarized data on the Flaming Gorge; Western Uinta Range; Crawford Mountain; North, Central, and Southern Wasatch Range; and Vernal Mine and Vernal Field phosphate deposits. Locations, published reserve and resource information, geology, mineralogy, mine and mill data, transportation of product, and bibliography of sites were included in the directory.[10]

Potash.—Production of all potassium salts in the State decreased 20%. Total sales of the products declined 22% in volume and 29% in value. Stocks dropped about 17% by the end of the reporting period. The three companies recovering potash in the State were Great Salt Lake Minerals, Kaiser Aluminum & Chemical, and Texasgulf Inc. Great Salt Lake Minerals used solar evaporation and selective crystallization processes to recover potassium sulfate and byproduct salt, sodium sulfate, and magnesium chloride from the concentrated brines of Great Salt Lake. Brines were pumped from the north arm of the lake to 19,500 acres of solar evaporation ponds on Bear Lake Bay west of Ogden at Little Mountain, Weber County. Plans for expanding the company's evaporation ponds were suspended because of heavy precipitation resulting in the Great Salt Lake flooding its shores; instead, over $1.5 million was spent to raise and strengthen existing dikes.

The Kaiser solar evaporation installation near Wendover, covering 87,816 acres, collected natural brines in 140 miles of ditches on the Bonneville Salt Flats of the Great Salt Lake deserts. The brines were concentrated in a primary 8,000-acre evaporation pond. Potassium salts were harvested and

processed through a flotation concentrator to separate the halite (sodium chloride) and sylvite (potassium chloride). In September, the mill was temporarily closed because of severe flooding by Great Salt Lake; customers were supplied from stockpiled material. Potash was sold for fertilizers, and magnesium chloride was sold for dust suppression and for producing sugar from sugar beets.[11]

Texasgulf, a subsidiary of Société Nationale Elf Aquitaine (a 67% French Government-controlled oil company), recovered potassium salts at its Cane Creek operation near Moab, Grand County. Pennsylvanian Age evaporites were solution mined at a depth of 2,789 feet; the brines were then evaporated on solar ponds and the salts harvested and processed by flotation to recover potash and byproduct salt.

Salt.—Solar salt producers included American Salt Co. and Great Salt Lake Minerals, Weber County; Lake Crystal Salt Co., Box Elder County; Lakepoint Salt Co., a division of Domtar Industries Inc., Tooele County; Morton Salt Co., a division of Morton-Thiokol Inc., Salt Lake County; and Texasgulf, Grand County. Redmond Clay and Salt, Sevier County, mined rock salt near Redmond. Moab Brine Co. (La Sal Oil Co.) recovered salt from brine in Grand County. Production and sales declined when heavy precipitation diluted the solar-evaporation pond brines. In December, deep snows resulted in an unusual demand for deicing Salt Lake City streets, depleting county stockpiles of salt.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

A rise in construction in the State generated nearly a one-third increase in the output and value of construction sand and gravel. In urban and nearby rural areas, sand and gravel operators were faced with typical environmental and zoning problems. The State Air Quality Bureau ordered two north Davis County operators, Ideal Rock Products Co. and Parsons Ready Mix, to bring their properties into compliance with air-quality standards or face closure. Blowing sand was the principal complaint. Hanglider associations protested that gravel pits at the Point of the Mountain presented a hazard to pilots because the mounds that had been left disturbed air currents unique to the area. The Utah County Planning Commission recommended a zoning change that would prohibit Gibbons & Reed Co. from mining gravel at the mouth of American Fork Canyon.

Industrial.—Salt Lake Valley Sand & Gravel Co. continued producing industrial sand in Utah County for use in engine traction and sandblasting.

Table 7.—Utah: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	2,029	$3,970	$1.96	NA	NA	NA
Gravel	4,445	9,152	2.06	NA	NA	NA
Sand and gravel (unprocessed)	1,105	1,798	1.63	NA	NA	NA
Total or average	7,579	14,920	1.97	e9,800	e$19,800	e$2.02
Industrial sand	W	W	13.50	24	W	W
Grand total or average	W	W	W	e9,824	W	W

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

Sodium Sulfate.—Great Salt Lake Minerals continued to recover sodium sulfate from the brines of Great Salt Lake at its operation west of Ogden. Production increased in 1983. Of the three States producing the product (California, Texas, and Utah), Utah ranked third. Sodium sulfate was used in the ceramic, detergent, glass, and paper industries.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before

yearend.

The quantity and value of crushed stone production increased dramatically as residential and industrial construction improved and as the State rushed to recover from heavy precipitation, spring flooding, and the rising Great Salt Lake. Crushed rock was used to repair flood-damaged roads and dams, to raise and strengthen dikes protecting industries on the shores of Great Salt Lake, and to raise and stabilize the rail lines across the causeway spanning the north arm of the lake and skirting the southern shore.

Listed in descending order of output, the following companies quarried limestone: Southern Pacific Transportation Co., Box Elder County, for riprap and jetty stone; Martin Marietta Mountain Div., Juab County, for cement; Continental Lime, Millard County, for lime manufacture; Ideal Basic Industries, Morgan County, for cement; Lone Star Industries, Salt Lake County, for cement; U.S. Steel, Utah County, for its steel operation; LeGrand Johnson Corp., Cache County; Gibbons & Reed's Concrete Products Co., Tooele County; and Cedarstrom Calcite, Utah County, for poultry grit. Utah Marblehead quarried dolomitic limestone in Tooele County for dead-burned dolomite and a refractory stone for metallurgical purposes. Genstar Lime, Tooele County, also quarried dolomite in Tooele County. Sandstone was quarried by Ideal Basic Industries and Martin Marietta for cement manufacture and by the Cache County Road Department and Utah State Highway Department, Washington County, for dense road base and some unpaved road surfaces. Volcanic rock was quarried by Diversified Marketing Services, Millard County, for lightweight aggregate, and by Lava Products Inc. for unpaved road surfaces for terrazzo and exposed stone. The U.S. Bureau of Reclamation quarries slate for bituminous aggregate, dense road base, and unpaved road surfaces.

Companies and local, State, and Federal Government agencies quarried 4,050,360 tons of limestone and dolomite valued at $13,528,730; 243,071 tons of sandstone and quartzite valued at $717,938; 27,030 tons of slate valued at $54,060; 86,394 tons of volcanic stone valued at $333,404; and 195 tons of other stone valued at $1,560. The average unit value of crushed stone quarried was $3.32 per ton. Crushed stone was produced at 42 quarries in 20 counties; the leading county was Box Elder, followed by Millard, Morgan, Tooele, Salt Lake, and Cache Counties.

Table 8.—Utah: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	22	82
Other coarse aggregate	116	118
Coarse aggregate, graded: Bituminous aggregate, coarse	17	33
Coarse and fine aggregate:		
Graded road base or subbase	96	351
Unpaved road surfacing	114	192
Terrazzo and exposed aggregate	W	256
Other coarse and fine aggregate	4	4
Chemical and metallurgical:		
Cement manufacture	1,456	5,806
Lime manufacture	W	2,885
Special:		
Lightweight aggregate	W	5
Other[2]	2,582	4,906
Total	4,407	[3]14,636

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."

[1]Includes limestone, dolomite, sandstone, quartzite, volcanic cinder and scoria, and miscellaneous stone.

[2]Includes poultry grit and mineral food, dead-burned dolomite, uses not specified, and uses indicated by symbol W.

[3]Data do not add to total shown because of independent rounding.

Sulfur (Recovered).—Chevron Oil Co. recovered sulfur from its refinery in Davis County.

Sulfuric Acid.—Nationally, Utah ranked second in output of sulfuric acid. Recovered as a byproduct of copper production, the commodity declined in quantity and value.

Vermiculite.—Although no crude vermiculite was mined in Utah, Vermiculite Intermountain Inc. brought in the material for expansion at its Salt Lake City plant. Output and value of exfoliated vermiculite increased; the product was used chiefly for block and loose-fill insulation, fireproofing, and in roofing, concrete, and plaster aggregates.

[1]State Liaison Officer, Bureau of Mines, Denver, CO.
[2]University of Utah, Graduate School of Business. Utah Construction Report. V. 26, No. 4, 1983, p. 2.
[3]Wunder, R. D. Bingham Canyon Becomes More Productive. Min. World, v. 36, No. 9, 1983, pp. 32-34.
[4]Burger, J. R. (ed.). Mercur Is Getty's First Gold Mine. Eng. and Min. J., v. 184, No. 10, Oct. 1983, pp. 48-51.
Keuhey, K. Y. and W. E. Coughlin. Getty Mining Co.'s Approach To Heap Leaching at the Mercur Mine. Pres. at SME-AIME Fall Meeting, Salt Lake City, UT, Oct. 19-21, 1983. Soc. Min. Eng. AIME preprint 83-419, 1983, 7 pp.
Larimer, C. Getty Gears up Mercur. Intermountain Pay Dirt, No. 47, Aug. 1983, pp. 8B-10B.
Skillings, D. N. Getty Mining Co. Starting Up Its Mercur Gold Operation in Utah. Skillings' Min. Rev., v. 72, No. 17, Apr. 23, 1983, pp. 4-9.
Turk, T. V. and S. A. Sass. Engineering Design of the Mercur Gold Project Ore Processing Facility. Pres. at SME-AIME Fall Meeting, Salt Lake City, UT, Oct. 19-21, 1983. Soc. Min. Eng. AIME preprint 83-328, 1983, 6 pp.
[5]Intermountain Pay Dirt. Johnson Matthey's Gold, Silver Refinery Fully Operational. No. 43, Mar. 1983, p. 27A.
[6]Burger, J. R. (ed.). Ranchers End-Slices Escalante Silver Deposit. Eng. and Min. J., v. 185, No. 1, Jan. 1984, pp. 48-53.
Ranchers Exploration and Development Corp. Annual Report for the year ending June 30, 1983, p. 8.
[7]Faddies, T. B., R. E. Lippoth, and G. M. Mellor. Application of Detailed Geology to Production, Planning, and Ore Search: Trixie Mine, East Tintic District, Utah. Pres. at SME-AIME Fall Meeting, Salt Lake City, UT, Oct. 19-21, 1983. Soc. Min. Eng. AIME preprint 83-412, 1983, 9 pp.
[8]Sushan, L. Bonanza; The Only Place on Earth Where Everybody Knows What Gilsonite Is. The Standard Oiler, Sept.-Oct. 1983, pp. 1-5.
[9]Engineering and Mining Journal. Chevron's Phosphate Project Passes Environmental Tests. V. 184, No. 9, Sept. 1983, p. 25.
[10]Spangenberg, D. R., E. F. Carey, and P. M. Takosky. Minerals Availability Commodity Directory on Phosphate. BuMines IC 8926, 1983, pp. 327-366.
[11]Industrial Minerals (London). Salt Lake Closure. No. 193, Oct. 1983, p. 15.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt:			
American Gilsonite Co., a subsidiary of Standard Oil Co. of California.	Suite 1150, Kennecott Bldg. Salt Lake City, UT 84133	Underground mines and plant	Uintah.
Hydrocarbon Mining Inc., a subsidiary of Western Strategic Minerals Inc.	North 9507 Division St. Suite A Spokane, WA 99218	do	Do.
Ziegler Chemical & Mineral Corp.	Star Route Vernal, UT 84078	do	Do.
Beryllium:			
Brush Wellman Inc	67 West 2950 South Salt Lake City, UT 84115	Open pit mines and plant	Juab and Millard.
Cement:			
Ideal Basic Industries Inc., Cement Div.[1]	Star Route Morgan, UT 84050	Quarries and plant	Morgan.
Martin Marietta Cement, Mountain Div., a subsidiary of Martin Marietta Corp.[1 2]	4885 South 900 East Salt Lake City, UT 84117	do	Millard.
Portland Cement Co. of Utah, a division of Lone Star Industries Inc.[1]	615 West 800 South Box 1469 Salt Lake City, UT 84110	do	Salt Lake.
Clays:			
Interpace Corp., Structural Div.	736 West Harrisville Rd. Box 447 Ogden, UT 84402	Open pit mines and plant	Utah.
Interstate Brick Co., a subsidiary of Mountain Fuel Co.	9780 South 5200 West West Jordan, UT 84084	do	Tooele and Utah.
Utelite Corp	Box 387 Coalville, UT 84017	Open pit mine and plant	Summit.
Western Clay Co.[1]	Box 1067 Aurora, UT 84620	Open pit mines	Sevier.
Copper:			
Kennecott, a subsidiary of Kennecott Corp., Utah Copper Div.[3]	1129 East 3900 South Box 6500 Salt Lake City, UT 84106	Open pit mine, mills, smelter, refinery.	Salt Lake and Utah.
Gold:			
Getty Mining Co., a subsidiary of Getty Oil Co.	Box 838 Tooele, UT 84074	Open pit mine, mill, carbon-in-pulp plant.	Tooele.
Gypsum:			
Georgia-Pacific Corp	Box 80 Sigurd, UT 84657	Open pit mine and plant	Sevier.
United States Gypsum Co	Box 120 Sigurd, UT 84657	do	Do.
Iron and steel:			
United States Steel Corp.[1]	Geneva Works Box 510 Provo, UT 84603	Steel plant	Iron.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lime:			
Continental Lime Co., a subsidiary of Steel Bros. Canada Ltd.[1]	268 West 400 South Suite 201 Salt Lake City, UT 84101	Quarry and plant	Millard.
Genstar Lime Co., a subsidiary of Genstar Corp.[1]	Box 357 Grantsville, UT 84029	Open pit mine and plant	Tooele.
Utah Marblehead Lime Co., a subsidiary of General Dynamics Corp.[1]	Box 596 Grantsville, UT 84029	do	Do.
Magnesium:			
AMAX Magnesium Corp., a subsidiary of AMAX Inc.	238 North 2200 West Salt Lake City, UT 84116	Solar evaporation plant	Do.
Phosphate rock:			
Chevron Resources Co., a division of Chevron Industries Inc., a subsidiary of Standard Oil Co. of California.	Manila Star Route Vernal, UT 84078	Open pit mine and plant	Uintah.
Potassium salts:			
Great Salt Lake Minerals & Chemicals Corp., a division of Gulf Resources & Chemicals Corp.[4]	765 North 10500 West Little Mountain Box 1190 Ogden, UT 84402	Solar evaporation, concentrator, plant.	Weber.
Kaiser Aluminum & Chemical Corp., Bonneville Ltd. Div.[5]	Box 580 Wendover, UT 84083	do	Tooele.
Texasgulf Inc., a subsidiary of Société Nationale Elf Aquitaine.[6]	Box 1208 Moab, UT 84532	Solution mine, solar evaporation, concentrator, plant.	Grand.
Salt:			
American Salt Co	Box 477 Grantsville, UT 84029	Plant	Tooele.
Morton Salt Co., a division of Morton-Thiokol Inc.	A.M.F. Box 22054 Salt Lake City, UT 84122	do	Salt Lake.
Sand and gravel:			
Construction:			
Concrete Products Co., a division of Gibbons & Reed Co.	41 West Central Ave. Box 7356 Murray, UT 84107	Pits and plant	Davis, Salt Lake, Summit, Wasatch.
Ideal Rock Products Co. of Savage Western Industries.	2635 East South Weber Dr. Ogden, UT 84403	Pits and plants	Box Elder, Davis, Salt Lake.
Monroc Inc	1730 North Beck St. Box 537 Salt Lake City, UT 84110	Pits and plant	Salt Lake.
Pioneer Sand and Gravel Co.	Box 18457 Kearns, UT 84118	do	Do.
Industrial:			
Salt Lake Valley Sand & Gravel Co.	800 North 1550 West Orem, UT 84057	Pit	Do.
Silver:			
Ranchers Exploration and Development Corp.	Box 308 Enterprise, UT 84725	Underground mine, mill, plant	Iron.
Stone:			
Southern Pacific Transportation Co.	One Market Plaza San Francisco, CA 94105	do	Box Elder.
Star Stone Inc	Box 218 Oakley, ID 83346	do	Do.
Vanadium:			
Atlas Minerals Div. of Atlas Corp.	Box 1207 Moab, UT 84532	Underground mines and plant	Emery, Grand, San Juan.
Energy Fuels Nuclear Inc	Box 787 Blanding, UT 84511	Underground mines, ore-buying station, mill.	Emery, Garfield, San Juan.
Union Carbide Corp., Metals Div.	Box 1029 Grand Junction, CO 81501	Underground mines	Grand and San Juan.

[1]Also stone.
[2]Also clays.
[3]Also gold, lime, molybdenum, rhenium, selenium, silver, and stone.
[4]Also magnesium compounds, salt, and sodium sulfate.
[5]Also magnesium compounds.
[6]Also salt.

The Mineral Industry of Vermont

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Office of the State Geologist, Agency of Environmental Conservation, for collecting information on all nonfuel minerals.

By L. J. Prosser, Jr.,[1] and Charles A. Ratté[2]

The value of nonfuel mineral production in Vermont was $42.1 million in 1983, a decline of $8 million compared with that of 1982. Output of asbestos and crushed stone increased while that of construction sand and gravel, dimension stone, and talc decreased compared with 1982 totals. The sharpest decline was reported for dimension stone in which output dropped 84,000 tons and value, $9.5 million.

Developments in 1983 affecting the State's mineral industry included a 3-month strike by workers at Vermont Asbestos Group Inc. (VAG), that continued at year-end; permanent closure of Eastern Magnesia Talc Co.'s underground talc mine and mill; announcement by Thompson-Weyman Co. of development plans for a $30 million marble mine and plant; and a change in ownership of the State's leading dimension granite producer, Rock of Ages Corp.

Table 1.—Nonfuel mineral production in Vermont[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel (construction) thousand short tons	3,218	$6,854	e3,000	e$6,200
Stone:				
Crushed do.	e1,200	e5,300	1,339	5,579
Dimension do.	e202	e29,446	118	19,995
Combined value of other nonmetals	XX	8,550	XX	10,355
Total	XX	50,150	XX	42,129

eEstimated. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Vermont, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Addison	W	$473	Sand and gravel (construction).
Bennington	$137	1,749	Do.
Caledonia	(2)	233	Do.
Chittenden	W	1,599	Do.
Essex	(2)	W	Do.
Franklin	W	215	Do.
Lamoille	W	W	Talc.
Orange	1,182	246	Sand and gravel (construction).
Orleans	43	703	Do.
Rutland	17,666	620	Do.
Washington	W	295	Do.
Windham	W	W	Talc.
Windsor	W	W	Talc, sand and gravel (construction).
Undistributed[3]	27,790	9,271	
Sand and gravel (construction)	e7,254	XX	
Stone:			
Crushed	XX	e5,300	
Dimension	XX	e29,446	
Total	[4]54,073	50,150	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Grande Isle County is not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Vermont business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	266.6	264.2	-0.9
Unemployment	do	23.0	19.0	-17.4
Employment (nonagricultural):				
Mining	do	.5	.4	-20.0
Manufacturing	do	46.2	47.2	+2.2
Contract construction	do	7.8	9.0	+15.4
Transportation and public utilities	do	8.5	8.7	+2.4
Wholesale and retail trade	do	41.8	43.1	+3.1
Finance, insurance, real estate	do	8.5	8.9	+4.7
Services	do	50.4	50.9	+1.0
Government	do	37.4	35.4	-5.4
Total nonagricultural employment	do	201.1	203.6	+1.2
Personal income:				
Total	millions	$4,909	$5,272	+7.4
Per capita		$9,478	$10,036	+5.9
Construction activity:				
Number of private and public residential units authorized		2,210	4,298	+94.5
Value of nonresidential construction	millions	$131.5	$79.0	-39.9
Value of State road contract awards	do	$41.0	$30.5	-25.6
Shipments of portland and masonry cement to and within the State	thousand short tons	114	137	+20.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$50.2	$42.1	-16.1
Value per capita, resident population		$97	$80	-17.5
Value per square mile		$5,219	$4,382	-16.0

pPreliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Trends and Developments.—Nationally, Vermont ranked second in production of asbestos and talc and third in dimension stone. In 1983, dimension stone output dropped 41% in Vermont and 11% in the United States. The State's share of domestic

production decreased from 15% to 10%. Despite a 3-month strike, asbestos production increased, and Vermont's portion of U.S. output was 4% higher in 1983 compared with that of 1982. Although one of the State's leading talc producers closed, Vermont's share of the Nation's talc production remained about the same in 1983 compared with that of 1982.

Legislation and Government Programs.—During the year, the Office of the State Geologist, Agency of Environmental Conservation, continued cooperative programs with the U.S. Bureau of Mines and U.S. Geological Survey (USGS). In 1983, the Vermont-USGS cooperative topographic mapping program completed two 7-1/2- by 15-minute (1:25,000 metric scale) topographic maps of the St. Johnsbury, VT, and Lancaster, NH-VT, Quadrangles.

Research continued on a U.S. Bureau of Mines sponsored waste slate-waste marble project. Manville Service Corp. of Denver, CO, began testing the economic feasibility of using products produced during the initial phase of the study (alkali-resistant glass fibers, lightweight concrete aggregate, and ceramic bricks and tiles) under competitive industrial conditions.

Field studies for a State-sponsored program of geologic and mineral resource assessment of State-owned lands were completed for the Okemo State Forest in Ludlow-Mount Holly. Other State projects included completion of ground radiometric surveys in the towns of Highgate, Milton, and Starksboro; initial work on a new bedrock and surficial geologic map in the Northfield 7-1/2-minute Quadrangle; and development of a program to locate and map existing and potential mineral resources for protection under Vermont's Land Use and Development Law. Four new publications are available from the Vermont Department of Libraries, 111 State Street, Montpelier, VT 05602. These are "1982 Supplement to the Bibliography of Vermont Geology"; "Bedrock Geology of the Milton Quadrangle," Special Bulletin No. 3; "Geology of the Starksboro Area," Special Bulletin No. 4; and "Simplified Lithotectonic Synthesis of the Pre-Silurian Rocks of Western New England," Special Bulletin No. 5.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Asbestos.—Both shipments and value of asbestos production increased nearly 29% in 1983 compared with 1982 totals. VAG's Lowell Mine in Orleans County was one of three operating asbestos mines in the United States; the other two are in California.

In October, workers at VAG went on strike when the labor contract expired and negotiations failed. The strike continued through the remainder of the year, and because of the annual winter shutdown, contract negotiations were not expected to resume until spring. During the first 2 months of the strike, VAG shipped asbestos from stockpile.

Also during the year, a multimillion dollar foreclosure suit filed by the Franklin-Lamoille Bank was dismissed when VAG reached a debt payment agreement with the bank. The foreclosure suit had stalled efforts of securing matching financial assistance for a $300,000 Federal grant for upgrading machinery at the mine.

The Economic Development Council of Northern Vermont provided assistance to VAG in receiving certification that the mine was subjected to unfair foreign competition. That certification from the Trade Adjustment Center of the U.S. Department of Commerce made VAG eligible to receive grants for technical assistance and engineering work.[3]

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Output of construction sand and gravel declined from 3.2 million tons in 1982 to 3.0 million tons in 1983. In the past 10 years, the State's sand and gravel industry averaged an annual production of about 2.9 million tons. Quantity and value data for the past decade are shown in the following tabulation:

Year	Quantity (thousand short tons)	Value (thousands)	Value per ton
1974	2,394	$3,588	$1.50
1975	2,356	3,693	1.57
1976	2,379	3,758	1.58
1977	3,405	5,837	1.71
1978	3,726	6,425	1.72
1979	3,660	6,240	1.70
1980	1,900	4,171	2.20
1981[e]	3,196	7,254	2.27
1982	3,218	6,854	2.13
1983[e]	3,000	6,200	2.07
Average	2,923	5,402	1.85

[e]Estimated.

Since 1980, the leading counties in sand and gravel production have been Addison, Bennington, and Chittenden. Road base and coverings and concrete aggregate remained the primary uses of sand and gravel mined in Vermont.

Table 4.—Vermont: Sand and gravel sold or used by producers

	1982			1983[e]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	743	$1,615	$2.17	NA	NA	NA
Gravel	1,637	4,165	2.54	NA	NA	NA
Sand and gravel (unprocessed)	838	1,074	1.28	NA	NA	NA
Total or average	3,218	6,854	2.13	3,000	$6,200	$2.07

[e]Estimated. NA Not available.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—The State's crushed stone industry produced a total of 1.3 million tons of limestone, granite, and marble; an increase of about 140,000 tons compared with that of 1982. Limestone was mined at six quarries in four counties in western Vermont and accounted for about three-fourths of the State's total output. Uses for the limestone included concrete aggregate, dense-graded road base, filter stone, and filler.

Granite was quarried by one company in Washington County. Marble was produced at two quarries; one in Orleans County, the other in Rutland County.

In September, Thompson-Weyman, Cartersville, GA, announced plans for development of a $30 million marble mine and plant at Brandon, Rutland County. The company estimates mining about 120,000 tons of marble annually for use as a filler in paper products, plastics, and paint. Thompson-Weyman also owns a 50% interest in White Pigment Corp. in Florence, which produces a similar product.

Late in the year, Shelburne Limestone Corp. applied to the local zoning board for an amendment that would permit quarry operations on agricultural lands. The amendment would allow the company to renew mining operations at the Fonda Junction Quarry affecting about 10 acres of the 120 acres owned by Shelburne at the Franklin County site. About 20,000 tons of limestone would be quarried per year if the amendment is approved.

Dimension.—Vermont produced about 118,000 tons (1.2 million cubic feet) of dimension stone, ranking third in output. Granite was produced at 5 quarries in Washington and Windsor Counties; marble at 1 quarry in Rutland County; and slate at 14 quarries in Bennington and Rutland Counties.

Nortek Inc., a Rhode Island-based conglomerate, signed a letter of intent to sell Rock of Ages, the largest producer of dimension granite in Vermont, to a group led by the chairman and president of the John

Swenson Granite Co. Inc. of Concord, NH. The sale was expected to be complete early in 1984. Rock of Ages' Wetmore and Morse Quarries and Adams and Pirie Quarries, all in Washington County, were the 3d and 10th, respectively, leading dimension stone operations in the United States in total sales value in 1983.

Vermont Marble Co. resumed mining black marble at the Goodsell Quarry along the southern shore of Isle La Motte. The company expected to quarry about 15,000 cubic feet of the marble during the next 2 years. After quarrying, the marble is shipped to Vermont Marble's finishing plant in Proctor; end products include floor and wall tiles, fireplace hearths, mantles, and desk tops.

Table 5.—Vermont: Dimension stone[1] sold or used by producers in 1983, by use

Use	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Rough blocks for building construction	8,709	87	$675
Monumental	81,214	821	12,395
Dressed stone:			
Flagging	9,845	108	748
Roofing slate	1,278	14	682
Flooring slate	9,885	109	2,638
Other[2]	7,408	74	2,856
Total	118,339	1,213	[3]19,995

[1]Includes granite, marble, and slate.
[2]Includes ashlars, partially squared pieces, monumental, structural and sanitary, and uses not specified.
[3]Data do not add to total shown because of independent rounding.

Talc.—Vermont ranked second nationally in talc production in 1983. Output decreased slightly compared with that of 1982. During the year, developments in Vermont's talc-soapstone industry included the possibility of two mine openings and the closing of one operation.

Cyprus Mines Corp., a subsidiary of Standard Oil Co. (Indiana), continued an exploratory drilling program for talc in Chester, Windsor County. A 100-ton bulk sample was shipped to the company's Alpine, AL, pilot plant for testing. A decision on developing the deposit was expected in 1984.

Newfane Soapstone Associates announced plans to reopen a soapstone quarry in Windham County that had been abandoned for more than 100 years. The company planned to mine about 400,000 tons of soapstone over a 20-year period.

In November, Eastern Magnesia Talc Co. closed its underground talc mine in Johnson, Lamoille County. Engelhard Corp. of New Jersey, the parent firm of Eastern Magnesia, cited pricing pressure and declining profits as reasons for the unexpected shutdown.[4] The mine was permanently sealed and the mill was for sale at yearend.

Vermont Talc Co., a division of OMYA Inc., announced plans to double capacity at its rolling mill in Chester. The expansion plans were pending a decision by the District Environmental Commission, which was expected in 1984.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.
[2]State geologist, Agency of Environmental Conservation, Montpelier, VT.
[3]Barre (VT) Times-Argus. Nov. 3, 1983, p. 2.
[4]Burlington (VT) Free Press. Nov. 9, 1983, p. 1.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Vermont Asbestos Group Inc	Box 70 Hyde Park, VT 05655	Pit	Orleans.
Sand and gravel:			
Calkins Sand & Gravel Inc	Box 82 Lyonville, VT 05851	Pits and plant	Caledonia and Orleans.
William E. Daily Inc	Route 1, Box 51 Shaftsbury, VT 05262	Pits	Bennington.
Hinesburg Sand & Gravel Co	Box 200 Hinesburg, VT 05461	----do	Chittenden.
Stone:			
Crushed:			
Cooley Asphalt Paving Corp	Box 542 Barre, VT 05641	Quarry	Washington.
Shelburne Limestone Corp	30 Jewett Swanton, VT 05488	Quarries	Chittenden and Franklin.
Frank W. Whitcomb Construction Corp.	Box 429 Bellows Falls, VT 05101	Quarry	Chittenden.
White Pigment Corp	Florence, VT 05744	Quarries	Addison and Rutland.
Dimension:			
OMYA Inc	Box 10 Florence, VT 05744	Quarry	Rutland and Windsor.
Rock of Ages Corp	Box 482 Barre, VT 05641	Quarries	Washington and Windsor.
John Swenson Granite Co. Inc	North State St. Concord, NH 03301	Quarry	Washington.
Talc:			
OMYA Inc	Chester, VT 05143	Mine and mill	Windham.
Windsor Minerals Inc	Windsor, VT 05089	Mines and mills.	Windsor.

The Mineral Industry of Virginia

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Virginia Division of Mineral Resources for collecting information on all nonfuel minerals.

By Doss H. White, Jr.[1] and Palmer C. Sweet[2]

The value of sales by the nonfuel sector of Virginia's mineral industry totaled $289 million in 1983. This was a $26 million increase over 1982 sales, but $20.5 million below the record high established in 1979.

Virginia ranked 24th in 1983 in the production of nonfuel mineral commodities. However, excluding iron oxide pigments, Virginia's extractive mineral output is exclusively industrial minerals, and when compared with other industrial mineral producing States, Virginia ranked among the leaders.

Virginia's extractive mining industry produced 14 individual mineral commodities; stone, lime, and sand and gravel accounted for approximately 75% of the total value. The State led the Nation in the production of a feldspar marketed as "Virginia aplite" and kyanite, ranked in the top 10 in lime sales, and was 1 of 3 States with vermiculite production.

Table 1.—Nonfuel mineral production in Virginia[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	422	$2,237	784	$5,467
Gem stones		NA	20	NA	20
Iron oxide pigments, crude	short tons	1,269	372	W	W
Lime	thousand short tons	641	29,118	557	24,637
Sand and gravel (construction)	do.	6,978	28,522	e7,200	e30,800
Stone:					
Crushed	do.	e35,200	e142,300	37,959	158,724
Dimension	do.	e4	e1,130	93	3,067
Combined value of aplite, cement, gypsum, kyanite, sand and gravel (industrial), talc (soapstone), vermiculite, and value indicated by symbol W		XX	59,484	XX	66,629
Total		XX	263,183	XX	289,344

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Virginia, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Accomack	[2]	W	Sand and gravel (construction).
Albemarle	W	$55	Do.
Amelia	$90	71	Clays.
Amherst	W	--	
Appomattox	W	--	
Augusta	3,167	W	Sand and gravel (construction).
Bath	W	--	
Bedford	W	--	
Bland	W	--	
Botetourt	42,743	W	Cement, clays.
Brunswick	W	[3]	
Buchanan	W	[3]	
Buckingham	W	W	Kyanite.
Campbell	W	W	Sand and gravel (construction).
Caroline	562	805	Do.
Carroll	312	--	
Charles City	[2]	W	Do.
Chesapeake (city)	[2]	W	Do.
Chesterfield	W	W	Sand and gravel (construction), clays.
Clarke	W	[3]	
Craig	[2]	W	Sand and gravel (construction).
Culpeper	W	[3]	
Dinwiddie	W	[3]	
Fairfax	W	10	Sand and gravel (construction).
Fauquier	W	[3]	
Franklin	W	W	Talc.
Frederick	W	W	Sand and gravel (industrial), lime.
Giles	W	W	Lime.
Gloucester	[2]	W	Sand and gravel (construction).
Goochland	5,490	[3]	
Grayson	W	[3]	
Greensville	W	W	Clays.
Halifax	W	[3]	
Hanover	W	W	Aplite.
Henrico	1,081	12,023	Sand and gravel (construction).
Henry	W	W	Do.
Isle of Wight	[2]	--	
James City	[2]	W	Do.
King and Queen	[2]	W	Sand and gravel (construction), clays.
King George	[2]	1,979	Sand and gravel (construction).
King William	[2]	32	Do.
Lancaster	[2]	W	Do.
Lee	2,260	[3]	
Loudoun	11,914	[3]	
Louisa	W	W	Vermiculite.
Middlesex	[2]	10	Sand and gravel (construction).
Montgomery	W	26	Clays.
New Kent	[2]	W	Sand and gravel (construction).
Northampton	[2]	12	Do.
Northumberland	[2]	W	Do.
Nottoway	W	[3]	
Orange	W	W	Clays.
Pittsylvania	W	W	Sand and gravel (construction).
Prince George	[2]	W	Do.
Prince William	W	[3]	
Pulaski	W	372	Iron oxide pigments.
Richmond (city)	W	W	Clays.
Roanoke	3,936	42	Do.
Rockbridge	W	W	Do.
Rockingham	1,690	W	Sand and gravel (construction).
Russell	4,600	[3]	
Scott	1,473	[3]	
Shenandoah	W	W	Lime.
Smyth	5,964	W	Gypsum, lime, clays, sand and gravel (construction).
Southampton	[2]	W	Sand and gravel (construction).
Spotsylvania	W	W	Do.
Stafford	W	W	Do.
Suffolk (city)	--	W	Do.
Surry	[2]	1	Do.
Sussex	--	W	Do.
Tazewell	W	4	Clays.
Virginia Beach (city)	W	W	Sand and gravel (construction), sand and gravel (industrial).
Warren	W	W	Cement, lime.
Washington	2,141	[3]	
Westmoreland	[2]	W	Sand and gravel (construction).

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Virginia, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Wise	$3,035	(3)	
Wythe	W	(3)	
York	(2)	--	
Undistributed[4]	164,352	$104,312	
Sand and gravel (construction)	e24,470	XX	
Stone:			
Crushed	XX	e142,300	
Dimension	XX	e1,130	
Total	279,280	5263,183	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]The following counties or cities are not listed because no nonfuel mineral production was reported: Alexandria (city), Alleghany, Arlington, Bedford (city), Bristol (city), Buena Vista (city), Charlotte, Clifton Forge (city), Colonial Heights (city), Covington (city), Cumberland, Danville (city), Dickenson, Emporia (city), Essex, Fairfax (city), Falls Church (city), Floyd, Fluvanna, Franklin (city), Fredericksburg (city), Galax (city), Greene, Hampton (city), Harrisonburg (city), Highland, Hopewell (city), Lexington (city), Lunenburg, Lynchburg (city), Madison, Martinsville (city), Mathews, Mecklenburg, Nansemond, Nelson, Newport News (city), Norfolk (city), Norton (city), Page, Patrick, Petersburg (city), Portsmouth (city), Powhatan, Prince Edward, Radford (city), Rappahanock, Richmond, Roanoke (city), Salem (city), South Boston (city), Staunton (city), Waynesboro (city), Williamsburg (city), and Winchester (city). County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Includes gem stones and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Virginia business activity

	1982	1983p	Change, percent
Employment and labor force, annual average:			
Total civilian labor force, thousands	2,650.2	2,702.5	+2.0
Unemployment, do	213.6	163.8	-23.3
Employment (nonagricultural):			
Mining[1], do	16.5	18.1	+9.7
Manufacturing, do	388.8	405.8	+4.4
Contract construction, do	95.8	113.4	+18.4
Transportation and public utilities, do	116.6	120.2	+3.1
Wholesale and retail trade, do	450.1	484.6	+7.7
Finance, insurance, real estate, do	106.0	111.8	+5.5
Services, do	438.8	454.5	+3.6
Government, do	503.4	508.0	+.9
Total nonagricultural employment[1], do	[2]2,115.9	2,216.4	+4.8
Personal income:			
Total, millions	$60,576	$65,682	+8.4
Per capita	$11,056	$11,835	+7.0
Construction activity:			
Number of private and public residential units authorized	29,940	54,346	+81.5
Value of nonresidential construction, millions	$1,152.7	$1,413.1	+22.6
Value of State road contract awards, do	$214.2	$261.0	+21.8
Shipments of portland and masonry cement to and within the State, thousand short tons	1,465	1,793	+22.4
Nonfuel mineral production value:			
Total crude mineral value, millions	$263.2	$289.3	+9.9
Value per capita, resident population	$48	$52	+8.3
Value per square mile	$6,448	$7,098	+10.1

pPreliminary.

[1]Includes bituminous coal and oil and gas extraction.

[2]Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

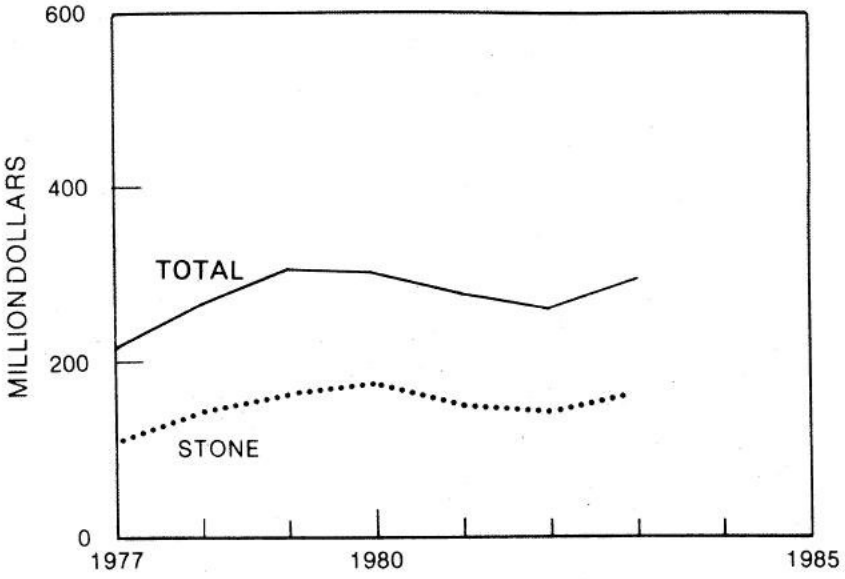

Figure 1.—Value of stone and total value of all nonfuel mineral production in Virginia.

Trends and Developments.—Following a record-high production in 1979, which was valued at $309.8 million, sales by Virginia's mineral producers slumped for 3 consecutive years, and 1982 value was almost $50 million below the record. The 3-year decline, the result of the effects of the depressed national economy, which was first noted in late 1979 and deepened into a recession in 1981, cost the State's mineral producers a minimum of $78 million in sales during 1980-82, based on the industry matching or exceeding the 1979 sales record.

The afflicted economy had a twofold effect on Virginia's mineral industry; the initiation of new mineral ventures came to a virtual standstill and several existing operations terminated production. During 1980-83, excluding aggregate producers, only two mining companies began operation within the State; one, Saltville Silica Inc., an industrial sand operation, filed for reorganization and was inoperative at yearend. Chemstone Corp., a ferrovanadium plant at Strasburg, terminated production in mid-1982, and during 1983, Engelhard Corp., the parent company, was negotiating sale of the plant. The State's only secondary lead producer ceased production in mid-1983. The closure was not related to the economy, however. Shenvalley Lime Corp. purchased the Stephens City operation of Genstar Stone Products Co. in Frederick County.

Exploration Activities.—Callahan Mining Corp. conducted an exploration program for gold in Fauquier County in the northeastern part of the State. The company's activity was centered on two abandoned gold mines—the Franklin and Little Elliot. By September, Callahan had drilled four 500-foot holes on the Franklin property and was considering a trenching program. The company has been active in Virginia's "gold belt" since 1981.

Legislation and Government Programs.—The 1983 Virginia Assembly passed a bill regulating the practice of geology in the State. The bill established minimum qualifications necessary for an individual to be certified as a professional geologist and set an annual fee, payable to the Virginia Treasury, for registration of geologists.

The Virginia Division of Mineral Resources continued to collect and compile information on mineral resources by field and laboratory studies and liaison with the mineral industry. Mineral resources were examined during the course of Division geologic mapping and stratigraphic and

commodity studies, and the information was incorporated in Division publications and maintained on file. Sampling was done where warranted; approximately 200 representative samples of clay materials have been collected to date in the Coastal Plain and evaluated for ceramic and nonceramic products in cooperation with the U.S. Bureau of Mines, Tuscaloosa Research Center.

Field visits were made periodically to known sites of mineral production or processing in order to maintain current knowledge of the mineral industry. A directory of the mineral industry in Virginia is revised and published every 2 years by the Division.

Oil and gas activities in the mid-Atlantic area of the Outer Continental Shelf were monitored, and selected well data and samples are on file. Records and sets of well cuttings for the few tests drilled to date for oil or gas on the Coastal Plain were also preserved in the Division files.

The Division routinely supplied mineral resources information in answer to a wide range of requests from companies, consultants, government agencies, and individuals. This was accomplished by means of office consultations, correspondence, and telephone.

Economic geology and geochemical projects in progress in 1983 included high-silica resources of Alleghany, Botetourt, Craig, and Roanoke Counties; clay material resources; carbonate study; marl study; terrace deposit in Buckingham County; alumina resources; analyses of coal samples; oil and gas studies in southwest Virginia; saltpeter occurrences in Virginia; industrial silica resources in Virginia; 1984 mineral directory; tantalite-columbite-wodginite occurrences in Virginia; oil and gas maps in Virginia; rock porosity in Virginia; waste material resources; and tin in Rockbridge County.

Reports completed by the section and published in 1983 included (1) "Virginia Gold-Resources Data," (2) "Virginia's Mineral Industry," (3) "Mineral Industries and Resources of Virginia (map)," (4) "Large Gem Topaz Crystal Discovery," (5) "Strontium Minerals From Wise County, Virginia—An Update," (6) "Present and Future Industrial-Mineral Resources in Virginia," and (7) "Directory of the Mineral Industry in Virginia—1983."

In December, Virginia's 14-member uranium panel, the Uranium Administrative Group, recommended another year of study to allow State agencies time to determine risk limits and performance standards for the uranium industry. The Governor's staff and several State legislators agreed with the panel's recommendation.

Marline Uranium Corp. has conducted exploration activity in southern Virginia for several years and in 1982 announced a major discovery in Pittsylvania County. Marline and Union Carbide Corp. have reached an agreement to jointly develop the stated 30-million pound deposit if State officials determine that development will not impact on the quality of the environment.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

In retrospect, 1982 sales were an improvement over those experienced during the early 1980's by most of the State's mineral producers. Although sales were 7% below the record high reported in 1979, the year was the first in three that demand increased over that experienced during 1981.

Aplite.—Virginia is the only State with "Virginia aplite" production. The material is a feldspar-family mineral that is used in the manufacture of container glass. Past rail tariffs on feldspar led to the material being termed aplite, which was less costly than feldspar to ship.

In 1983, one company, The Feldspar Corp., produced aplite at a surface mine in Hanover County in eastern Virginia. The ore was recovered from a surface mine adjacent to the processing plant. After drilling and shooting, diesel-powered shovels are used to load the ore, which is trucked to a crushing facility at the plant. After crushing, the ore is conveyed to the plant where screening, grinding, magnetic separation, and drying produce a low-iron product used primarily in the manufacture of beverage bottles.

Cement.—The State's cement industry is comprised of three companies: Lone Star Cement Inc. with five kilns; Lone Star Lafarge Inc., one kiln; and Riverton Corp., one kiln.

Raw material for clinker manufacturing was obtained from a variety of sources. Lone Star Cement mined an Ordovician age limestone and shale unit at their facility in

the western part of Virginia, and mill scale was purchased from Roanoke Electric Steel Co.

Lone Star Lafarge operated one of three calcium aluminate cement plants in the United States at Chesapeake. The plant produces three basic types of Cement Fondu—low, medium, and high Al_2O_3. Raw material for this type of cement is normally high-purity bauxite and limestone with low silica and magnesia content. The Chesapeake facility uses the dry process to produce clinker. The company also imports clinker for cement manufacturing. Cement output from this plant is used primarily for high-temperature applications.

Riverton's northern Virginia plant is one of three plants in the country producing masonry cement exclusively. Locally mined limestone was calcined and mixed with out-of-State portland cement to produce a cement for masonry applications. The company also mines and crushes a noncement-grade limestone for aggregate sales.

Output of portland and masonry cement increased somewhat over the 1982 level.

Clays.—Virginia's clay industry, composed of 10 companies operating 16 mines, is concentrated in 3 distinct geographical areas: the southwest, the east, and the city of Richmond.

Table 4.—Virginia: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1979	1,059	3,512
1980	762	3,172
1981	502	2,016
1982	422	2,237
1983	784	5,467

Southwestern Virginia producers mined Paleozoic shales for common and face brick manufacture. One company in Tazewell County produced clay dummies (blasthole stemming material) used principally by the coal industry.

Eastern Virginia producers mined a variety of phyllites, schists, saprolite, and clays for the manufacture of common and face brick. One company in Richmond mined both Pleistocene clay and saprolite from Pre-Cambrian rock for brick production, and a company in King and Queen County mined and processed a montmorillonite clay for absorbent production, principally material for pet waste absorption.

Two companies, Virginia Solite Co. and Weblite Co., mined shale used in lightweight concrete and concrete block.

Gypsum.—United States Gypsum Co. operated an underground mine at Locust Cove and a wallboard plant at Plasterco. The company also operated a wallboard plant at Norfolk; material for this plant was imported from Nova Scotia.

The company's Locust Cove Mine in Smyth County produced gypsum and anhydrite, which was trucked under contract to the wallboard plant in Washington County. The crude gypsum was ground, mixed with chemicals and water to produce a slurry, which was then formed into wallboard, and was dried in a coal-fired kiln. The Plasterco facility also produced a vinyl-clad board.

The Norfolk plant used gypsum obtained from company mines in Canada. The demand for wallboard paralleled the upswing in construction activity.

Kyanite.—Once again, Virginia led the Nation in the production of kyanite, an aluminum silicate with broad applications in the refractories and ceramics industry. Georgia is the only other kyanite-producing State.

Kyanite Mining Corp. operates two surface mines and processing facilities at Willis Mountain and East Ridge in Buckingham County in central Virginia. A kyanite concentrate is obtained by flotation of kyanite-bearing quartzite obtained by surface mining. Various grades of kyanite were produced as was calcined kyanite.

Overseas markets accounted for approximately 35% of the company's output—the Port of Hampton Roads was the export point. Much of the kyanite-mullite sold in the domestic market was trucked to Dillwyn and shipped on the Chesapeake and Ohio or Norfolk and Western Railroads. The company also has a trucking line that handles a portion of the output.

Lime.—For the past several years, Virginia has ranked in the top 10 in lime production. Major markets are the paper, steel, and water treatment industries; and output increased over that reported in 1982 as the paper and steel industries recovered from the economic slump. Pertinent data on the State's lime-producing industry are as follows:

Company	Location	Mine type
W. S. Frey Co. Inc	Clearbrook	Surface.
United States Gypsum Co.	Ripplemead	Underground.
Virginia Lime Co	do	Do.

At yearend, negotiations were underway for United States Gypsum's acquisition of the high-calcium lime operation of Gold Bond Building Products, a division of National Gypsum Co., at Ripplemead in Giles County. The Gold Bond property includes an underground mine and a five-kiln lime plant.

Lithium.—Foote Mineral Co. operated a lithium hydroxide plant at Sunbright in southwestern Virginia. The basic material for the manufacturing process, lithium carbonate, was obtained from the company's mining processing complex at Kings Mountain, NC. Lithium hydroxide has application in multipurpose, lithium-based grease manufacture.

Mica.—Two firms, Asheville Mica Co. and its affiliate, Mica Co. of Canada, operated mica fabricating plants at Newport News on the Atlantic coast. Crude sheet mica was purchased through New York brokers from Madagascar and India. Asheville Mica utilized the imported mica to produce fabricated plate mica; Mica Co. of Canada used splittings from Asheville Mica to produce reconstituted plate mica and mica paper. The firms also imported finished mica shapes.

Perlite (Expanded).—Manville Building Materials Corp. operated a perlite expansion plant at Woodstock in Shenandoah County. Perlite mined in New Mexico was shipped to the northern Virginia plant and expanded at temperatures between 1,400° and 2,000° F to produce a material used in the manufacture of roof insulation board.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

The "Directory of the Mineral Industry in Virginia—1983," published by the Virginia Division of Mineral Resources,[3] lists 131 sand and gravel producers in the State; an additional 12 are listed as producers of sand-size material from stone crushing. The estimate for production and sales in 1983, 3.8 million short tons valued at $9.4 million, represents data based on a 9-month period as reported by companies representing 62% of the State's production in 1982.

Industrial.—Industrial sand was produced by Unimin Corp. at Gore and J. C. Jones Sand Co. Inc. at Virginia Beach. CED Process Minerals Inc. at Gore purchased industrial-grade sand for processing. During the year, the State's newest industrial sand company, Saltville Silica at Saltville, ceased operation.

Table 5.—Virginia: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	2,829	$11,313	$4.00	NA	NA	NA
Gravel	3,509	16,283	4.64	NA	NA	NA
Sand and gravel (unprocessed)	639	926	1.45	NA	NA	NA
Total or average	[1]6,978	28,522	4.09	[e]7,200	[e]$30,800	[e]$4.28
Industrial sand	W	W	11.74	W	W	10.64

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Virginia's stone industry, 60 crushed stone producers and 6 dimension stone operations, produced a variety of stone products during 1983. Production of both stone types increased for the first year since 1979, and the State ranked sixth in the output and sales of crushed and dimension stone.

Crushed.—The State's crushed stone industry was composed of 60 companies operating 98 quarries and crushing plants. Three of Virginia's crushed stone producers received awards from the National Crushed Stone Association for site appearance and community excellence during 1983. The firms and awards were Luck Stone Corp., Charlottesville plant, Showplace Award; Martin Marietta Aggregates, Charlottesville-Red Hill, Outstanding Award; and Vulcan Materials Co., Stafford quarry, Showplace Award.

Table 6.—Virginia: Crushed stone sold or used by producers in 1983, by use[1]

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	258	810
Riprap and jetty stone	370	1,979
Filter stone	122	415
Other	W	W
Coarse aggregate, graded:		
Concrete aggregate, coarse	4,603	20,645
Bituminous aggregate, coarse	4,093	18,216
Bituminous surface treatment aggregate	2,140	9,707
Railroad ballast	1,194	4,144
Other	W	W
Fine aggregate (-3/8 inch):		
Stone sand:		
Concrete	1,039	4,632
Bituminous mix or seal	162	530
Screening, undesignated	578	2,263
Other	W	W
Coarse and fine aggregate:		
Graded road base or subbase	8,332	33,031
Unpaved road surfacing	1,524	6,048
Terrazzo and exposed aggregate	6	37
Crusher run or fill or waste	4,979	17,663
Agricultural:		
Agricultural limestone	901	7,015
Poultry grit and mineral food	W	W
Other	W	W
Chemical and metallurgical:		
Cement manufacture	1,280	2,038
Lime manufacture	462	2,770
Ferrosilicon	7	W
Flux stone	66	197
Glass manufacture	W	W
Sulfur oxide removal	W	W
Special:		
Mine dusting or acid water treatment	176	1,422
Asphalt fillers or extenders	W	W
Other fillers or extenders	105	1,467
Roofing granules	(2)	1
Other	5,562	23,691
Total	37,959	[3]158,724

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes dolomite, granite, limestone, marble, sandstone, slate, traprock, and miscellaneous stone.
[2]Less than 1/2 unit.
[3]Data do not add to total shown because of independent rounding.

Two companies, Amlite Corp. and Solite Corp., mined slate used in lightweight concrete and concrete block.

During the year, Arundel Corp. of Baltimore acquired Bowles Inc. of Richmond. Arundel sold the contracting portion of the new acquisition but retained ownership of two ready-mix and granite quarrying operations in the Richmond area.

Luck Stone Corp. of Richmond moved their portable plant from Elkton, Rockingham County, to a Greene County site near Ruckersville during December. The plant was scheduled to be completed and in operation in January 1984.

Dimension.—Virginia's dimension stone producers, six companies operating six quarries, mined and/or shaped slate, granite, diabase, soapstone, and quartzite during 1983. Four companies reported production-value data for 1983. Pertinent information on the major producers is as follows:

Stone type	Company	County
Diabase	Virginia Granite Co.	Culpeper.
Granite	Tosalma Stone Quarry.	Hanover.
Limestone	Mower Quarries	Fauquier.
Slate	Arvonia-Buckingham Slate Corp. Inc.	Buckingham.
Do	LeSueur-Richmond Slate Corp.	Do.
Soapstone	Alberene Stone Co.	Do.

Three companies mined flagstone from a quartzite in the Weverton Formation in Campbell and Fauquier Counties.

Luck Stone opened their fourth Stone Center at the company's Charlottesville quarry. The Stone Centers are retail-commercial stores displaying a variety of stone products used in landscaping, fireplaces, walkways, bathroom vanities, and for interior and exterior home decorating. Stone is obtained from several other States and foreign sources.

Alberene Stone Co., the State's only soapstone producer, shipped from stockpile during the year; all quarries were inactive.

Sulfur (Recovered).—Amoco Oil Co. recovered elemental sulfur at its crude oil refinery in York County. Sulfur recovery was by the Claus process and was marketed for use in the manufacture of fertilizer.

Talc.—Blue Ridge Talc Co. Inc. produced a product marketed as talc for use by the foundry industry as a mold release agent. The company operated a grinding plant on the Franklin-Henry County boundary. The ore, a talc, chlorite, dolomite schist, was mined by contract and trucked to the plant where it was ground and bagged.

Vermiculite.—Three States, Virginia, South Carolina, and Montana, mined vermiculite ore during 1983. Virginia Vermiculite Ltd. mined and processed crude vermiculite in Louisa County. After processing, which included screening, washing, grinding, and drying, the vermiculite was marketed unexfcliated. The major customer was a fertilizer manufacturer in Ohio; other sales were to greenhouses with exfoliation furnaces.

METALS

Virginia, a major metal producer during Colonial times, currently imports most of the metallic ore processed instate. The upswing in the economy, which characterized 1983, increased the demand for many of the State's metal products. However, two producers, ferrovanadium and lead, were closed at yearend.

Ferrovanadium.—Chemstone Corp., a subsidiary of Engelhard Corp., had a ferrovanadium plant at Strasburg in Shenandoah County. The plant closed in mid-1982 and remained closed throughout 1983 because of weak ferrovanadium demand. At yearend, Engelhard officials were negotiating for the sale of the Strasburg facility.

Gold.—The State's only gold operation, Walnut Creek Mining Inc., continued work on an auriferous quartz vein in Orange County. A commercial gold-panning operation was also operated by Walnut Creek at a site west of Fredericksburg near the community of Wilderness.

Iron Oxide Pigments.—Hoover Color Corp. and Blue Ridge Talc processed crude iron oxide pigments during 1983. Hoover mined crude umber and sienna pigment for processing, and both companies processed material obtained from out-of-State sources. Hoover production was sold on the open market while most Blue Ridge Talc output was used in-house for a paint coloring agent. Virginia Earth Pigments Co. also sold small amounts of stockpiled crude iron oxide for further processing.

Iron and Steel.—Iron was manufactured and cast into a variety of products by several foundries in the State. Two of the largest are located in Richmond and Lynchburg. During the year, Lynchburg Foundry was sold to Columbus Foundries of Columbus, GA.

Two companies, Roanoke Electric Steel Corp. and Roanoke and Intercoastal Steel Corp., Chesapeake, comprise the State's steel industry. The two operated a total of six electric furnaces using scrap as feed. In the fourth quarter, Roanoke Electric was operating at close to capacity with the rolling mill at 18 turns and the melt shop at 20.[4] At yearend, Intercoastal was operating at approximately 60% of capacity. In December, Intercoastal was completing plans for the installation of a $1.2 million continuous-billet caster; the installation was scheduled for completion in October 1984.[5]

Lead.—The State's only secondary lead smelter, Hyman Viener & Sons, closed in midyear. The closure was due to internal problems and was not related to the economy or lead demand.

Magnetite.—Reiss Viking Corp. operated a grinding facility in Tazewell County to produce a ground magnetite product used in coal-washing plants. Principal markets were in Alabama, Tennessee, Kentucky, and Virginia.

Manganese.—Union Carbide imported manganese ore from Gabon; it was ground at a plant in Newport News and then shipped to company plants for the manufacture of batteries.

---

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, AL.
[2]Head geologist, Economic Geology Section, Virginia Division of Mineral Resources.
[3]Sweet, P. C. Directory of the Mineral Industry in Virginia—1983. VA Div. Miner. Res., 28 pp.
[4]American Metal Market. Aug. 19, 1983.
[5]———. Jan. 27, 1984.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County or city
Aplite:			
The Feldspar Corp	Route 1, Box 23 Montpelier, VA 23192	Quarry and plant	Hanover.
Cement:			
Lone Star Cement Inc.[1]	Box 27 Cloverdale, VA 24077	do	Botetourt.
Lone Star Lafarge Inc	Box 5128 Chesapeake, VA 23320	Plant	Chesapeake (city).
Riverton Corp.[2]	Riverton, VA 22651	Quarry and plant	Warren.
Clays:			
Brick and Tile Corp	Box 45 Lawrenceville, VA 23868	Pits and plant	Brunswick and Greensville.
General Shale Products Corp	Box 3547 Johnson City, TN 37601	do	Rockbridge, Smyth, Tazewell.
Webster Brick Co. Inc	Box 12887 Roanoke, VA 24029	do	Botetourt and Orange.
Gypsum:			
United States Gypsum Co	Box 4686 Norfolk, VA 23523	Plant	Norfolk (city).
Do	Route 1 Saltville, VA 24370	Mine and plant	Smyth and Washington.
Iron oxide pigments (crude):			
Hoover Color Corp	Box 218 Hiwassee, VA 24347	do	Pulaski.
Kyanite:			
Kyanite Mining Corp	Dillwyn, VA 23936	Mines and plant Plant	Buckingham. Prince Edward.
Lime:			
National Gypsum Co	Route 635 Ripplemead, VA 24150	do	Giles.
Virginia Lime Co	Route 635 Ripplemead, VA 24150	do	Do.
Perlite (expanded):			
Manville Building Materials Corp	Box 442 Woodstock, VA 22644	do	Shenandoah.
Sand and gravel (1982):			
Lone Star Industries Inc	Box 420 Norfolk, VA 23501	Pits and plant	Charles City, Chesterfield, Henrico, Prince George.
Sadler Materials Corp	Box 5607 Virginia Beach, VA 23455	Pits	Henrico and Prince George.
West Sand and Gravel Co. Inc	Box 6008 Richmond, VA 23222	do	Henrico.
Stone:			
Lone Star Industries Inc	Box 420 Norfolk, VA 23501	Quarries	Brunswick, Chesterfield, Dinwiddie.
Luck Stone Corp	Box 4682 Richmond, VA 23229	do	Albemarle, Augusta, Fairfax, Goochland, Halifax, Mecklenburg, Pittsylvania, Prince William, Rockingham, Washington.
Vulcan Materials Co., Midsouth Div	Box 7 Knoxville, TN 37901	do	Washington.
Talc:			
Blue Ridge Talc Co. Inc.[3]	Box 39 Henry, VA 24102	Quarry and plant	Franklin.

[1]Also sand and gravel and stone.
[2]Masonry cement only; also produces limestone and lime.
[3]Also finished iron oxide pigments.

The Mineral Industry of Washington

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Washington Division of Geology and Earth Resources for collecting information on all nonfuel minerals.

By Herbert R. Babitzke[1] and Bonnie Butler Bunning[2]

The value of nonfuel mineral production in Washington was $187 million in 1983, an increase of 9% over that reported in 1982. Nonmetals, primarily cement, sand and gravel, stone, lime, and diatomite, accounted for 97% of the total output value. Gold and silver accounted for the remainder. Washington ranked 34th in the Nation in the value of its nonfuel minerals production for 1983.

Trends and Developments.—The State's economy followed that of the Nation into recovery, but at a slower pace. Markets appeared to be strengthening, although metals refining trends were mixed during the year. Seasonally adjusted manufacturing employment leveled out during the second half of 1983. The aerospace industry made some gains in November, with further increases expected for 1984. Strengthening production areas included aluminum refining, instruments, chemicals, and heavy trucks. Employment gains were also noted in the stone, clay, and glass industries.

Table 1.—Nonfuel mineral production in Washington[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement (portland)	thousand short tons	1,154	$75,988	W	W
Clays	do.	251	1,829	282	[2]$1,715
Gem stones		NA	200	NA	200
Sand and gravel:					
Construction	thousand short tons	15,190	40,295	[e]15,800	[e]50,300
Industrial	do.	242	2,809	337	4,581
Stone:					
Crushed	do.	[e]8,600	[e]23,800	10,451	29,607
Dimension	do.	[e]14	[e]2,375	1	37
Talc	do.	8	20	W	W
Combined value of barite, cement (masonry), clays (fire clay, 1983), copper (1982), diatomite, gold, gypsum, lead (1982), lime, olivine, peat, silver, and values indicated by symbol W		XX	[r]24,766	XX	101,025
Total		XX	[r]172,082	XX	187,465

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes fire clay; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Washington, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Adams	$74	$135	Sand and gravel (construction).
Asotin	(2)	W	Do.
Benton	W	W	Do.
Chelan	W	W	Sand and gravel (industrial), sand and gravel (construction).
Clallam	W	W	Clays, sand and gravel (construction).
Clark	753	1,151	Sand and gravel (construction), clays.
Cowlitz	500	(3)	
Douglas	(2)	--	
Ferry	W	W	Gold, silver.
Franklin	W	W	Sand and gravel (construction).
Grant	W	W	Diatomite, sand and gravel (construction).
Grays Harbor	952	2,069	Sand and gravel (construction).
Island	36	350	Do.
Jefferson	W	34	Do.
King	W	63,186	Cement, sand and gravel (construction), clays, gold, peat, silver.
Kitsap	1,035	1,659	Sand and gravel (construction).
Kittitas	W	W	Sand and gravel (construction), gold.
Klickitat	303	W	Sand and gravel (construction).
Lewis	30	W	Do.
Lincoln	1,231	718	Do.
Mason	W	(3)	
Okanogan	W	310	Sand and gravel (construction), peat, gypsum, silver, lead, copper.
Pacific	795	(3)	
Pend Oreille	W	W	Cement, sand and gravel (construction).
Pierce	W	12,247	Sand and gravel (construction), lime, clays, peat.
San Juan	(2)	1,814	Sand and gravel (construction).
Skagit	W	1,552	Sand and gravel (construction), olivine, talc.
Skamania	W	66	Sand and gravel (construction).
Snohomish	W	2,860	Do.
Spokane	W	416	Do.
Stevens	11,492	4,968	Lime, sand and gravel (industrial), sand and gravel (construction), clays, barite.
Thurston	271	1,042	Sand and gravel (construction).
Wahkiakum	85	(3)	
Walla Walla	131	W	Sand and gravel (construction).
Whatcom	W	W	Cement, sand and gravel (construction).
Whitman	434	(3)	
Yakima	W	921	Sand and gravel (construction).
Undistributed[4]	148,263	50,409	
Sand and gravel (construction)	e42,130	XX	
Stone:			
Crushed	XX	e23,800	
Dimension	XX	e2,375	
Total	[5]208,508	172,082	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Columbia and Garfield Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Private investments in Washington's metallic mineral resources were four times greater in 1983 than in 1982. The dramatic increase was due primarily to advanced development of three mining projects within the State, especially the Asamera Inc. and Breakwater Resources Ltd. joint venture near Wenatchee. Exploration expenditures for metallic and nonmetallic minerals were essentially the same as in 1982.

The Wenatchee Valley became the focal point for gold exploration and development. More than 1,000 claims were filed after a Canadian mining company, Asamera, announced its Chelan County discovery. Generally, the claims were located between Leavenworth and Lake Wenatchee and into the Liberty area along Blewett Pass. Asamera was developing the B-Reef area, now called the Cannon Mine; production was scheduled to begin in 1985. A total of 19 companies were exploring for gold in Chelan County in 1983, and 68 companies were actively searching for metallic minerals statewide.

Public hearings were held in November by the Federal Environmental Protection Agency (EPA) to determine the fate of ASARCO Incorporated's Tacoma copper smelter. The smelter has the capacity for producing 66,800 tons of copper per year and is the only domestic smelter that can process copper ore and concentrate having a high arsenic content. The Tacoma smelter is also the only domestic producer of arsenic metal and arsenic trioxide. EPA endorsed a specific ambient standard for arsenic proposed by Washington State regulatory authorities. That standard sets a maximum of 2 micrograms of arsenic per cubic meter of air averaged over 24 hours. The proposed Best Available Technology requirements would seek a reduction in arsenic emissions from the operation's converters and from fugitive emission sources. Asarco reported that further controls beyond what has already been done would make the smelter uneconomical.

Table 3.—Indicators of Washington business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,009.5	2,068.0	+2.9
Unemployment	do.	269.6	253.0	-6.2
Employment (nonagricultural):				
Mining[1]	do.	2.4	2.8	+16.7
Manufacturing	do.	270.5	272.4	+.7
Contract construction	do.	65.0	64.4	-.9
Transportation and public utilities	do.	84.7	88.9	+5.0
Wholesale and retail trade	do.	372.6	398.4	+6.9
Finance, insurance, real estate	do.	89.6	92.3	+3.0
Services	do.	317.1	325.6	+2.7
Government	do.	326.7	334.0	+2.2
Total nonagricultural employment[1]	do.	1,528.6	1,578.8	+3.3
Personal income:				
Total	millions	$49,111	$51,823	+5.5
Per capita		$11,466	$12,051	+5.1
Construction activity:				
Number of private and public residential units authorized		17,891	26,535	+48.3
Value of nonresidential construction	millions	$1,186.0	$1,098.7	-7.4
Value of State road contract awards	do.	$275.0	$122.0	-55.6
Shipments of portland and masonry cement to and within the State	thousand short tons	1,022	1,083	+6.0
Nonfuel mineral production value:				
Total crude mineral value	millions	$172.1	$187.5	+9.0
Value per capita, resident population		$41	$44	+7.3
Value per square mile		$2,523	$2,751	+9.0

[p]Preliminary.
[1]Includes bituminous coal extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Legislation and Government Programs.—The Mining and Mineral Resources and Research Institute at the University of Washington in Seattle, created under Public Law 95-87, received $150,000 from the U.S. Bureau of Mines in 1983 for operations and research efforts. Part was used as seed money to develop programs for major projects with other agencies, and part was used for research fellowships.

Distribution of proceeds in lieu of taxes from the U.S. Bureau of Land Management (BLM) to Washington local governments was $1,438,979. This amount was in addition to $823,438 the State received from the BLM under the Mineral Leasing Act.

Activities of the State Division of Geology and Earth Resources included publishing new 7-1/2-minute quadrangle maps of the Monitor and Wenatchee quadrangles to accompany Bulletin 75. Also completed was a geochemical survey attempting to locate anomalous tin, tungsten, and molybdenum values associated with old prospects in northeastern Washington. In addition, popular but out of print reports on the State's gold and silver deposits were reprinted.

Mapping continued in the Columbia Basin on a U.S. Department of Energy program, and 7-1/2-minute quadrangle maps were published for Pullman, Moscow West, Colton, and Uniontown. Two 15-minute maps were also published for the Ellensburg and Yakima quadrangles.

Plans were formulated to produce a new Washington State Geologic Map. In conjunction with the State map project, a contract was signed with the U.S. Geological Survey to generate offshore stratigraphic and/or structural maps.

The Division continued to regulate surface mines, oil, gas, and geothermal drilling.

Parts of the State's Surface Mining Act were amended during the regular 1983 session of the 48th Legislature. The changes that went into effect were (1) annual fee increased from $25 to $250, (2) bond requirements changed from a maximum of $2,500 per acre to actual estimated cost through completed reclamation, (3) the 30-day time period to correct reclamation deficiencies can be waived in emergency situations, (4) civil penalties of up to $500 per day may be imposed for noncompliance, and (5) in selected cases, the Federal Office of Surface Mining (OSM) preempts the State law pertaining to the regulation of surface coal mines. OSM implemented the Washington State Surface Coal Mining Program on May 13, 1983.

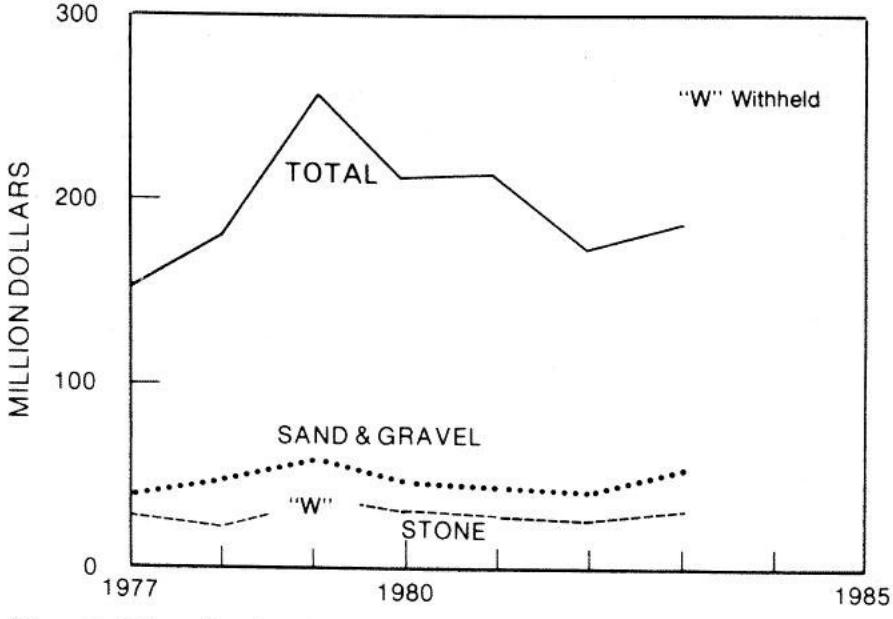

Figure 1.—Value of sand and gravel and stone, and total value of nonfuel mineral production in Washington.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

There were 31 companies that produced or explored for industrial minerals in 1983, about the same as reported for 1982. Increased production was noted for nearly all nonmetals produced.

Barite.—Six companies reported exploration and development for barite in northeastern Washington during 1983. C-E Minerals, a wholly owned subsidiary of Combustion Engineering Inc., continued to produce barite from the Flagstaff Mountain Mine near Newport. The barite was processed at C-E Minerals' nearby mill at Leadpoint in northern Stevens County. C-E Minerals also reported premine development at the Uribe barite deposit on Bruce Creek. A small amount of production was also reported by David Beck from the Chopot Mine, Stevens County. Other companies involved were LaSota-Jones Lead-Zinc Corp. exploring in Pend Oreille County, and L. F. Baum and Associates, Boise Cascade Corp., and Cominco American Incorporated conducting statewide reconnaissance for barite.

Calcium Chloride.—Two companies in Tacoma, Pierce County, produced calcium chloride. Occidental Chemical Corp. (formerly Hooker Chemical Corp.) produced calcium chloride, chlorine, and ammonia. Reichhold Chemicals Inc. produced calcium chloride as a byproduct from the plant's production of organic compounds.

Cement.—Portland cement was produced by four companies in King, Pend Oreille, and Whatcom Counties: Ideal Basic Industries Inc. and Lone Star Industries Inc., Seattle; Lehigh Portland Cement Co., Metaline Falls; and Columbia Cement Corp., Bellingham. Lone Star, Lehigh, and Columbia Cement also produced masonry cement. Portland cement was used by ready-mix concrete dealers (80%), concrete product manufacturers (10%), and others, including building material dealers, highway contractors, other contractors, and miscellaneous (10%). All four plants used coal and electricity for fuel and energy. Three of the plants also consumed natural gas. Raw materials used in the production of cement were limestone, clay, sand, iron ore, fly ash, slag, and gypsum.

Columbia Cement opened its new eastern Washington distribution plant at Pasco on July 11 to serve the needs of eastern Washington consumers.

At yearend, Lehigh cut production at the Metaline Falls plant, owing to surplus inventories, and laid off 48 employees. This layoff marked the first at Metaline Falls in more than a decade of production.

Clays.—Production of clays in 1983 increased over that reported for 1982. Clay was produced by four companies in four counties. Most of the clay produced came from Clallam and King Counties, with 88% of the State's production. Fire clay was also produced in King County. About 97% of common clay production was used for face brick or portland cement.

Diatomite.—Washington State had one diatomite producer in 1983—Inorganic Specialties, a division of the Witco Chemical Corp., at Quincy. The company has been taking material from a surface mine near George in Grant County. All the diatomite produced was used for filtration medium and fillers. In addition to exploration by Witco in Grant County, L. F. Baum and Associates was conducting a statewide search, while Sunshine Valley Minerals Inc. was exploring for diatomite in Okanogan County.

Gypsum.—Agro Minerals Inc. continued mining crude gypsum from the State's only gypsum mine at Poison Lake, Okanogan County. Agro Minerals has been mining gypsite from the Poison Lake Mine since 1948. The granulated gypsum produced was used primarily as a soil amendment. In addition, calcined gypsum was produced in Seattle by Norwest Gypsum Inc., and in Tacoma by Domtar Gypsum America Inc.

Lime.—Continental Lime Inc.'s Tacoma plant in Pierce County and Northwest Alloys Inc. near Addy in Stevens County produced lime in 1983. Production was down but value was considerably higher than that reported in 1982.

Olivine.—Olivine was produced in Skagit and Whatcom Counties in 1983. Production and value were up over that reported in 1982. IMC Olivine milled olivine from stockpiled material mined from the Twin Sisters Quarry at Hamilton in Skagit County. IMC continued exploration and development to extend its reserves. Olivine was also mined by Olivine Corp. at the Swen Larson Quarry near Bellingham in Whatcom County. Exploration was also conducted by B. Sterling and L. F. Baum and Associates during the

year.

Peat.—Three companies reported production of peat during 1983—Maple Valley Humus in King County, Bonaparte Peat in Okanogan County, and Zycom Inc. in Pierce County.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Industrial sand and gravel was produced by four companies in Chelan, King, and Stevens Counties. Major end uses for the product were in containers, flux, traction, and production of ferrosilicon. These end uses consumed 76% of the total. Production of industrial sand and gravel increased 39% and value 63% over the 1982 figures.

Table 4.—Washington: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	3,347	$9,437	$2.82	NA	NA	NA
Gravel	8,543	24,331	2.85	NA	NA	NA
Sand and gravel (unprocessed)	3,301	6,527	1.98	NA	NA	NA
Total or average	[1]15,190	40,295	2.65	[e]15,800	[e]$50,300	[e]$3.18
Industrial:						
Sand	191	W	W	306	W	W
Gravel	51	W	W	31	W	W
Total or average	242	2,809	11.61	337	4,581	13.58
Grand total or average	15,432	43,104	2.79	[e]16,137	[e]54,881	[e]3.40

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total or average."
[1]Data do not add to total shown because of independent rounding.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Production of crushed stone increased 22% in quantity and 24% in value over that of 1982. Major use was for graded road base and subbase and unpaved road surfacing, which consumed 38% of the crushed stone produced during the year.

Dimension stone was produced in Skagit and Stevens Counties.

Table 5.—Washington: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	618	2,894
Coarse aggregate, graded:		
Concrete aggregate, coarse	84	177
Bituminous aggregate, coarse	402	1,052
Bituminous surface treatment aggregate	596	1,579
Railroad ballast	261	649
Fine aggregate (-3/8 inch):		
Stone sand, concrete	138	415
Stone sand, bituminous mix or seal	157	342
Screening, undesignated	207	599
Other fine aggregate	35	127
Coarse and fine aggregate:		
Graded road base or subbase	2,327	5,910
Unpaved road surfacing	1,652	5,197
Terrazzo and exposed aggregate	11	51
Crusher run or fill or waste	68	123
Other coarse and fine aggregate	60	169

See footnotes at end of table.

Table 5.—Washington: Crushed stone[1] sold or used by producers in 1983, by use —Continued

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Agricultural: Agricultural limestone	1	W
Chemical and metallurgical:		
Lime manufacture	30	150
Dead-burned dolomite manufacture	430	W
Ferrosilicon	37	W
Special:		
Whiting or whiting substitute	[2]	W
Other fillers or extenders	[2]	W
Roofing granules	[2]	W
Other[3]	3,337	10,172
Total	10,451	[4]29,607

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes limestone, dolomite, granite, sandstone, quartzite, traprock, volcanic cinder and scoria, and miscellaneous stone.
[2]Less than 1/2 unit.
[3]Includes macadam, filter stone, cement manufacture, flux stone, coarse aggregate (large), coarse aggregate (graded), uses not specified, and uses indicated by symbol W.
[4]Data do not add to total shown because of independent rounding.

Sulfur.—Atlantic Richfield Co. and Mobil Oil Corp., both in Whatcom County, reported recovery of sulfur during the oil refining process in 1983.

Talc.—Cascade Talc Inc. produced talc from the Cascade talc pit in Skagit County. All of the talc sold was used in insecticides.

METALS

Metallic mineral production and development were concentrated in Chelan, King, Ferry, Okanogan, and Stevens Counties. During 1983, there were nine mining projects in production or under development. A minimum of 68 exploration companies were active during the year; most were seeking gold and silver.

Aluminum.—Washington ranked first in the Nation in quantity and value of primary aluminum produced in the State in 1983, with more than 1 million tons valued at $1.7 billion. The State's seven reduction plants accounted for an estimated 29% of all 1983 aluminum production in the United States. The plants made nearly a full recovery from 1982 yearend operating rates of about 68% of capacity. Except for Kaiser Aluminum & Chemical Corp.'s Mead plant, all had returned to full production. The seventh of eight potlines at the Mead plant was scheduled for restart in January 1984. The incentives for restart of operations were increased product demand, a doubling in the price of aluminum compared with that of 1982, and reduced electricity rates from the Bonneville Power Administration.

Table 6.—Washington: Estimated primary aluminum plant production

Year	Quantity (thousand short tons)	Percent of national total	Value (thousands)
1979	1,211	24	$1,476,957
1980	1,171	23	1,678,645
1981	1,209	24	1,837,630
1982	967	27	1,470,074
1983	1,081	29	1,682,233

Gold.—Gold was produced from two mines in Ferry and Kittitas Counties. The bulk of the gold recovery was from Hecla Mining Co.'s Knob Hill Mine at Republic. According to Hecla's annual report, the Knob Hill Mine's known commercial ore reserves would be mined out in 1984. An exploration program instituted in 1982, both at the mine and at surrounding properties owned by Hecla, was to continue during 1984 in an effort to locate mineralization that could prolong the life of the Republic Unit.

Most of the exploration activity for gold was in Chelan County. In 1982, only 2 companies reported gold exploration, but that number jumped to 19 in 1983, after Asamera and Breakwater Resources announced drilling results at the Cannon Mine near Wenatchee. At least 45 other companies have land holdings in the area. More than one-half of the money invested in metallic minerals exploration in the State for 1983 went to Chelan County. From March 1983 to yearend, more than 6,000 claims were filed in the county, particularly

near Wenatchee, and numerous holes were drilled on prospects throughout the district. Asamera delineated a deposit of 4 to 6 million tons of ore grading 0.20 ounce of gold per ton at the Cannon Mine. Development consisted of a 22-foot-diameter shaft, a decline, and more than a mile of underground headings. Production from the Cannon was scheduled to start early in 1985.

Near the Knob Hill Mine, Crown Resource Corp. began producing gold and silver from the Seattle Mine and continued exploration for gold and silver at the South Penn and Granny properties. In King County, 200 feet were added to the Apex Mine's haulage tunnel. The Apex and Damon Mines are owned by CSS Management Corp. The U.S. Bureau of Mines assisted CSS Management in the installation of new technology to treat complex sulfide ore and minimize pollution. In northern Ferry County, Vulcan Mountain Inc. began gold and silver production using heap-leaching technology at the Gold Dyke Mine. Attention was also drawn to the Junction Reef Prospect of Veronex Resources Ltd. of Vancouver, British Columbia, Canada, and Rexcon Inc. of Spokane, where the companies discovered anomalously high gold values in altered host rocks and some visible gold in an associated vein system.

Magnesium.—Northwest Alloys, a wholly owned subsidiary of the Aluminum Co. of America (Alcoa) at Addy, restarted the eighth of nine magnesium furnaces on October 17. The company continued the production of magnesium metal from dolomite mined near the plant site at Addy. The process used is the silicothermic technique using in-plant manufactured ferrosilicon and aluminum-quartzite flux. Plant production capacity is about 25,000 tons of magnesium metal per year, most of which is used by Alcoa as an alloying agent for aluminum. The company introduced a 35-pound magnesium slab ingot for use in the steel industry. That, coupled with additional demand for their 47-pound ingots, allowed the company to operate at near capacity.

Molybdenum.—Although the molybdenum market has not improved significantly since 1981, three companies have discussed proposals with the Colville Confederated Tribal Business Council for the resumption of activity at the Mount Tolman molybdenum project. There had been considerable exploration drilling by AMAX Inc. in years past, but the soft market caused AMAX to pull out of the venture in 1981.

Silicon.—Union Carbide Corp. started hiring and training employees for its Moses Lake polysilicon plant. Production was scheduled to begin in 1984. The company will produce about 1,200 tons of polycrystalline silicon to be used in the electronics industry.

The Hanna Mining Co. reopened its Rock Island silicon and ferrosilicon plant on May 1 after a 7-month closure. The plant had closed because of high inventory and a low demand from the steel and aluminum industries. The improvement in demand, the agreement among the workers to take a wage cut, and lower power rates allowed the plant to restart ahead of schedule. Hanna, in operation at Rock Island since 1974, has become a major supplier of silicon and ferrosilicon throughout the Pacific Northwest.

Silver.—Production of silver was reported by only one company in 1983. Hecla recovered byproduct silver from the Knob Hill Mine near Republic. Production decreased from that reported in 1982.

Production reportedly began in October at the underground Deer Trail Mine near Fruitland in Stevens County. The silver vein system was developed by Madre Mining Ltd. of Vancouver, British Columbia, Canada. The new Madre tunnel has delineated two areas at the Hoodoo and Madre levels.

Kaaba Resources Inc., Vancouver, British Columbia, Canada, announced the opening of the old Ruby silver mine at the base of Chopaka Mountain in Okanogan County, west of Oroville. A 500-ton-per-day mill was under consideration with production to begin in 1984.

The Rocky Mines Co. shipped nearly 800 tons of ore from the Silver Bell Mine in Okanogan County. The ore graded 10 to 12 ounces of silver per ton and was milled by Hecla. Further drilling was scheduled at the property.

Titanium.—International Titanium Inc. (ITI) continued production of titanium sponge at Moses Lake. The first sponge shipments were made to one of its equity holders, Wyman Gordon Co., a manufacturer of specialty metal forgings. ITI initiated its first magnesium recycle cell in November, based on a new design developed in Japan. The company reduced production in September because of reduced demand from the aircraft industry.

---

[1]State Liaison Officer, Bureau of Mines, Spokane, WA.
[2]Geologist and field office supervisor, Washington Division of Geology and Earth Resources, Spokane, WA.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Aluminum Co. of America	Box 120 Vancouver, WA 98660	Plant	Clark.
Do	Box 221 Wenatchee, WA 98801	do	Chelan.
Intalco Aluminum Corp	Box 937 Ferndale, WA 98248	do	Whatcom.
Kaiser Aluminum & Chemical Corp.	Box 6217 Spokane, WA 99207	do	Spokane.
Do	3400 Taylor Way Tacoma, WA 98421	do	Pierce.
Martin Marietta Aluminum Inc	6801 Rockledge Dr. Bethesda, MD 20034	do	Klickitat.
Reynolds Metals Co	Box 999 Longview, WA 98632	do	Cowlitz.
Cement:			
Columbia Cement Corp. a subsidiary of Ashland Technology Inc.[1]	Box 37, Marietta Rd. Bellingham, WA 98225	do	Whatcom.
Ideal Basic Industries Inc.[2]	Box 8789 Denver, CO 80201	do	King.
Lehigh Portland Cement Co.[1]	718 Hamilton Mall Box 1882 Allentown, PA 18105	do	Pend Oreille.
Lone Star Industries Inc	Box 1020 Seattle, WA 98111	do	King.
Clays:			
Mutual Materials Co	Box 2009 Bellevue, WA 98009	Pits and plant	King and Pierce.
North American Refractories, Western Div., Allied Chemical Co.	Box 120 Renton, WA 98057	do	King and Stevens.
Diatomite:			
Inorganic Specialties, a division of Witco Chemical Corp.	520 Madison Ave. New York, NY 10072	Mine and plant	Grant.
Gold:			
Hecla Mining Co.[3]	Hecla Building Wallace, ID 83873	Mine and mill	Ferry.
Lime:			
Northwest Alloys Inc.[1 4 5]	Box 138A, RRT 1 Addy, WA 99101	Plant and mine	Stevens.
Tacoma Lime, a division of Continental Lime Inc.	1220 Alexander Ave. Tacoma, WA 98421	do	Pierce.
Peat:			
Bonaparte Peat	Aeneas Rt., Box 5 Tonasket, WA 98855	Bog	Okanogan.
Maple Valley Humus	18805 SE. 170th St. Renton, WA 98055	Bog	King.
Sand and gravel (industrial):			
Industrial Mineral Products Inc	Box 95 Ravensdale, WA 98051	Pit and plant	Do.
Lane Mountain Silica Co	Box 236 Valley, WA 99181	Pit	Stevens.
Stone:			
Burlington Northern Railroad Co	1310 American Bank Bldg. Portland, OR 97205	Quarries	Various.
De Atley Corp	Box 648 Lewiston, ID 83501	Quarries and plant	Do.
U.S. Forest Service, Region 6	319 SW. Pine St., Box 3623 Portland, OR 97208	Quarries	Do.
Washington State Highway Department.	Highway Administration Bldg. Olympia, WA 98504	do	Do.
Woodworth & Co. Inc	1200 East D St. Tacoma, WA 98421	Quarries and plant	Pierce.

[1]Also stone.
[2]Also clays.
[3]Also silver.
[4]Also industrial sand and gravel.
[5]Also magnesium.

The Mineral Industry of West Virginia

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the West Virginia Geological and Economic Survey for collecting information on all nonfuel minerals.

By Donald K. Harrison[1] and Dewey S. Kirstein[2]

The value of West Virginia's nonfuel mineral production in 1983 was $103.9 million, a $28.4 million increase over that of 1982. In 1983, crushed stone accounted for nearly 37% of the total nonfuel mineral value in the State. Other commodities produced included portland and masonry cement, common and fire clays, lime, salt, and sand and gravel (construction and industrial). Mineral commodities processed or manufactured included aluminum, ferroalloys, fluorspar, synthetic graphite, synthetic iron oxide, iron and steel, nickel, silicon, iron and steel slag, zinc, and zirconium.

Nationally, West Virginia ranked 38th in the value of nonfuel minerals produced in 1983, up from 41st position in 1982. In addition, it ranked third in fire clay production and ferroalloy shipments, and fourth in synthetic iron oxide shipments. The State continued to be one of the leading manufacturers of glassware because of the availability of skilled labor, inexpensive natural gas, and industrial sand resources in the State.

Table 1.—Nonfuel mineral production in West Virginia[1]

Mineral		1982		1983	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2]	thousand short tons	210	$583	249	$532
Salt	do.	942	W	1,026	W
Sand and gravel (construction)	do.	751	3,392	e700	e3,400
Stone (crushed)	do.	e5,900	e22,700	9,439	37,962
Combined value of cement, clays (fire clay), lime, sand and gravel (industrial), and values indicated by symbol W		XX	r48,945	XX	62,079
Total		XX	r75,620	XX	103,973

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes fire clay; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in West Virginia, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Berkeley	$30,411	$24,612	Cement, clays, lime.
Brooke	(2)	--	
Grant	355	W	Sand and gravel (construction).
Greenbrier	6,483	(3)	
Hampshire	W	(3)	
Hancock	W	W	Sand and gravel (construction), clays.
Harrison	W	(3)	
Jackson	10	(3)	
Jefferson	W	(3)	
Kanawha	W	(3)	
Lincoln	W	W	Clays.
Logan	W	(3)	
Marshall	W	W	Salt.
Mason	--	92	Sand and gravel (construction).
Mercer	W	(3)	
Mineral	478	(3)	
Monongalia	W	(3)	
Morgan	W	W	Sand (industrial).
Pendleton	W	W	Lime.
Pocahontas	457	(3)	
Preston	W	(3)	
Raleigh	2,152	(3)	
Randolph	4,931	(3)	
Tucker	370	(3)	
Tyler	W	W	Salt.
Wetzel	(2)	W	Sand and gravel (construction).
Wood	(2)	--	
Wyoming	W	W	Sand (industrial).
Undistributed	39,299	28,217	
Sand and gravel (construction)	e2,601	XX	
Stone (crushed)	XX	e22,700	
Total[4]	87,548	75,620	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Barbour, Boone, Braxton, Cabell, Calhoun, Clay, Doddridge, Fayette, Gilmer, Hardy, Lewis, McDowell, Marion, Mingo, Monroe, Nicholas, Ohio, Pleasants, Putnam, Ritchie, Roane, Summers, Taylor, Upshur, Wayne, Webster, and Wilt Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2]Construction sand and gravel was produced; data not available by county.

[3]Crushed stone was produced; data not available by county.

[4]Data do not add to totals shown because of independent rounding.

Trends and Developments.—Output of most nonfuel minerals produced in the State increased over 1982 levels with the exception of lime and construction sand and gravel, which decreased slightly. Increases in quantity were reported for crushed stone (60%), masonry cement (43%), portland cement (27%), common clay (19%), fire clay (19%), industrial sand (13%), and salt (9%). Although output of most construction mineral commodities have not rebounded to their record highs of the 1970's, the reported increases appear to be an indication that the construction mineral industry is recovering from the recession of the past few years.

Despite the high unemployment rate in the State during most of 1983 (West Virginia had the highest unemployment rate in every month among the 50 States), several mineral-related developments helped to keep the unemployment rate from going even higher. During the year, Kaiser Aluminum & Chemical Corp. began operating two of four potlines at its Ravenswood works, which had been closed since January 1982. With the restart of the potlines, more than 500 workers were recalled to work in the smelting portion of the plant.

In Weirton, nearly 8,000 jobs were saved when steelworkers overwhelmingly approved a plan to purchase the Weirton steel mill. The plant, owned and operated by National Intergroup Inc. (formerly National Steel Corp.), was scheduled to close unless the sale was approved. The Weirton mill is

Table 3.—Indicators of West Virginia business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	777.9	754.4	-3.0
Unemployment	do.	167.7	128.5	-23.4
Employment (nonagricultural):				
Mining[1]	do.	48.3	50.2	+3.9
Manufacturing	do.	88.6	90.2	+1.8
Contract construction	do.	16.9	18.1	+7.1
Transportation and public utilities	do.	38.7	39.3	+1.6
Wholesale and retail trade	do.	121.1	126.1	+4.1
Finance, insurance, real estate	do.	21.7	21.9	+.9
Services	do.	101.9	105.4	+3.4
Government	do.	124.7	129.6	+3.9
Total nonagricultural employment[1 2]	do.	562.0	580.7	+3.3
Personal income:				
Total	millions	$17,142	$17,561	+2.4
Per capita		$8,758	$8,937	+2.0
Construction activity:				
Number of private and public residential units authorized		1,824	1,816	-.4
Value of nonresidential construction	millions	$146.5	$190.3	+29.9
Value of State road contract awards	do.	$244.0	$325.0	+33.2
Shipments of portland and masonry cement to and within the State	thousand short tons	487	473	-2.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$75.6	$104.0	+37.6
Value per capita, resident population		$39	$53	+35.9
Value per square mile		$3,127	$4,291	+37.2

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.
[2]Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

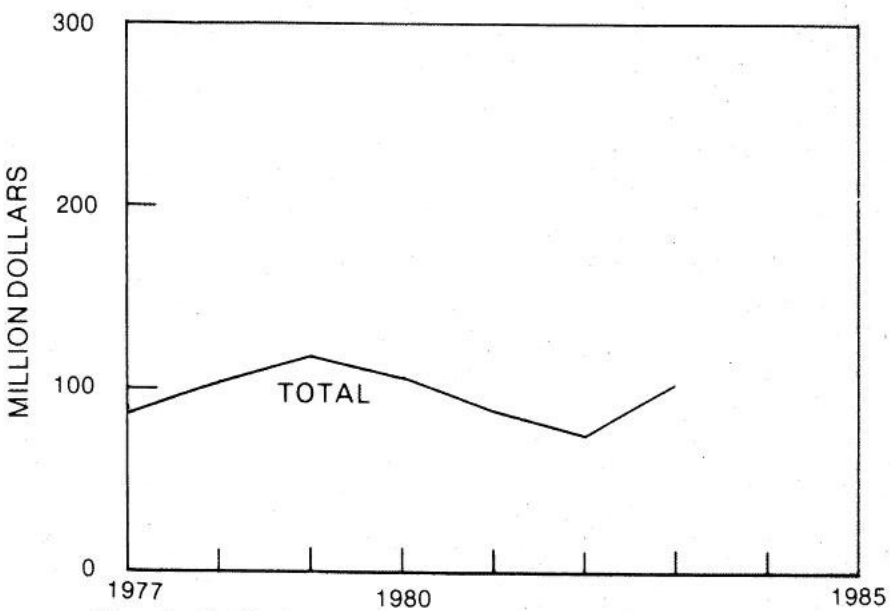

Figure 1.—Total value of nonfuel mineral production in West Virginia.

the largest employer in Hancock County.

In another mineral-related development, researchers at West Virginia University (WVU) have determined that mixing phosphate rock with pyrite-bearing overburden from coal mines is more effective than current practices in preventing acid mine drainage. Field tests by Island Creek Coal Co. at its Craigsville property appear encouraging, and costs, based on $53 per metric ton of phosphate rock, f.o.b. Craigsville, are similar to those of alkaline materials. If the process becomes commercial, water quality in coal mining districts could improve dramatically and a new market for low-grade phosphate rock could develop.

Legislation and Government Programs.—The West Virginia Legislature passed several acts that directly or indirectly affect the State's mineral industry.

Senate bill 116, passed in March, revised the West Virginia Surface Coal Mining and Reclamation Act. The bill amended and reenacted 15 sections of Article 6, Chapter 20 of the Code of West Virginia and also added a new section, designated 20-6-43, to the act. Another act, Senate bill 27, passed in February, amended and reenacted section 20-6-7 of Article 6. This bill provides for the continuation and reestablishment of the Reclamation Commission of the Department of Natural Resources.

House bill 1941, passed in March, amends Article 6, Chapter 22 of the Code of West Virginia and added a new section, designated 4(a). The bill will permit the appointment of a Chairman of the Board to the Miner Training, Education, and Certification Department.

Two other bills passed in 1983 included Senate bill 707, which allows for the cooperation of the State of West Virginia and the Federal Government in the management of Federal lands within the State, and Senate bill 28, relating to the West Virginia Geological and Economic Survey (WVGES). Senate bill 28 amends and reenacts Chapter 29-2-4 of the State's Code to continue the WVGES. It also allows for the establishment of a nonrevolving special revenue account for user fees for computer and analytical services to defray the costs of those services.

Federal legislation containing a provision for the appropriation of $2.2 million for Webster and Pocahontas Counties for revenues lost as a result of the Cranberry Wilderness designation was signed into law. The compensation to the two counties was an amendment to House resolution 5161, signed into law in January 1982, that designated the Cranberry back country as a federally designated wilderness. An estimated 39 million short tons of low-sulfur, low-ash coal underlies the back country.

The Economic Section of the WVGES continued to collect data and conduct ongoing research toward expanding the growth and development of the State's nonfuel mineral industry. Two reports published during the year concerning the nonfuel mineral industry included a directory of the State's mineral producers and processors[3] and a report on the status of West Virginia's mineral industry.[4]

For the past 5 years, the Economic Section has been conducting research on the State's limestone resources. In addition to sampling and analyzing the samples, the WVGES has compiled a computerized data base of analytical and physical data from both current sampling and analyses as well as previously published sources. With the aid of the computer, a program was developed to plot the depth and thickness of subsurface limestone beds that occur near West Virginia's navigable waterways. Several of the WVGES reports concerning limestone evaluations in 1983 include the deep mining of the Greenbrier Limestone,[5] a report on the limestone resources of Harrison County,[6] and an overall outlook of the importance of West Virginia's limestone resources.[7]

Other projects conducted by the Economic Section included an assessment of raw materials needed for construction near the State's high-growth areas. This project is directed toward the evaluation of raw materials needed for masonry, concrete, and concrete products. Samples of sand and gravel, brick clay, and lightweight aggregate shale were collected for testing and evaluation. Also, fieldwork and ground checking of nearly 200 anomalous radioactive occurrences continued during the year. The anomalies were identified by low-level airborne surveys conducted by the U.S. Department of Energy during 1980.

The Mining and Mineral Resources and Research Institute at WVU, Morgantown, received $150,000 in fiscal year 1983 from the U.S. Bureau of Mines. The funds are designed to encourage the training of mining engineers and other scientists involved in mineral-related studies. These funds must be matched with non-Federal funds and can be used for research projects, dem-

onstrations, fellowships, or other programs.

The U.S. Bureau of Mines awarded an additional $1,824,000 grant to Pennsylvania State University and WVU for research on respirable dusts, which causes black lung, silicosis, and other lung diseases. The two universities together have been named as the newest Generic Center for Mineral Technology and will join four other generic centers established and funded in 1982.

Also during fiscal year 1983, the U.S. Bureau of Mines had nine active contracts or grants in West Virginia valued at $212,603. These were awarded to WVU and various private firms for mineral-related studies.

Several studies pertaining to the amelioration of acid mine drainage (AMD) were conducted in the State during the year. The U.S. Bureau of Mines conducted a study and published a report on the abatement of AMD using anionic surfactants.[8] Large-scale tests were conducted at an 8-acre active refuse area in the northern part of the State and at an 11-acre inactive refuse pile in southern West Virginia. In addition, WVU and Buffalo Coal Co. are studying the effects of using natural wetland bogs to combat AMD from abandoned mines. The WVGES is also involved in a long-term study of the subject.

In fiscal year 1983, West Virginia received more than $232,250 from the Federal Government as its share of royalties for various activities in Monongahela National Forest. The majority of the moneys (39%) were attributable to mineral leasing and mining royalties.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Capital Cement Corp. operated the State's only cement (portland and masonry) plant at Martinsburg in Berkeley County in the State's eastern panhandle. The cement plant, previously owned and operated by Martin Marietta Corp., was sold in July to Capital Cement for $16.5 million. Capital Cement, a subsidiary of Riverton Corp., also purchased Martin Marietta's companion cement terminals in Baltimore, MD, and Washington, DC.

The wet-process plant, which includes three coal-fired kilns, has an annual grinding capacity of 935,000 short tons per year and uses electric precipitators for pollution control. Raw materials used in the manufacturing process included limestone and shale mined at the plantsite and industrial sand and gypsum mined elsewhere.

Production and value of portland cement was up 27% and 29%, respectively, over 1982 levels; masonry cement rose 43% in output and 40% in value.

Clays.—In 1983, both common and fire clays were produced in the State. Common clay and shale was mined by Continental Clay Products Co. and Capital Cement (formerly Martin Marietta Cement) in Berkeley County and by Sanders Dummy Co. in Lincoln County. Berkeley County, in the eastern panhandle, continued to account for virtually all of the State's production. Fire clay was mined by one company, Globe Refractories Inc., in Hancock County.

Although production of common clay increased nearly 19% in 1983, total value of production fell nearly 9%, the result of lower unit prices. Principal uses of the common clay from Berkeley County were for the manufacture of cement and face brick. Common clay mined by Sanders Dummy in Lincoln County was sold as "dummy clay" used for mine explosive stemming.

Output and value of fire clay rebounded in 1983, increasing 19% and 31%, respectively. This is in contrast to the nearly 51% drop in output in 1982 compared with 1981 levels. Fire clay was used in the manufacture of firebrick and various refractory specialties.

Fluorspar.—Although no fluorspar was produced in the State, 23,977 short tons was consumed in West Virginia during the year. The 1983 tonnage represents a decline of 19% compared with the 29,648 tons shipped into the State in 1982. Fluorspar was used by the ceramic industry as a flux and opacifier in the manufacture of glass products; it was also used as flux in steelmaking, for hydrofluoric acid, and in other manufacturing processes.

Gem Stones.—Several varieties of mineral specimens were found in the State's predominantly sedimentary rocks. Specimens include coral, opal, various quartz varieties, and two coal ore coallike minerals.

Graphite (Synthetic).—West Virginia ranked sixth of 15 States that produced synthetic graphite in 1983. One company, Union Carbide Corp., continued to produce

graphite specialties at its plant in Clarksburg, Harrison County. In late 1982, the company increased its specialties capacity by 50%. Products included anodes, electrodes, unmachined graphite shapes, and carbon raisers used in steelmaking.

Lime.—Lime was produced by one company in 1983. Both quicklime and hydrated lime were produced by Germany Valley Limestone Co. in Pendleton County. The Riverton Corp., which closed in July 1982 and produced only quicklime, remained idle during 1983.

Both production and value of quicklime decreased nearly 32% in 1983 because of the Riverton closure and lower production levels by Germany Valley Limestone. However, output and value of hydrated lime increased 16% and 19%, respectively, over 1982 levels.

Salt.—Three companies produced salt brine from deep well solution mining operations in Marshall and Tyler Counties. Although production rose only 9% to slightly over 1 million tons, compared with 1982 levels, value rose substantially increasing nearly 49%. All of the salt produced was used for the manufacture of chlorine, caustic soda, and other chemicals.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Based on these estimates, output of construction sand and gravel decreased nearly 7%, while value remained essentially the same because of higher unit values. In 1982, five companies mined construction sand and gravel from five operations in four counties.

Industrial.—Industrial sand was produced by two companies—Pennsylvania Glass Sand Corp. in Morgan County and by Tolers Sand Co. in Wyoming County. Morgan County continued to account for the majority of the State's production. Average value per ton in 1983 was $17.17 compared with $17.67 in 1982. Leading end uses for the sand produced in Morgan County was for flat glass, containers, and specialty glass. The sand produced in Wyoming County was used primarily for traction purposes. Although most of the State's industrial sand was transported by truck, nearly one-third of the total was shipped by rail.

Silicon.—In September, Standard Oil Co. of Indiana (Amoco) completed its $12 million acquisition of Solarex Corp. The acquisition included the company's solar-powered cell manufacturing plant in Frederick, MD, and the silicon wafer plant of Semix Corp. (a Solarex subsidiary) in Martinsburg, WV. The silicon wafer is the basic building block of the solar cell. Prior to this acquisition, Amoco owned nearly 38% of Solarex.

Slag, Iron and Steel.—In 1983, two companies, both located in Weirton, processed slag produced by the State's steel industry. Standard Slag Co. processed air-cooled iron (blast furnace) slag, and International Slag Co. processed steel slag produced in basic oxygen furnaces.

Although shipments of pig iron in 1983 increased nearly 12% over 1982 levels, sales of iron and steel slag decreased 17% and 15%, respectively. Because the construction industry is the major user of slag, the decrease is most likely attributable to a decrease in contract construction and lack of available monies for highway and road construction.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone accounted for nearly 37% of the State's total nonfuel mineral production. Both crushed limestone and sandstone were produced, with limestone accounting for nearly 88% of the State's total output. A total of 40 companies operated 49 quarries—36 of these were crushed limestone operations and 13 were crushed sandstone operations. Leading counties in order of output were Monongalia, Greenbrier, Berkeley, and Jefferson.

The primary uses for crushed stone were for construction aggregate, road base, cement manufacture, mine dusting, agricultural lime, and fill. Although most of the stone was shipped by truck, a small amount was transported by barge and rail.

Table 4.—West Virginia: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	63	230
Filter stone	60	312
Coarse aggregate, graded:		
Concrete aggregate, coarse	504	2,119
Bituminous aggregate, coarse	214	805
Bituminous surface-treatment aggregate	78	339
Other graded coarse aggregate	79	W
Fine aggregate (-3/8 inch):		
Stone sand, concrete	70	341
Stone sand, bituminous mix or seal	162	718
Other fine aggregate	137	560
Coarse and fine aggregate:		
Graded road base or subbase	1,209	5,138
Unpaved road surfacing	292	1,251
Crusher run or fill or waste	254	972
Other coarse and fine aggregate	56	W
Agricultural: Agricultural limestone	50	375
Special:		
Mine dusting or acid water treatment	238	3,712
Other[2]	5,972	21,090
Total	[3]9,439	37,962

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."

[1]Includes limestone and sandstone.

[2]Includes poultry grit and mineral food, macadam, railroad ballast, terrazzo and exposed aggregate, cement manufacture, lime manufacture, flux stone, asphalt fillers or extenders, glass manufacture, screening (undesignated), uses not specified, and uses indicated by symbol W.

[3]Data do not add to total shown because of independent rounding.

METALS

Aluminum.—Kaiser Aluminum reactivated two of its four potlines at Ravenswood during the year. The smelting operation had been shut down since January 1982 pending labor negotiations and to reduce inventories. The first potline was reopened in August and the second in November. By yearend, the smelter was operating at 50% capacity (81,500 short tons). With the start-up of the second line, 2,355 workers were employed at the plant—525 in the smelting division and 1,830 at the fabrication plant.

The fabrication portion of the plant remained in operation throughout the smelter shutdown. Recently, the plant was equipped with a new cold-rolling mill that can process 40,000-pound coils at speeds up to 5,000 feet per minute with automated quality control. The new rolling mill is capable of producing the wider coils to which many aluminum can manufacturers are converting because 12 can bodies, rather than the previous industry standard of 10, can be produced across the width of the metal.

Ferroalloys.—In 1983, three companies produced ferroalloys: Elkem Metals Co. at its plant in Fayette County; the Foote Mineral Co. at its Graham plant in Mason County; and Chemetals Corp., a subsidiary of SEDEMA S.A., at Kingwood in Preston County. Although shipments continued to decline by 10% in 1983, value of the shipments decreased by nearly 46%. Shipments and value were lower in 1983 because of the continuing weak demand by the iron and steel industries, the major consumer of ferroalloys, and because of competition from foreign imports.

A strike that began on October 2 at Foote's ferrosilicon plant in Graham ended on October 30, with ratification of a new 3-year agreement. Foote announced that both parties agreed that wage and benefit concessions were essential in the new contract in order for Foote to remain competitive.

Iron Oxide Pigments (Finished).—West Virginia ranked fourth in the Nation in the shipments of finished iron oxide pigments. Mobay Chemical Corp., a subsidiary of Bayer AG of the Federal Republic of Germany, the sole producer in the State, operated a plant in New Martinsville, Wetzel County. In 1983, shipments increased nearly 62% and value rose 74% compared with 1982 levels. The company produces the iron oxides by the aniline process. This process, developed in Germany in the 1920's, involves the reduction of organic compounds, which reduces nitrobenzene to aniline with scrap iron to produce iron oxide pigments. The process makes it possible to process red, yellow, black, and brown iron oxides.

Regenerator iron oxides were also recovered from steel plant wastes by National Intergroup at its steel mill in Weirton. In 1983, shipments rebounded to close to those

of 1981. In 1982, shipments dropped nearly 74% compared with 1981 levels.

Iron and Steel.—Shipments of pig iron in 1983 increased nearly 12% over 1982 levels reflecting a mild recovery in the steel industry. This increase closely parallels total national shipments, which increased nearly 13% in the same period.

Two integrated companies produced pig iron and steel in West Virginia in 1983. National Intergroup operated a plant in Weirton, and Wheeling-Pittsburgh Steel Corp. operated plants in Benwood, Follansbee, Beech Bottom, and Wheeling. All plants operated below capacity. A steel minimill was operated in Huntington by Steel of West Virginia Inc.

After 18 months of negotiations, steelworkers overwhelmingly approved a plan in September to purchase National Intergroup's Weirton steel mill, Weirton. When the sale is finalized in 1984, the plant will be the Nation's largest employee-owned company. The steelworkers voted on three issues—contract concessions, a new pension plan, and the employee stock ownership plan. National Intergroup is asking $386 million for the mill to be paid by 1998. The price includes $74.7 million in cash up front and assumption of $192.3 million in debts. Under the approved new 6-year contract, hourly workers would have to accept an 18.8% cut in pay and benefit cuts of 20.9%. The new steel company, to be named Weirton Steel Corp., would have a raw steel capacity of 4 million short tons per year and would be the 10th largest domestic steel producer. At yearend, steel was being produced from two of four blast furnaces. The plant has run at a two-furnace level for more than 1 year. Relining work on a third blast furnace was in progress at yearend.

Nickel.—Huntington Alloys Inc. (HAI), a division of Inco Alloy Products Co. (IAPC), continued to produce wrought high-nickel alloys at its Huntington plant in Cabell County. The alloys were used by the energy, chemical, aerospace, and other major industries. In 1983, HAI, which has about 1,900 employees, had sales of $207 million, down 8% from that of 1982 owing principally to lower prices. However, demand increased in the latter part of the year.

In early 1984, the company decided to consolidate its nickel alloy research and development efforts at the two producing locations—Huntington, WV, and Hereford, United Kingdom. Consequently, some of the investigative and technical staff and most of the pilot plant and special equipment at IAPC's Sterling Forest, NY, laboratory will be moved to Huntington. Following the transfer, the Sterling Forest laboratory will be closed and sold. The new operating unit, called Inco Alloys International, will continue to be supported by ongoing research and development programs in both the United States and the United Kingdom.[9]

Zinc.—The Meadowbrook Corp., a wholly owned subsidiary of T. L. Diamond & Co. Inc., operated a zinc plant at Spelter, Harrison County. Zinc drosses, ashes, and other residues were used to produce zinc dust, oxides, and other zinc products.

Zirconium.—Corhart Refractories Co. produced high-density zircon and chromic oxide refractory brick using imported ores at its Buckhannon plant in Upshur County. Imported tin oxide was also used at the plant to produce tin oxide electrodes.

---

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, PA.
[2]Economic geologist and head, Economic Section, West Virginia Geological and Economic Survey, Morgantown, WV.
[3]Kirstein, D. S., and N. M. Simcoe. West Virginia Mineral Producers and Processors Directory. WV Geol. and Econ. Surv., Publ. MRS-1, 10th ed., 1983, 155 pp.
[4]Kirstein, D. S. West Virginia Mineral Industry Status. WV Geol. and Econ. Surv., Publ. MB-1, 1983, 28 pp.
[5]Welker, D. B. Deep Mining the Greenbrier Limestone in Western West Virginia. WV Geol. and Econ. Surv., 1983, Mountain State Geology magazine.
[6]Kirstein, D. S., and D. B. Welker. Limestone Resources of Harrison County, West Virginia. WV Geol. and Econ. Surv., Open File Rep. OF8401, 1983.
[7]Kirstein, D. S. Limestone—West Virginia's Unsung Mineral Hero. WV Geol. and Econ. Surv., 1984, Mountain State Geology magazine.
[8]Kleinmann, R. L. P., and P. M. Erickson. Control of Acid Drainage From Coal Refuse Using Anionic Surfactants. BuMines RI 8847, 1983, 16 pp.
[9]Inco. 1983 Annual Report. Pp. 13-15.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Kaiser Aluminum & Chemical Corp.	Box 98 Ravenswood, WV 26164	Refinery	Jackson.
Cement:			
Capital Cement Corp.[1]	Box 885 Martinsburg, WV 25401	Quarry and plant	Berkeley.
Clays:			
Continental Clay Products Co	Box 1111 Martinsburg, WV 25401	Pit	Do.
Globe Refractories Inc	Box D Newell, WV 26050	Underground mine	Hancock.
Sanders Dummy Co	Box 24 Midkiff, WV 25504	Pit	Lincoln.
Iron oxide pigments (finished):			
Mobay Chemical Corp	Penn Lincoln Parkway West Pittsburgh, PA 15205	Plant	Wetzel.
National Steel Corp., Weirton Steel Div.	Weirton, WV 26062	do	Hancock.
Lime:			
Germany Valley Limestone Co	Box 302 Riverton, WV 26814	Quarry and plant	Pendleton.
Salt:			
FMC Corp	Box 8127 South Charleston, WV 25303	Brine wells	Tyler.
LCP Chemicals-West Virginia Inc.	Drawer J Moundsville, WV 26041	Brine wells and plant	Marshall.
PPG Industries Inc	1 Gateway Center Pittsburgh, PA 15222	do	Do.
Sand and gravel:			
Construction (1982):			
Dravo Corp	1 Oliver Plaza Pittsburgh, PA 15222	Dredges	Various.
ET&S Inc	Route 1 Cheshire, OH 45620	Quarry and plant	Mason.
Petersburg Blocks Inc	Box 75L Petersburg, WV 26847	do	Grant.
Shippingport Sand & Gravel Co.	1200 Stambaugh Bldg. Youngstown, OH 44501	Plant	Hancock.
Industrial:			
Pennsylvania Glass Sand Corp.	Box 187 Berkeley Springs, WV 25411	Quarry and plant	Morgan.
Tolers Sand Co	Route 1, Box 132B Welch, WV 24801	Dredge	Wyoming.
Stone (crushed):			
Acme Limestone Co	Box 27 Fort Spring, WV 24936	Mine and quarry	Greenbrier.
Fairfax Sand & Crushed	Box 98 Thomas, WV 26292	Quarries	Grant, Mineral, Randolph.
Greer Limestone Co., a division of Greer Steel Co.	Greer Bldg. Morgantown, WV 26505	Mine and quarries	Monongalia and Pendleton.
Lone Star Industries Inc	Route 3, Box 489 Morgantown, WV 26505	Mine	Monongalia.
United States Steel Corp	600 Grant St. Pittsburgh, PA 15230	Quarry	Jefferson.

[1]Also clays and crushed stone.

The Mineral Industry of Wisconsin

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Wisconsin Geological and Natural History Survey for collecting information on all nonfuel minerals.

By James J. Hill,[1] Thomas J. Evans,[2] and Wanda J. West[3]

Nonfuel mineral production in Wisconsin was valued at $101.2 million in 1983, the lowest figure reported since 1973. The drop in value was attributed to the State's loss of taconite production, which ended in April 1982. This was the first year since the early 1800's that metallic mineral production had not been reported in the State. Output of several other mineral commodities increased slightly as the State's economy began to improve following the recession of 1981-82. Stone and sand and gravel contributed the greatest amount to the State's mineral production value, followed by lime, cement, and peat. Iron oxide pigments, perlite, and vermiculite were processed in Wisconsin from crude material brought in from out-of-State sources. Sulfur was recovered as a refinery byproduct.

Table 1.—Nonfuel mineral production in Wisconsin[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Iron ore (usable) thousand long tons, gross weight	263	W	--	--
Lime thousand short tons	312	$17,685	319	$17,624
Peat do.	9	W	9	W
Sand and gravel: do.	14,515	29,218	e14,200	e28,800
Construction do.	788	9,662	621	7,208
Industrial				
Stone: do.	e11,400	e36,100	14,252	39,896
Crushed do.	e37	e2,644	24	2,884
Dimension				
Combined value of abrasive stone, cement, and values indicated by symbol W	XX	r16,400	XX	4,779
Total	XX	r111,709	XX	101,191

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Wisconsin, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Adams	--	$43	Sand and gravel (construction).
Ashland	W	55	Do.
Barron	(2)	251	Do.
Bayfield	W	1	Do.
Brown	W	W	Lime, sand and gravel (construction).
Buffalo	$231	16	Sand and gravel (construction).
Burnett	(2)	207	Do.
Calumet	201	W	Do.
Chippewa	(2)	103	Do.
Clark	58	364	Do.
Columbia	W	W	Sand (industrial).
Crawford	192	W	Sand and gravel (construction).
Dane	2,126	944	Do.
Dodge	W	W	Lime, sand and gravel (construction).
Door	W	559	Sand and gravel (construction).
Douglas	12,259	W	Lime, cement, sand and gravel (construction).
Dunn	W	W	Sand and gravel (construction).
Eau Claire	(2)	W	Do.
Florence	(2)	--	
Fond du Lac	W	W	Lime, sand and gravel (construction).
Forest	(2)	109	Sand and gravel (construction).
Grant	1,255	(3)	
Green	W	(3)	
Green Lake	W	W	Sand (industrial), sand and gravel (construction).
Iowa	598	(3)	
Iron	--	W	Sand and gravel (construction).
Jackson	W	W	Iron ore, sand (industrial), sand and gravel (construction).
Jefferson	504	102	Sand and gravel (construction).
Juneau	W	25	Do.
Kenosha	(2)	1,474	Do.
Kewaunee	(2)	234	Do.
La Crosse	754	34	Do.
Lafayette	715	(3)	
Langlade	(2)	W	Sand and gravel (construction).
Lincoln	(2)	229	Do.
Manitowoc	W	W	Lime, sand and gravel (construction).
Marathon	W	659	Sand and gravel (construction).
Marinette	W	62	Do.
Marquette	(2)	140	Do.
Milwaukee	W	W	Cement.
Monroe	1,459	(3)	
Oconto	107	348	Sand and gravel (construction).
Oneida	(2)	448	Do.
Outagamie	1,429	(3)	
Ozaukee	183	364	Sand and gravel (construction).
Pepin	101	40	Do.
Pierce	W	W	Sand (industrial), sand and gravel (construction).
Polk	W	135	Sand and gravel (construction).
Portage	(2)	1,405	Do.
Price	(2)	42	Do.
Racine	W	871	Do.
Richland	131	12	Do.
Rock	707	1,423	Do.
Rusk	(2)	388	Do.
St. Croix	323	370	Do.
Sauk	W	W	Sand and gravel (construction), abrasive stone.
Sawyer	(2)	W	Sand and gravel (construction).
Shawano	W	567	Do.
Sheboygan	55	601	Do.
Taylor	(2)	684	Do.
Trempealeau	658	(3)	
Vernon	205	(3)	
Vilas	(2)	138	Sand and gravel (construction).
Walworth	(2)	872	Do.
Washburn	(2)	W	Do.
Washington	W	1,487	Do.
Waukesha	4,384	W	Sand and gravel (construction), peat.
Waupaca	W	609	Sand and gravel (construction).
Waushara	(2)	W	Do.
Winnebago	1,320	W	Do.
Wood	132	(3)	
Undistributed[4]	87,145	56,550	
Sand and gravel (construction)	e34,522	XX	

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Wisconsin, by county[1] —Continued

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Stone:			
Crushed	XX	[e]$36,100	
Dimension	XX	[e]2,644	
Total	[5]$151,755	111,709	

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Menominee County is not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed and dimension stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone."

[2]Construction sand and gravel was produced; data not available by county.

[3]Stone, either crushed or dimension, was produced; data not available by county.

[4]Includes some sand and gravel that cannot be assigned to specific counties (1982) and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Wisconsin business activity

		1982	1983[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,438.4	2,421.1	-0.7
Unemployment	do.	334.3	239.6	-28.3
Employment (nonagricultural):				
Mining	do.	1.4	1.8	+28.6
Manufacturing	do.	465.1	494.7	+6.4
Contract construction	do.	45.2	51.0	+12.8
Transportation and public utilities	do.	84.2	84.7	+.6
Wholesale and retail trade	do.	408.6	418.1	+2.3
Finance, insurance, real estate	do.	95.7	96.9	+1.2
Services	do.	379.8	383.2	+.9
Government	do.	321.5	313.3	-2.6
Total nonagricultural employment	do.	1,801.5	[1]1,843.6	+2.3
Personal income:				
Total	millions	$51,033	$52,889	+3.6
Per capita		$10,725	$11,132	+3.8
Construction activity:				
Number of private and public residential units authorized		12,312	16,062	+30.5
Value of nonresidential construction	millions	$633.8	$685.3	+8.1
Value of State road contract awards	do.	$173.3	$293.2	+69.2
Shipments of portland and masonry cement to and within the State	thousand short tons	1,080	1,283	+18.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$111.7	$101.2	-9.4
Value per capita, resident population		$24	$21	-12.5
Value per square mile		$2,000	$1,802	-9.9

[p]Preliminary.

[1]Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

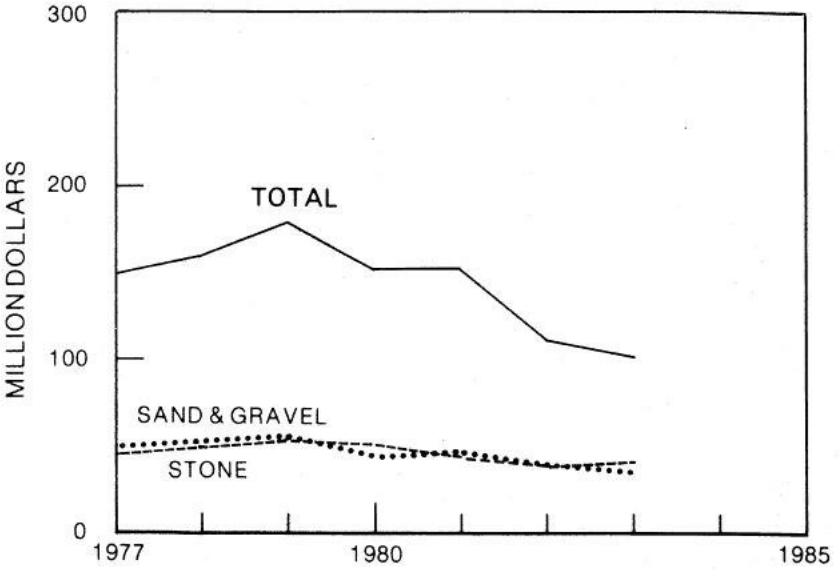

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Wisconsin.

Trends and Developments.—During 1983, Wisconsin's economy and mining industry began to recover from the recession. Statistics published by the State Department of Industry, Labor and Human Relations, showed several positive trends in the economy. The State's average unemployment rate dropped 3.8% compared with that of 1982, with most of the decline reported from June through December. Employment in the mining sector averaged 11.1% more than that of 1982, even though taconite production had ended. The number of building plans examined for compliance with the State's commercial building code increased 26.1% compared with that of 1982. This building activity increased demand for mineral commodities used in construction.

The Wisconsin Department of Development reported that capital investment in the State's manufacturing sector increased sharply and that new jobs more than doubled those of 1982 because of new industries starting up and plant expansions. Capital spending for plants and equipment was up 77% over that of 1982, reaching about $461.1 million. There were 282 projects started in 1983 compared with 193 projects in 1982.

The most notable development during the year was Inland Steel Co.'s announcement in October that it was permanently closing its Jackson County Iron Co. (JCIC) taconite mine and plant near Black River Falls. The reason cited for the closure was the continuing reduced demand for steel products. About 275 employees were affected by the shutdown. The JCIC facilities had been idle since April 1982.

Throughout the year, Exxon Minerals Co. continued to work closely with the Wisconsin Department of Natural Resources (DNR) and the public in processing the multitude of State and local permits required for developing the Crandon zinc-copper deposit in Forest County. Exxon had submitted an environmental impact report and a mining-permit application to the DNR in late December 1982. In September, the DNR released a projected timetable for the remaining review process, which included preparing an Environmental Impact Statement and holding a Master Hearing as required by Wisconsin law. According to the timetable, a decision on the Crandon Project was not expected before early 1987.

Exploration Activities.—Metallic mineral exploration increased in 1983. Three companies were newly licensed during the

year bringing to 17 the number of companies holding exploration licenses. Of these 17 licensees, 9 actually engaged in exploratory drilling, completing 74 drill holes, compared with 57 exploration holes drilled in 1982 (excluding 20 holes drilled by Exxon on the Crandon deposit for feasibility studies). Drilling was spread out over 14 counties with major areas of exploration concentrated in Florence County, Iron County, and southeast Price-northwest Lincoln Counties.

For the first time since 1979, metallic mineral exploration occurred in southern Wisconsin and, particularly, in southeastern Wisconsin where Mobil Oil Corp. completed 18 drill holes in search of base metal mineralization in Ordovician age carbonates. Mobil also drilled a hole in Lafayette County in southwestern Wisconsin. The objective of this drilling appeared to be basic geologic studies and stratigraphic testing as it all was done under short-term lease. Drilling activity during 1983 is summarized in table 4.

Table 4.—Wisconsin: Metallic mineral exploration in 1983

Licensed exploration companies	Number of drill holes	Total footage drilled
AMAX Exploration Inc	2	795
American Copper & Nickel Co. Inc	4	1,137
Amoco Minerals Co	5	2,767
Ernest K. Lehmann & Associates of Wisconsin Inc	17	12,704
Kerr-McGee Corp	5	2,840
Mineralco Inc	1	550
Mobil Oil Corp	19	10,397
Noranda Exploration Inc	6	7,240
UOP Inc	15	10,164
Total	74	48,594

Source: Wisconsin Geological and Natural History Survey. Metallic Mineral Exploration in Wisconsin, Summary of 1983 Activity.

Approximately 14,100 acres was leased for metallic exploration in 1983. This excluded the acreage Mobil drilled under a short-term lease but included 1,800 acres apparently leased for gem stones (diamonds) in Florence and Forest Counties. Iron County had the greatest amount of acreage leased, including an 8,200-acre block of county forest lands leased to Kerr-McGee Corp.[4]

A sizable amount of oil and gas leasing activity began in Wisconsin during 1983. Amoco Production Co. was reportedly seeking more than 100,000 acres of private and county-owned lands in Ashland, Bayfield, and Iron Counties. Also, applications for oil and gas exploration rights on approximately 170,000 acres of land in Chequamegon National Forest were submitted at yearend.

Shipping.—The Seaway Port Authority of Duluth reported waterborne commerce passing through the Port of Duluth-Superior totaled 28.8 million metric tons in 1983, 12.5% more than the 25.6 million tons reported in 1982. Iron ore and concentrates shipments to domestic ports totaled 14.3 million tons, a slight improvement over the 13.1 million tons shipped in 1982. Shipments to Canada totaled 1.5 million tons, down from the 1.7 million tons exported in 1982. Domestic and Canadian limestone and limestone products delivered to the port totaled 963,674 tons in 1983, compared with 934,614 tons in 1982. Some of these commodities are used by the CLM Corp. lime plant and the Huron Cement Div. of National Gypsum Co. clinker-grinding facility in Superior. Cement was delivered to a distribution center in Duluth, and some limestone was trucked from the port to sugar refineries in western Minnesota. Iron ore and concentrates shipped through the Burlington Northern Inc. facility on Allouez Bay in Superior totaled 8.8 million tons in 1983, compared with 8.1 million tons shipped in 1982. Burlington Northern commenced the 1983 ore-shipping season on April 5 and ended on December 21.

The Midwest Energy Terminal in Superior shipped a record-high quantity of low-

sulfur Montana coal to generating plants in Michigan during 1983. The first cargo was shipped on April 14 and the last vessel was loaded on December 14. Terminal employees loaded 5.7 million tons of coal aboard Great Lakes freighters, the most since the terminal opened 7 years ago. The previous record high was 4.2 million tons shipped in 1981.

Waterborne commerce entering the Port of Green Bay on Lake Michigan was reported to be 2.2 million tons in 1983, compared with 2.0 million tons in 1982. The major commodity entering the port was coal, followed by cement and limestone. Potash, salt, and sand were also delivered to the port.

The Port of Milwaukee reported a 4.5% increase in tonnage passing through the port in 1983 because of the economic upturn. Port receipts of selected nonfuel mineral commodities are shown in table 5. Cement was shipped to area distribution centers for construction use. Clinker was imported for use at a local cement-grinding facility. Area foundries used sand and pig iron. Salt was used mainly for snow and ice removal, and potash was imported for fertilizer manufacture.

Table 5.—Port of Milwaukee: Selected nonfuel mineral commodity imports[1]

(Short tons)

Commodity	1982	1983
Cement	339,258	330,037
Clinker	32,086	92,000
Gypsum	--	4,400
Pig iron[2]	--	2,993
Potash	21,549	11,821
Salt	408,871	388,058
Sand	37,415	10,782
Total	839,179	840,091

[1]Includes Canadian imports and domestic receipts.
[2]Includes only City of Milwaukee docks.

Source: Port of Milwaukee, U.S.A.

Legislation and Government Programs.—Although no mining legislation was enacted during the year, several mineral-related bills introduced in the 1983 legislative session were expected to be signed into law during 1984. Assembly Bill 298 was introduced in March to revise the State's alien land law that limited to 640 acres the amount of land a foreign corporation could own. Under the bill, mining exploration leases and mining would be exempt from the 640-acre limit.

Assembly Bill 520, introduced in the legislature in May, authorized creating local government ordinances to regulate nonmetallic mining and mined-land reclamation.

Senate Bill 480, introduced in November, provided for registering severed mineral interests. This bill was patterned after an Indiana statute that the U.S. Supreme Court had ruled constitutional. An earlier Wisconsin law that had required mineral rights registration was ruled unconstitutional by the Wisconsin Supreme Court in 1977.

Assembly Bill 900, introduced during the first week of January 1984, would revise current law and allow the DNR to specify a time period of up to 10 years for temporary cessation of mining because of a strike or adverse economic conditions before requiring minesite reclamation. Previously the time limit was 5 years.

Court proceedings related to the Noranda Exploration Inc. challenge of the State's 1978 Geologic Information Act continued throughout the year. Appeal hearings of a 1982 district court ruling upholding the constitutionality of the law were held before the State Supreme Court in February. The supreme court ruled in July that public disclosure provisions of the law were unconstitutional, but disagreement over the status of other provisons in the law arose. In December, E. K. Lehmann & Associates brought an action before the Dane County Circuit Court to clarify the effect of the supreme court decision. A hearing and decision on this latest action were expected in the spring of 1984.

The Mining Impact and Local Investment Fund Board disbursed more than $500,000 to local governmental units for mining-impact investigation and mitigation in 1983. With revenues of nearly $169,000 from the metallic-mine net proceeds tax and the iron ore concentrates tax, the board made discretionary payments of over $93,000; guaranteed annual permit-period payments to four governmental units near Exxon's Crandon Project of $100,000 each; and made direct payments, totaling almost $16,000, to local governments near the Black River Falls Mine. The discretionary payments are primarily to fund local impact committees' activities dealing with mine-related impacts, legal services, planning, and impact mitigation. Permit-period payments are guaranteed annual payments to local governmental units in which an active metallic mining project has been proposed and mine permits are being sought. The direct payments to local governments near the Black

River Falls Mine represent their share of net proceeds taxes JCIC paid. In September, the board announced grant awards of nearly $34,000 in its discretionary payment program for 1984. Other 1984 payments by the board were estimated to be $434,000 for permit-period payments and direct guaranteed payments.

On January 1, the Wisconsin Geological and Natural History Survey submitted its Principal Report to the Lafayette County Board of Supervisors concerning the impact of mine closings on ground water quality in the Shullsburg area. Closing underground zinc-lead mines near Shullsburg, within the southwest Wisconsin zinc-lead district, resulted in several private water supply wells producing waters with markedly elevated sulfate levels. The report documented the relationship of mine closure to adverse water quality in the area. At yearend, ground water investigations were underway to monitor the water quality produced in newly constructed wells and in surrounding wells beyond the area of immediate impact.

Under a grant from the U.S. Department of Energy, the Wisconsin Geological and Natural History Survey completed sampling peat deposits in 1983. Initiated in 1981, the project will provide the basis for a new estimate of State peat resources and the characterization of peat for fuel and nonfuel uses. At yearend, a final report was being prepared; completion of the report was scheduled for October 1984.

The Wisconsin Survey continued its bedrock geologic mapping program with the release of its new 1:100,000 statewide map. A new 1:100,000-scale bedrock geology map of Marathon County was in final cartographic preparation at yearend. Bedrock geology mapping at the 1:250,000 scale continued in northwest, west-central, and east-central Wisconsin.

In June, Wisconsin's U.S. Senators introduced Senate Bill 1610, which would designate four new wilderness areas in Wisconsin. An identical bill (HR 3578) was introduced in the House of Representatives. The areas included 4,195 acres known as the Porcupine Lake Area of Chequamegon National Forest in Bayfield County. In addition, several portions of the Nicolet National Forest in Forest County, known collectively as the Headwaters Wilderness, were included in the bill. Headwaters comprises the Kimball Creek Unit (7,527 acres), the Pine Unit (8,738 acres), and the Shelp Lake Unit (3,685 acres). Action on these bills was expected in 1984.

In fiscal year 1983, the State received approximately $556,500 from the Federal Government for its share of funds generated by activities on national forest lands (timbering, mineral leasing, recreation, user fees, etc.). This figure compares with $512,580 the State received in fiscal year 1982.

The Forest Service, U.S. Department of Agriculture, identified 41,541 acres of National Forest System land in Wisconsin for further study in its Asset Management Program. The program is designed to identify Federal lands that are inefficient to manage or are no longer needed by the Federal Government. National legislation is needed before national forest land can be sold. Additional analysis for the possible sale of lands in the further-study category was put on hold pending enactment of legislation.

The U.S. Bureau of Land Management (BLM) Lake States Office in Duluth, MN, was closed in 1983, and personnel were transferred to Milwaukee. The office's geographic area of responsibility includes Michigan, Minnesota, and Wisconsin. Employees were surveying Federal lands the agency managed in these States for transfer to State and local ownership. Public domain lands BLM managed in the East tend to be small, widely scattered parcels that could be more efficiently and inexpensively managed by other government agencies. BLM's policy is to dispose of its acreage in the eastern half of the United States through transfer or sale. When feasible, management responsibilities are transferred to other Federal, State, or local agencies that can do a better job of on-site management.

BLM administers approximately 4,200 acres of public lands, consisting of nearly 830 tracts scattered throughout 59 Wisconsin counties. Federal mineral ownership under State, county, and private surface ownership totals approximately 148,000 acres.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasive Stone.—Baraboo Quartzite Co. Inc. mined quartzite at a small quarry east of Baraboo, Sauk County, for use as a deburring and burnishing medium. The extremely hard rock is drilled and blasted by a contractor. Material is then transported from the quarry face by a front-end loader, operated by company personnel, to the crusher. After crushing, the material is tumbled to remove rough edges and screened to about 20 different sizes, ranging from about 4 inches to sand size. Packaged in 100-pound bags, the abrasive was shipped to metal-stamping plants in several States and foreign countries. Production increased slightly over that of 1982 as the economy began to improve.

Cement.—One company operated a cement-grinding facility in Wisconsin during 1983. St. Marys Wisconsin Cement Inc., a subsidiary of St. Marys Cement Ltd., Ontario, Canada, produced gray portland cement (Types I, II, general use and moderate heat) and masonry cement at its grinding plant in Milwaukee. St. Marys obtains its clinker from an out-of-State source. Sales of both portland and masonry cement increased during the year because of improvements in the economy and increased construction. All shipments to consumers were by truck, mainly in bulk form. Most portland cement was shipped to ready-mix companies, concrete-product manufacturers, and building material dealers. Lesser amounts were shipped to highway and other contractors.

Wisconsin's only other cement-grinding facility—National Gypsum, Huron Cement Div., grinding plant at Superior, Douglas County—was idle throughout the year. Operations at the plant were discontinued in September 1982 because of depressed market conditions.

Dundee Cement Co., Dundee, MI, opened a new distribution terminal in LaCrosse in August. Cement is shipped to the terminal by barge from Dundee's plant in Clarksville, MO. The terminal incorporates a barge unloading system capable of unloading barges pneumatically at a rate of 200 short tons per hour. Each silo at the site has a 3,750-ton capacity.[5]

Martin Marietta Cement sold its distribution terminal in Madison to Davenport Cement Co., affiliated with Cementia Holdings A.G. of Zurich, Switzerland.[6] Martin Marietta had expanded the terminal in 1981.

Lime.—Wisconsin was ranked 14th of the 39 States producing lime. In 1983, lime was the third most valuable mineral commodity produced in the State. Three companies produced lime at five plants. Western Lime & Cement Co. operated plants in Brown, Dodge, and Fond du Lac Counties; Rockwell Lime Co. operated a plant in Manitowoc County; and CLM Corp. produced lime at a plant in Douglas County. Each of the plants produced both quicklime and hydrated lime, except for Western Lime & Cement's Knowles plant in Dodge County, which produced only hydrated lime. Lime production increased about 2% compared with that of 1982. About 70% of the State's output was quicklime. Both quicklime and hydrated lime declined in unit value by an average of $1.43 per short ton. Lime was used in mason's lime, paper and pulp manufacture, sewage treatment, and water purification; other uses included finishing lime, road stabilization, and steel production. Lime was shipped to several different States, Canada, and overseas. Lime consumption in the State, from all domestic sources, totaled 154,000 tons.

During the year, Rockwell Lime tested burning solvent wastes in its lime kiln as a substitute for a portion of the natural gas it normally burns. The Environmental Protection Agency and the Wisconsin DNR were analyzing test results. Analysis of the data was to be completed in 1984. If the results prove satisfactory, Rockwell must apply to the DNR for a license to burn the waste regularly.

Western Lime & Cement continued construction of a new rotary-kiln unit at its Eden plant in Fond du Lac County. To be completed in the fall of 1984, the new kiln will add 350 tons per day to the plant capacity. Western Lime's Eden and Green Bay operations received safety awards during the year for time worked without a disabling injury.

Peat.—Three companies in Waukesha County produced peat during the year. Bogda's Top Soil & Excavating Co., operating near New Berlin, produced bulk peat for soil improvement. Certified Peat & Sod Inc., also operating near New Berlin, produced and distributed packaged and bulk peat for soil improvement. Demilco Inc., a division of Nitragin Sales Corp., mined and kiln dried peat near Delafield for shipment to a plant in Milwaukee where it was used as an ingredient for seed inoculant. Both reed-sedge and humus peat were mined in the State. Output remained about the same as

in 1982.

Perlite (Expanded).—One company expanded perlite during the year. Midwest Perlite Co. operated a plant at Appleton in Outagamie County. Sales declined, but average value increased about $15 per short ton. The processed material was used mainly for horticultural purposes; lesser quantities were used as a concrete and plaster aggregate and cavity-fill insulation.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

During the year, McHenry Sand & Gravel Co. Inc. of McHenry, IL, sold Kenosha Materials Co., a ready-mix producer in Kenosha, to Tews Cement & Lime Co. of Milwaukee. Kenosha Materials had operated two sand and gravel pits in Kenosha County.

Table 6.—Wisconsin: Sand and gravel sold or used by producers

	1982			1983		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	3,667	$7,571	$2.06	NA	NA	NA
Gravel	8,828	18,421	2.09	NA	NA	NA
Sand and gravel (unprocessed)	2,021	3,225	1.60	NA	NA	NA
Total[1] or average	14,515	29,218	2.01	e14,200	e$28,800	e$2.03
Industrial sand	788	9,662	12.26	621	7,208	11.60
Grand total or average	15,303	38,880	2.54	e14,821	e36,008	e2.43

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Industrial.—Three companies produced sand for industrial purposes in five counties. For the second consecutive year, production declined; output dropped 21% compared with that of 1982. Average unit value decreased about 5%. Major sales of sand were for foundry applications, glass containers, hydraulic fracturing, and sandblasting. Compared with 1982 sales, the greatest loss was for sand used in foundries. Sales also declined for sand used in glass manufacturing and for hydraulic fracturing.

During 1983, Martin Marietta sold its industrial sand operation near Portage in Columbia County, along with nine operations in several other States, to Unimin Corp. of Connecticut.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—In terms of value, crushed stone was the leading mineral commodity produced in Wisconsin. Nationally, the State was ranked 21st in production. Sales of crushed stone increased during the year, following the revival of the construction industry.

Crushed stone was mined in 46 of the State's 72 counties at 199 quarries. Limestone generated the greatest portion of crushed stone sales, followed by sandstone, granite, and traprock. The greatest number of quarries was in Dane County. Sauk County accounted for the greatest amount of sales.

In May, the largest mobile jaw crusher ever built began operations at a quarry near Rock Springs in Sauk County. Weaver Construction Co. of Iowa Falls, IA, ordered the crusher for the quarry it mines under contract to supply railroad ballast to the Chicago & North Western Transportation Co. The crusher can produce 1,200 short tons per hour, enough to fill as many as 150 railcars in an 8-hour shift.[7]

Table 7.—Wisconsin: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	104	510
Filter stone	23	83
Coarse aggregate, graded:		
Concrete aggregate, coarse	785	2,404
Bituminous aggregate, coarse	446	1,497
Bituminous surface-treatment aggregate	309	755
Railroad ballast	385	1,595
Fine aggregate (-3/8 inch):		
Stone sand, concrete	49	77
Stone sand, bituminous mix or seal	1	W
Screening, undesignated	192	399
Coarse and fine aggregate:		
Graded road base or subbase	5,228	12,133
Unpaved road surfacing	762	1,956
Terrazzo and exposed aggregate	W	13
Crusher run or fill or waste	275	580
Agricultural: Agricultural limestone	589	3,439
Chemical and metallurgical:		
Lime manufacture	184	655
Flux stone	2	W
Special:		
Roofing granules	161	782
Other[2]	4,758	13,017
Total[3]	14,252	39,896

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes limestone, dolomite, granite, sandstone, and traprock.
[2]Includes macadam, miscellaneous fillers or extenders, coarse aggregate (graded), combined coarse and fine aggregate, other uses not specified, and data indicated by symbol W.
[3]Data do not add to totals shown because of independent rounding.

Table 8.—Wisconsin: Crushed stone[1] sold or used by producers, by county

County	1981			1983		
	Number of quarries	Quantity (thousand short tons)	Value (thousands)	Number of quarries	Quantity (thousand short tons)	Value (thousands)
Brown	10	784	$1,540	11	1,059	$2,455
Buffalo	8	91	231	5	111	339
Calumet	1	63	122	3	148	301
Clark	1	29	58	1	W	W
Crawford	10	108	192	5	W	W
Dane	25	861	2,126	20	687	1,928
Dodge	11	403	783	11	725	2,417
Douglas	3	182	W	2	25	64
Dunn	1	W	W	1	12	185
Fond du Lac	6	327	918	5	334	726
Grant	12	626	1,255	10	473	1,108
Green Lake	2	57	88	1	W	W
Iowa	8	288	598	9	528	1,211
Jefferson	4	220	504	4	150	365
La Crosse	5	343	754	3	W	W
Lafayette	10	353	715	12	395	791
Manitowoc	1	311	1,828	1	W	W
Marathon	5	947	2,262	5	1,107	2,687
Marinette	3	369	1,669	3	152	748
Monroe	5	477	1,459	5	411	1,441
Oconto	2	49	107	1	W	W
Outagamie	5	590	1,429	4	707	1,469
Ozaukee	1	79	183	1	W	W
Pepin	1	38	101	1	7	19
Pierce	4	110	342	8	W	W
Richland	7	58	131	4	49	135
Rock	8	352	707	9	340	1,221
St. Croix	3	147	323	2	W	W
Sauk	6	824	1,857	3	1,135	3,175
Sheboygan	1	5	55	2	W	W
Trempealeau	6	192	658	7	W	W
Vernon	6	99	205	2	W	W
Waukesha	5	1,512	3,228	3	776	2,159
Waupaca	2	W	W	1	29	87
Winnebago	4	461	1,320	3	378	1,170
Wood	1	68	132	1	W	W
Undistributed[2]	26	3,766	12,083	30	4,514	13,695
Total	219	15,189	[3]39,962	199	14,252	39,896

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes limestone, dolomite, granite, sandstone, and traprock.
[2]Includes Ashland (1981), Bayfield (1981), Columbia, Door, Green, Juneau, Milwaukee, Polk, Racine, Shawano, Walworth (1983), and Washington Counties and data indicated by symbol W.
[3]Data do not add to total shown because of independent rounding.

Dimension.—Eleven companies produced dimension stone in 5 counties at 14 quarries. Seven companies at eight quarries produced limestone in Calumet, Fond du Lac, and Waukesha Counties in east-central and southeastern Wisconsin. Granite, the most valuable rock type mined, was produced by four companies at six quarries in Marathon and Marinette Counties in central and northeastern Wisconsin. Marathon and Waukesha Counties had the greatest number of quarries operating with five each.

Table 9.—Wisconsin: Dimension stone[1] sold or used in 1983, by use

Use	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Irregular shaped stone[2]	9,940	124	$357
Other rough stone[3]	2,485	29	196
Dressed stone:			
Ashlars and partially squared pieces[4]	6,135	77	327
Monumental	2,119	22	1,831
Curbing	38	(5)	2
Flagging	2,607	33	132
Other dressed stone[6]	894	11	40
Total[7]	24,218	297	2,884

[1]Includes granite and limestone.
[2]Includes rubble.
[3]Includes rough blocks for buildings and other construction and flagging.
[4]Includes veneer.
[5]Less than 1/2 unit.
[6]Includes slabs, blocks for buildings and other construction, and dressed stone not specified.
[7]Data may not add to totals shown because of independent rounding.

Sulfur (Recovered).—At its oil refinery in Superior, Murphy Oil Corp. recovered about 2,000 metric tons of byproduct sulfur.

Vermiculite (Exfoliated).—Koos Inc. exfoliated crude vermiculite from out-of-State sources at a plant in Kenosha. Major sales were for agricultural purposes.

METALS

Iron Ore.—Inland Steel Co. announced the permanent shutdown of its taconite facility near Black River Falls in October. Because of the low-level demand for steel, as well as the need to restructure Inland's iron pellet capacity to meet projected lower levels of demand, JCIC had been idle since April 1982. Reclamation at the minesite continued throughout 1983.

In JCIC's mining permit application and reclamation plan filed with the Wisconsin DNR, crude ore reserves were estimated at 22.8 million long tons as of January 1, 1981; mining was expected to last until the mid-1990's. Deducting crude ore mined in 1981 and 1982, approximately 19.8 million tons of ore remain in the ground.

JCIC shipped its first taconite pellets in 1969 and employed nearly 300 people at full production. Mine production was shipped by rail to Inland's Indiana Harbor Works, East Chicago, IN. With the mine's closing, iron ore production in Wisconsin ceased. Table 10 lists historical iron ore production in the State.

Table 10.—Wisconsin: Usable iron ore produced, by area

(Thousand long tons)

Year	Gogebic Range (Wisconsin part)	Menominee Range (Wisconsin part)	Black River Falls district	Mayville district	Baraboo district	Pierce County	Total
Prior to 1910	13,612	10,716	--	[1]755	304	[2]41	25,428
1910-19	7,356	1,640	--	1,057	339	1	10,393
1920-29	8,428	308	--	765	--	--	9,501
1930-39	8,134	67	--	2	--	--	8,203
1940-49	13,921	4	--	1	--	--	13,926
1950-59	14,709	348	--	--	--	--	15,057
1960-69	4,538	--	38	--	--	--	4,576
1970-79	--	--	7,881	--	--	--	7,881
1980	--	--	699	--	--	--	699
1981	--	--	854	--	--	--	854
1982	--	--	241	--	--	--	241
Total[3]	70,696	13,082	9,713	2,580	643	41	96,755

[1]Partly estimated.
[2]Incomplete total. Excludes data prior to 1906 that are not available.
[3]Data may not add to totals shown because of independent rounding.

Iron Oxide Pigments (Finished).—DCS Color & Supply Co. Inc. processed crude iron oxide pigments obtained from out-of-State sources at its plant in Milwaukee. The colorings are used in cement and construction materials, cosmetics, and paint and coatings. Foundries used the greatest amount of finished material.

Iron and Steel.—*Ferrous Foundries.*—Several developments occurred during the year in Wisconsin's foundry industry. Pelton Casteel Inc. of Milwaukee closed its Crucible Steel Castings Co. division in Milwaukee indefinitely. Equipment was to be stored until market conditions improved. About 150 jobs were terminated.

Federal Casting Div., a subsidiary of Chromalloy American Corp. of St. Louis, MO, shut down during the year, affecting about 50 employees. Federal Casting made malleable and ductile iron castings at its West Allis plant.

At yearend, Bucyrus-Erie announced the closing of its South Milwaukee foundry because of the depressed mining- and construction-equipment business. About 140 employees were to be affected by the shutdown.

Because of poor market conditions, Milwaukee Solvay Coke Co., the State's only coke-processing facility, closed during the year. A division of Pickands Mather & Co. of Cleveland, OH, the firm served foundries in Illinois, Michigan, and Wisconsin.

On the brighter side, the Waukesha Foundry Division of Abex Corp., Waukesha, began constructing a $4.1 million investment casting facility at Watertown. The new 80,000-square-foot plant was to be completed in two stages: 40,000 square feet was to be completed in 1983; the remainder, by mid-1986. Advanced foundry technology, including robots and high-capacity furnaces, will be featured at the plant. When fully completed, the plant was expected to provide 110 new jobs and quadruple current production capacity. The foundry will produce castings for valves and pumps for the construction, defense, and nuclear-power industries.

Zinc-Copper.—In December 1982, Exxon submitted an environmental impact report and a mining-permit application for the Crandon zinc-copper deposit in Forest County to the Wisconsin DNR. This submittal triggered an intensive review process, which was expected to last several years. During the year, Exxon continued to supply information and to perform additional studies to resolve questions that arose during the review process. Also, the firm continued to file applications for the many permits needed to activate the mine.

---

[1]State Liaison Officer, Bureau of Mines, Minneapolis, MN.
[2]Assistant professor, Minerals Information, Wisconsin Geological and Natural History Survey, Madison, WI.
[3]Program assistant, Bureau of Mines, Minneapolis, MN.
[4]Harkin, D. A. Mineral Transactions Activity and Terms in Wisconsin—1983. Univ. WI Agri. Econ. Staff Paper No. 218, 1984, 11 pp.
[5]Rock Products. V. 86, No. 12, Dec. 1983, p. 38.
[6]———. V. 86, No. 6, June 1983, p. 9.
[7] Pit & Quarry. V. 76, No. 4, Oct. 1983, pp. 72-74.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasive stone:			
Baraboo Quartzite Co. Inc	Box 123 Baraboo, WI 53913	Quarry and plant	Sauk.
Cement:			
St. Marys Wisconsin Cement Inc., a subsidiary of St. Marys Cement Ltd.	2200 Yonge St. Toronto, Ontario M4S 2C6 Canada	Grinding plant	Milwaukee.
Iron oxide pigments (finished):			
DCS Color & Supply Co. Inc	2011 South Allis St. Milwaukee, WI 53207	Plant	Do.
Lime:			
CLM Corp	12th Ave., West and Waterfront Duluth, MN 55802	do	Douglas.
Rockwell Lime Co	Route 2, Box 124 Manitowoc, WI 54220	do	Manitowoc.
Western Lime & Cement Co	Box 57 West Bend, WI 53095	Plants	Brown, Dodge, Fond du Lac.
Peat:			
Bogda's Top Soil & Excavating Co	12600 West Cleveland Ave. New Berlin, WI 53151	Bog and plant	Waukesha.
Certified Peat & Sod Inc	19000 West Lincoln Ave. New Berlin, WI 53151	do	Do.
Demilco Inc., a division of Nitragin Sales Corp.	3101 West Custer Ave. Milwaukee, WI 53209	do	Do.
Perlite (expanded):			
Midwest Perlite Co	4280 Parkway Blvd. Appleton, WI 54911	Plant	Outagamie.
Sand and gravel:			
Construction (1982):			
American Materials Corp	Box 338 Eau Claire, WI 54701	Pits and plants	Barron, Dunn, Eau Claire.
Baumhardt Sand & Gravel Co.	102 Fond du Lac Ave. Fond du Lac, WI 53019	do	Fond du Lac and Washington.
C. C. Linck Inc	1225 North Center St. Beaver Dam, WI 53916	do	Various.
McHenry Sand & Gravel Co. Inc.	Box 511 McHenry, IL 60050	do	Kenosha.
State Sand & Gravel Co	10833 West Watertown Plank Rd. Milwaukee, WI 53226	Pit and plant	Racine.
Tews Cement & Lime Co	6200 West Center St. Milwaukee, WI 53210	Pits and plants	Racine and Waukesha.
Valley Sand & Gravel Corp	563 West 19750 Luchow Dr. Muskego, WI 53150	Pit and plant	Waukesha.
Industrial:			
Badger Mining Corp	Box 97 Fairwater, WI 53931	Pits and plants	Green Lake, Jackson, Marinette.
Treco Sales Inc	Box 38 Bartlesville, OK 74003	Pit and plant	Pierce.
Unimin Corp	50 Locust Ave. New Canaan, CT 06840	do	Columbia.
Stone:			
Crushed:			
Granite:			
Belanger Granite Co	Route 2 Auburndale, WI 54412	Quarry and plant	Marathon.
Carl Wimmer	2807 Dove Ave. Wausau, WI 54401	do	Do.
Wissota Sand & Gravel Co.	Box 1268 Eau Claire, WI 54702	do	Douglas.
Limestone and dolomite:			
Halquist Stone Co. Inc.[1]	N52 W23564 Lisbon Rd. Sussex, WI 53089	Quarries and plant	Waukesha.
Arthur Overgaard Co	Box 87 Elroy, WI 53929	Quarries and plants.	Buffalo, Juneau, La Crosse, Monroe.
Vulcan Materials Co., Midwest Div.	Box 6 Countryside, IL 60525	do	Milwaukee, Racine, Waukesha, Winnebago.
Sandstone and quartzite:			
Foley Bros. Inc	Rock Springs, WI 53961	Quarry and plant	Sauk.
Minnesota Mining & Manufacturing Co.	3M Center St. Paul, MN 55101	do	Marathon.
Traprock (basalt):			
GAF Corp	Box 630 Pembine, WI 54156	do	Marinette.
TCI Traprock Inc	Box 176 Dresser, WI 54009	do	Polk.
Dimension:			
Granite:			
Anderson Bros. & Johnson Co.	Box 26 Wausau, WI 54401	Quarries and plant	Marathon and Marinette.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Dimension —Continued			
Granite —Continued			
Cold Spring Granite Co	Route 2, Box 416 Wausau, WI 54401	Quarry and plant	Marathon.
Lake Wausau Granite Co.	Box 397 Wausau, WI 54401	____do ____	Do.
Limestone:			
Buechel Stone Center Inc	Box 907 Fond du Lac, WI 54935	Quarries and plant	Fond du Lac.
Halquist Stone Co. Inc.[2]	N52 W23564 Lisbon Rd. Sussex, WI 53089	Quarry and plant	Waukesha.
Sulfur (recovered):			
Murphy Oil Corp	Box 2066 Superior, WI 54880	Byproduct sulfur recovery plant.	Douglas.
Vermiculite (exfoliated):			
Koos Inc	4500 13th Ct. Kenosha, WI 53140	Plant	Kenosha.

[1]Dimension limestone also.
[2]Crushed limestone also.

The Mineral Industry of Wyoming

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Wyoming for collecting information on all nonfuel minerals.

By Karl E. Starch[1] and Gary B. Glass[2]

The value of nonfuel minerals produced in Wyoming in 1983 was $629.9 million, a 6% decline from that of 1982 and the second consecutive year in which the value of nonfuel minerals produced in the State fell. This lower value resulted primarily from a 5% decline in the value of sodium carbonate produced and a 33% decline in the value of clays output. Lower values also occurred in lime and construction sand and gravel production. Value of output increased for portland cement, gypsum, iron ore, and crushed stone. Contrary movements occurred between the volume of output and value of output for iron ore, sodium carbonate, and crushed stone.

Comprising more than three-fourths of the total value, sodium carbonate was again the most important nonfuel mineral produced in the State. Bentonite was second in importance; iron ore, third; and portland cement, fourth. Wyoming was the Nation's major source of sodium carbonate, or natural soda ash, with more than 80% of total output, and of bentonite with 67% of national output. Wyoming ranked 11th among the States that produced nonfuel minerals in 1983, down two positions from its 1982 ranking. The State's output contributed less than 3% to the total value of the Nation's nonfuel minerals. Eight nonmetallic minerals and two metallic minerals were produced in the State in 1983.

The relative value of nonfuel minerals in Wyoming's economy in 1983 is demonstrated by comparing the per capita value of nonfuel mineral production in Wyoming, $1,255, to the national average per capita value, $91.

Table 1.—Nonfuel mineral production in Wyoming[1]

Mineral	1982		1983	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	2,561	$73,696	2,140	$49,059
Gem stones	NA	250	NA	250
Gypsum thousand short tons	283	2,805	382	2,963
Sand and gravel (construction) do.	3,382	10,279	e2,400	e8,000
Stone (crushed) do.	e2,300	e7,300	2,019	7,769
Combined value of beryllium concentrate, cement (portland), iron ore, lime, and sodium carbonate	XX	573,865	XX	561,860
Total	XX	668,195	XX	629,901

eEstimated. NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Wyoming, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Albany	$17,130	$12,632	Cement (portland), sand and gravel (construction), clays, gypsum.
Big Horn	W	29,191	Clays, gypsum, lime, sand and gravel (construction).
Campbell	(2)	W	Sand and gravel (construction).
Carbon	(2)	W	Do.
Converse	(2)	W	Do.
Crook	W	W	Clays, sand and gravel (construction).
Fremont	W	W	Iron ore, sand and gravel (construction).
Goshen	W	W	Lime, sand and gravel (construction).
Johnson	W	W	Clays, sand and gravel (construction).
Laramie	W	W	Sand and gravel (construction), beryllium concentrate.
Lincoln	(2)	W	Sand and gravel (construction).
Natrona	206	2,620	Sand and gravel (construction), clays.
Park	W	1,808	Gypsum, sand and gravel (construction).
Platte	W	222	Sand and gravel (construction).
Sheridan	(2)	W	Do.
Sublette	(2)	W	Do.
Sweetwater	W	W	Sodium carbonate, sand and gravel (construction).
Teton	(2)	W	Sand and gravel (construction).
Uinta	W	W	Sand and gravel (construction), clays.
Washakie	W	2,616	Clays, lime, sand and gravel (construction).
Weston	W	W	Clays, sand and gravel (construction).
Undistributed[3]	740,603	611,806	
Sand and gravel (construction)	e10,120	XX	
Stone (crushed)	XX	e7,300	
Total	[4]768,058	668,195	

eEstimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Hot Springs and Niobrara Counties are not listed because no nonfuel mineral production was reported. County distribution for construction sand and gravel (1981) and crushed stone (1982) is not available; total State values shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2]Construction sand and gravel was produced; data not available by county.

[3]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Wyoming business activity

		1982	1983p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	249.4	251.0	+0.6
Unemployment	do	25.1	17.0	-32.3
Employment (nonagricultural):				
Mining[1]	do	28.9	27.7	-4.2
Manufacturing	do	7.7	7.7	--
Contract construction	do	13.2	15.4	+16.7
Transportation and public utilities	do	16.3	16.6	+1.8
Wholesale and retail trade	do	43.1	43.9	+1.9
Finance, insurance, real estate	do	7.7	7.6	-1.3
Services	do	32.0	29.7	-7.2
Government	do	49.1	49.4	+.6
Total nonagricultural employment[1]	do	198.0	198.0	--
Personal income:				
Total	millions	$6,205	$6,156	-.8
Per capita		$12,211	$11,969	-2.0
Construction activity:				
Number of private and public residential units authorized		2,937	2,729	-7.1
Value of nonresidential construction	millions	$122.4	$72.1	-41.1
Value of State road contract awards	do	$110.7	$144.9	+30.9
Shipments of portland and masonry cement to and within the State	thousand short tons	405	382	-5.7
Nonfuel mineral production value:				
Total crude mineral value	millions	$668.2	$629.9	-5.7
Value per capita, resident population		$1,331	$1,225	-8.0
Value per square mile		$6,824	$6,440	-5.6

pPreliminary.

[1]Includes bituminous coal and oil and gas extraction.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

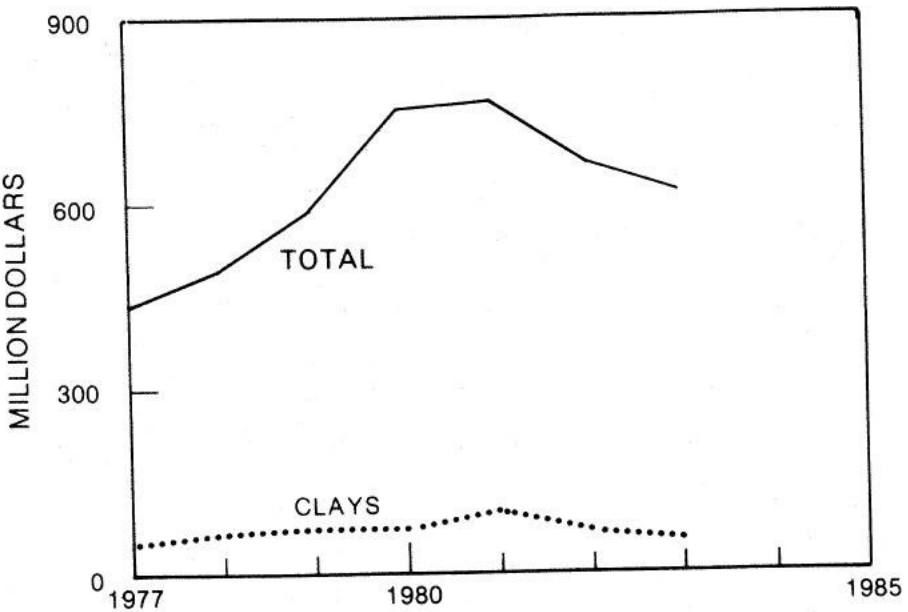

Figure 1.—Value of clays and total value of nonfuel mineral production in Wyoming.

Nonfuel minerals were produced in 21 of Wyoming's 23 counties; construction sand and gravel, in 21; crushed stone, in 7; bentonite, in 6; byproduct sulfur, in 6; gypsum, in 3; portland cement, in 1; and sodium carbonate, in 1. Sweetwater County, site of all five of Wyoming's large trona or sodium carbonate mines, remained the premier county in value of nonfuel mineral output.

During the year, the continued slump in soda ash and bentonite demand and closure of the State's only remaining iron ore operation, the Atlantic City Mine, were the most important events in nonfuel mineral industry trends in Wyoming. However, during the year, some indications pointed toward a bottoming out of the widespread slump in Wyoming's mining industry.

The taxable valuation of property and production in Wyoming, $7.9 billion in 1983, decreased for the first time since 1944 because of lower production and unit value of oil. Mineral production contributed nearly 71% of the State's tax base. Of the $6.3 billion assessed value of property in 1983, approximately $5.6 billion was on minerals, about $151 million on nonfuel minerals, and about $122 million on trona. Of the $379 million in ad valorem taxes paid on mineral production in 1983, trona producers paid $8.7 million, and other nonfuel mineral producers, $2 million. Severance tax collections from mineral production increased from $4.1 million in 1969 to $384.2 million in 1982. Trona producers paid $6.8 million of the total in 1982. The severance tax rate grew from 1% on all minerals in 1969 to 5.5% on trona in 1983 and 2% on other nonfuel minerals (6.0% on oil and gas and 10.5% on coal). Sales and use taxes on mineral output grew from $1.4 million in 1971 to $26.8 million in 1983; of the 1983 amount, nonfuel mineral producers paid about $4.2 million. Federal Government mineral-royalty returns to the State (50% of mineral income derived from Federal lands in the State) were $152.2 million in 1983. Total mineral income to the State of Wyoming from all these sources was $839.9 million (including severance tax collections for the first two quarters only), down about 16% from the 1982 level.

Unemployment in Wyoming declined in 1983, while the total labor force remained about the same. Employment in mining declined very slightly, from about 29,000 people in 1982 to less than 28,000 in 1983.

Wyoming ranked 18th among the States in per capita income in 1983, down from 8th

in 1982 and 4th in 1981; per capita income in the State was 102% of the national average in 1983. Although average weekly earnings in manufacturing in 1983 ($322.72) were lower than the national average ($372.86), the average weekly earnings in mining were higher in Wyoming ($552.11) than in the Nation-at-large ($493.34). Both mining wages and manufacturing wages grew faster in Wyoming in 1983 than the U.S. average. Mining wages in Wyoming grew 17% in 1983 and 6% in the whole United States; manufacturing wages grew 11% in Wyoming and 8% in the whole United States.

Exploration Activities.—Compared with neighboring States, Wyoming remains relatively unexplored for mineral deposits. Exploration increased in the Wyoming Archean Province as similarities between Wyoming's Precambrian and Canada's mineral-rich Superior Provinces were recognized. Exploration for precious metals was reported in every mountain range in the State. Timberline Minerals Inc. and Kerr-McGee Corp., Minerals Exploration Div., continued exploring for gold in the Seminoe Mountains. Exploration for gold and tungsten deposits in the Copper Mountain supracrustal belt in the Owl Creek Mountains was fairly high in the 1983 field season. Several firms, including Freeport Exploration Co. and United States Borax & Chemical Corp., explored the South Pass greenstone belt at the southern tip of the Wind River Range, the State's most productive gold-producing area; in addition, local prospectors conducted underground exploration and development of some of the historic gold mines and placer properties. Exxon Minerals Inc. prospected in the stratiform exhalative copper, silver, and zinc deposits in the Sierra Madre Mountains near the Ferris-Haggerty Mine; Exxon Minerals leased the Ferris-Haggerty Mine and associated claims from Nupec Resources Inc. Ferris-Haggerty was Wyoming's largest producing copper mine from 1897 to 1905. Timberline Minerals restaked some properties in this area that Conoco Inc. dropped last year. Kirkwood Exploration Co. conducted limited exploration in a copper-silver-gold deposit at the Copper King Mine in the Silver Crown District of the southern Laramie Range. Limited exploration was noted at the Griggs copper-silver-zinc mine in Wyoming's Overthrust Belt.

Exploration for diamond-bearing kimberlite continued. The Geological Survey of Wyoming sampled stream sediments in the Laramie Range, and Cominco American Incorporated and Superior Minerals Co. were still active in the Wyoming State Line District. Cominco rejected one potential resource as being too low grade for commercial mining. The University of Wyoming's Department of Geology and Geophysics and the Geological Survey of Wyoming continued jointly investigating the applicability of remote-sensing techniques to kimberlite exploration.

Exploration continued for such industrial minerals as bentonite, construction aggregates, gypsum, limestone and dolomite, sodium sulfate, sugar rock, and trona as present and prospective producers sought to expand reserves. Some exploration was conducted for high-silica sand deposits suitable for use in the manufacture of glass. Such deposits could complement the State's soda ash industry. A few companies were active in the anorthosite area of southeastern Wyoming. Aluminum Co. of America (Alcoa) continued to test anorthosite for use as aluminum ore. Phosphate in the Permian Phosphoria Formation in the Overthrust Belt of western Wyoming continued to attract interest, as did the large natural zeolite reserves of the Beaver Rim, Lysite Mountain, and Washakie Basin areas.

An Ore Genesis Symposium hosted by the Geological Survey of Wyoming, the Wyoming Geological Association, and the University of Wyoming's Department of Geology and Geophysics was held on the University of Wyoming campus in April. It drew a crowd of more than 250 people, an indication of the high interest in Wyoming mineral deposits.

Legislation and Government Programs.—The State legislature passed a number of bills intended to provide relief to Wyoming's mining industry.

SF 67, effective May 27, 1983, enlarged the time limits for filing liens on mines, quarries, and wells.

SF 78, effective February 28, 1983, would allow the Wyoming Department of Environmental Quality (DEQ) to rule a mine permit application deficient without having to deny it.

SF 85, effective May 27, 1983, provided for quarterly distribution of Federal mineral royalties.

SF 157A, effective February 25, 1983, would allow the DEQ to approve an interim status for mines forced to close but not terminating operations permanently. Such a mine would have to stabilize its property but could delay actual reclamation until a

decision was made on reopening the mine.

HB 149, effective July 1, 1983, provided for a title 30 revision of all State mining laws to remove obsolete, conflicting, and duplicative laws. It also provided for compensating members of the State Board of Mines and other administrative matters.

A bill to reduce severance taxes on iron ore and uranium ore produced in Wyoming was defeated on the grounds that it would not put any people back to work. The bill had been proposed as a means of relieving the depressed iron ore and uranium industries.

A Wyoming wilderness bill was proposed in the U.S. Congress to designate about 635,000 acres as an additional wilderness area in the State, bringing the number of acres in Wyoming classified as wilderness to 2.8 million acres, about 4.5% of the State's area. The U.S. Forest Service proposed that more than 635,000 acres be added; the National Wildlife Federation, 1.3 million additional acres; and the Sierra Club, 2.4 million additional acres. The bill had not worked its way through the legislative process by yearend.

Wyoming received a $24.7 million grant through the Office of Surface Mining to reclaim 44 abandoned mines in the State. The sites include 14 open mine portals, 3 vertical shafts, 1 cistern, 66 subsidence pits, 9 abandoned mine structures, and 3 open pits. In addition, a $10.6 million subsidence-control project at Rock Springs and a $400,000 project to reclaim 14 abandoned mines in Hot Springs and Albany Counties were allocated to the State.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Output of portland cement by Wyoming's only cement producer, the Monolith Portland Cement Co. plant south of Laramie, increased about 10% in 1983 over that of 1982. Although stocks were reduced about 12% during the year, material from stocks made up less than 1% of shipments. About 95% of the portland cement produced was Types I and II, general use and moderate heat; the balance was oil-well cement used in casing and capping oil wells. No masonry cement production was reported. More than 85% of the production was shipped to ready-mixed concrete companies, with the remainder, in descending order of importance, shipped to other contractors, miscellaneous customers, concrete product manufacturers, and building material dealers. More than two-thirds of the quantity shipped went directly to the customer rather than through a terminal; 96% was shipped in bulk; and all was reported shipped by truck. Gypsum, limestone, pyrite, sandstone, and shale were the raw materials consumed in the production process.

The Monolith plant's two wet-process kilns were reported to have been in production about 1 out of every 3 days during the year. Although 1983 output of the 325,000-short-ton-capacity plant increased slightly over the 1982 level, it remained close to the recession-reduced levels of the past several years.

Clays.—Wyoming produced 5% of the Nation's total clay output in 1983, but produced 67% of the Nation's high-swelling sodium bentonite. The 1983 total clay output was 16% lower than that of 1982 and 44% lower than 1981 production. The value of bentonite dropped even faster as the 1983 value was more than 34% less than the 1982 value. Thus, 1983 was the second year of declining bentonite output, but the rate of decline was slower than that of 1982. Nevertheless, bentonite continued to rank second in value among nonfuel minerals produced in Wyoming.

Eight companies reported bentonite output at 112 sites in 6 counties: Big Horn, Crook, Johnson, Natrona, Washakie, and Weston. Common clay, less than 10% of the total clay output, was produced by two companies at two sites in two counties, Albany and Uinta. Nearly 97% of bentonite output was from Big Horn, Crook, Johnson, and Weston Counties.

American Colloid Co. was the largest clay producer. Dresser Minerals, a division of Dresser Industries Inc.; Federal Bentonite, a division of Aurora Industries Inc.; and NL Industries Inc., Baroid Div.—all were in the same range of output. A second group of companies producing at a somewhat lower level were the Kaycee Bentonite Corp.; International Minerals & Chemical Corp.; Wyo-Ben Inc.; and Lone Star Industries Inc., a producer of common clay. The smaller producers were the Benton Clay Co. and Interstate Brick Co., the other producer of common clay in the State. The largest four companies produced nearly 60% of total output.

Bentonite producers continued to face

depressed markets in oil-well drilling and iron ore pelletization, the major uses of the clay. Use in drilling mud consumed more than 55% of bentonite output in 1983. Other major uses included foundry sand, about 19%, and pelletizing iron, 14%. Bentonite was also used in animal feed and for pond lining to prevent seepage (waterproof sealing) and in the manufacture of bricks, chemicals, insulation, and paint. Common clay was used mostly in producing portland cement, with a lesser amount manufactured into face brick.

A number of the bentonite mines remained closed, and the mills operated at reduced levels; employment in the industry continued to fall from about 1,200 workers in 1981, to less than 900 in 1982, to fewer than 700 in 1983.

Gem Stones.—Cominco and Superior Minerals continued testing the commercial potential of diamonds found at several locations in the State. Personnel at the Department of Geology and Geophysics of the University of Wyoming and the Geological Survey of Wyoming continued analyzing data collected by a National Aeronautics and Space Administration aircraft with special electronic equipment. Their study is aimed at identifying remote sensing data that can indicate the presence of the potentially diamond-bearing jade, kimberlite.

Other than the interesting prospect of diamonds, Wyoming gem stones consisted of jade (nephrite) found mostly in the Granite Mountain area of southern Fremont and southwestern Natrona Counties and marketed mostly in rock and mineral shops and trade fairs.

Gypsum.—Crude gypsum was produced by the Georgia-Pacific Corp., Gypsum Div., in Big Horn County; The Celotex Corp., a subsidiary of Jim Walters Corp. in Park County; and Wyoming Construction Co. in Albany County. Gypsum was calcined by Georgia-Pacific in Big Horn County and Celotex in Park County. Celotex was the largest producer in the State of both crude and calcined gypsum. Output of both increased considerably in 1983 over that of 1982 because of the recovery in construction activities.

Lime.—Two companies reported quicklime production in 1983—Holly Sugar Corp. at its plants in Torrington, Goshen County, and in Worland, Washakie County; and The Great Western Sugar Co. at its plant in Lovell, Big Horn County. Quicklime was used in refining beet sugar. The quantity produced in 1983 was more than 23% less than that of 1982.

Perlite (Expanded).—Two perlite expanding plants were established west of Green River in Sweetwater County in 1983. The larger of the two facilities, built and operated by the Harborlite Corp. of Escondido, CA, employed 10 to 15 people and planned to operate year round. It was Harborlite's third such facility, with others located in California and Michigan. Raw material for the operation was brought in from company-owned perlite mines in Arizona and a small amount from Idaho. The smaller facility, Western Perlite Corp., operated only several days per month utilizing raw materials shipped in from Idaho. The product of both facilities was marketed as filter aid.

Phosphate Rock.—No phosphate rock was reported mined in Wyoming in 1983. Stauffer Chemical Co., however, continued to beneficiate phosphate mined in Idaho at its Leefe plant west of Kemmerer in Lincoln County.

Chevron USA Inc. planned a 200,000-metric-ton-per-year phosphate fertilizer plant for a site south of Rock Springs. The plant would use sulfur produced as a by-product of natural gas processing in Uinta County and phosphate rock from a Chevron Resources Co. mine near Vernal, UT. The phosphate rock would be transported in slurry form through a 98.2-mile, 11-inch-diameter pipeline. Chevron USA received a permit to build the plant in 1983 and advertised for bids, with construction to begin in 1984.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Only construction sand and gravel was produced in the State. The 1983 production was estimated at 29% less than that of 1982. The Annual Report of the State Inspector of Mines of Wyoming estimated 729 people worked in construction sand and gravel operations in the State in 1983.

In a 5-to-4 decision June 6, 1983, the U.S. Supreme Court ruled that gravel qualified as a mineral under the Stock-Raising Homestead Act of 1916, which granted surface rights to individuals but reserved mineral rights for the Federal Government. In a suit Western Nuclear Inc. filed, a Federal district court ruled in 1979 that such gravel was a mineral, but the 10th U.S. Circuit Court of Appeals in Denver, CO, reversed that ruling in 1982. The 1983 Supreme Court ruling affected about 70 million acres of grazing land in the West.

Table 4.—Wyoming: Construction sand and gravel sold or used by producers

	1982			1983[e]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	367	$1,462	$3.99	NA	NA	NA
Gravel	2,700	8,031	2.97	NA	NA	NA
Sand and gravel (unprocessed)	315	786	2.49	NA	NA	NA
Total or average	3,382	10,279	3.04	2,400	$8,000	$3.33

[e]Estimated. NA Not available.

Sodium Carbonate.—In 1983, Wyoming continued as the world's largest sodium carbonate, or natural soda ash, producing region. The soda ash is produced from the ore trona, of which the State has the world's largest known resource. The Wyoming State Inspector of Mines reported about 6.4 million short tons of soda ash was produced in 1983 from about 11.6 million tons of trona ore. This output was about 85% of the total natural soda ash produced in the United States; at $76 per ton, the product accounted for nearly 80% of the total value of nonfuel minerals produced in Wyoming in 1983.

Five companies, all in Sweetwater County in the southwestern part of the State, produced soda ash in Wyoming. These companies and their approximate level of soda ash production (from the State Inspector's report) in 1983 were Allied Chemical Corp., 1.7 million tons; FMC Corp., 2.1 million tons; Stauffer Chemical Co. of Wyoming, 1.4 million tons; Tenneco Minerals Co., 0.5 million tons; and Texasgulf Inc., 0.5 million tons. The production level of these companies in 1983 was about 75% of capacity.

The 6% increase in soda ash production in 1983 was largely ascribed to increased exports. The market for glass, which in the recent past consumed 55% of soda ash output, remained depressed as demand for window and automobile glass remained at reduced levels; the market for glass in containers declined severely as use of plastic, metal, and paper containers accelerated. However, increased use of soda ash was noted in chemicals, pulp and paper, and soap and detergent.

Early in the year, an independent Japanese Government trade agency, the Japanese Fair Trade Commission, began investigating alleged unfair trade practices affecting Green River-based soda ash producers. Four Japanese soda ash manufacturers and a port-terminal operating company were under investigation. Wyoming producers, claiming they could deliver soda ash to Japan less expensively than that country could produce its own soda ash, alleged that trade barriers such as high unloading fees made the U.S. product less competitive.

In February, FMC laid off another 25 workers. Out of a total work force of about 1,400 people, FMC laid off 100. In April, Allied Chemical laid off 127 workers, reducing its work force to 850 compared with 1,150 a year earlier. In May, Stauffer Chemical reduced its work force by 117 people, to about 543. Stauffer Chemical was the only one of the four older soda ash producers in Wyoming that had not laid off workers in the current slump. In September, Texasgulf reduced its work force of 380 by 10%. For the year, more than 650 workers of a normal employment level of 4,000 workers were off work. By August, however, several companies believed the soda ash market was improving. Allied Chemical rehired 39 people in midyear.

In November, to expand its markets, FMC, largest of the Wyoming soda ash producers, cut its product price from $84 to $69 per ton; to remain competitive, other companies followed suit. This action also lowered the tax base for Sweetwater County and the State.

Texasgulf contracted for a $4 million to $6 million modification of its waste water and tailings disposal system to comply with a DEQ requirement. DEQ called for public comment on FMC's proposal to begin work on a commercial solution trona-mining project in early 1984; the company projected that solution mining could cut trona-mining costs by 25%. In a program called the "Nickel Solution," employees at several of Wyoming's five trona operations volunteered to contribute one nickel of each hour's wage to the glass-packaging industry in a promotion campaign for glass products.

The five soda ash companies paid the State of Wyoming about $6 million in severance taxes in 1983 and about $116 million in wages to employees, 52% of whom lived in Green River and 24% in Rock Springs.

The U.S. Bureau of Land Management announced plans to test a different leasing scheme for Federal trona deposits; in this approach, called "concessionary leasing," much larger parcels would be offered for bid.

Stone.—Crushed stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1982 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Six companies and the U.S. Forest Service reported producing stone at 11 quarries in 7 counties in Wyoming in 1983. All reported producing crushed stone; none reported producing dimension stone. Dolomite accounted for nearly one-half of crushed stone production; limestone and granite for most of the balance. Platte County was the major producing county, followed by Laramie, Albany, and Crook; Sublette, Teton, and Lincoln Counties contributed much smaller amounts. Dolomite was the only crushed stone produced in Platte County, limestone in Crook and Teton Counties, granite in Sublette County, and both granite and limestone in Albany and Laramie Counties.

Guernsey Stone Co. (Peter Kiewit & Sons Co.) and Morrison-Knudsen Co. Inc. were the largest producers, followed at some distance by Monolith and Summit Materials Co. The U.S. Forest Service, Great Western Sugar, and the Union Pacific Railroad Co. were smaller producers. The four largest producers supplied more than 90% of total output. One quarry in the 900,000- to 999,999-short-ton-per-year size range produced nearly one-half of the total output; one quarry in the 500,000- to 599,999-ton-per-year size range contributed 25% of total output. All other operations produced less than 300,000 tons per year. Trucks were the major form of transportation from quarry to consumption point.

More than 54% of the crushed stone produced in Wyoming in 1983 was used for railroad ballast; stone sand (concrete) and cement manufacture were the other major uses, which, with railroad ballast, consumed about 80% of the total. Other uses, in descending order of quantity, were dense road base, concrete aggregate, coarse aggregate, stone sand (bituminous mix or seal), riprap and jetty stone, sugar refining, unpaved road surfacing, roofing granules, and fill. Prices ranged from $1.02 per ton for coarse aggregate at the low end of the price range to $6.10 per ton for sugar refining limestone at the high end, with an overall average of $3.85 per ton. Crushed stone output in 1983 declined 12% compared with that of 1982, while value increased 6%. According to newspaper reports, Basin Inc. quarried about 60,000 tons of white marble 20 miles west of Wheatland and processed it for use in aquariums, architectural precast slabs, landscaping, roofing, sinks, and swimming-pool plaster in the company's plant at Wheatland. Shipments were made to 40 States, but most of the product went to Illinois and Texas.

Table 5.—Wyoming: Crushed stone[1] sold or used by producers in 1983, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Cement manufacture	206	433
Graded road base or subbase	(2)	(2)
Macadam	53	54
Railroad ballast	1,100	4,730
Other[3]	659	2,551
Total[4]	2,019	7,769

[1]Includes limestone, dolomite, granite, and miscellaneous stone.
[2]Less than 1/2 unit.
[3]Includes concrete aggregate (coarse), unpaved road surfacing, riprap and jetty stone, stone sand (concrete and bituminous mix or seal), crusher run or fill, roofing granules, sugar refining, and uses not specified.
[4]Data do not add to totals shown because of independent rounding.

Sulfur.—With continued increase of natural gas production from the Overthrust Belt area in western Wyoming, Wyoming has become a major source of byproduct sulfur. The sulfur was derived from "sweetening" of the natural gas.

Five companies produced byproduct sulfur at natural gas processing plants in Carbon, Fremont, Laramie, Park, Sweetwater, and Uinta Counties. The companies were Amoco Production Co., a subsidiary of Standard Oil Co. (Indiana); Chevron USA; Colorado Interstate Gas Co.; Husky Oil Co.; and Sinclair Oil Corp. The largest producer was Amoco, whose Whitney Canyon plant began producing in 1982. Second was the Chevron USA Carter Creek plant, also in Uinta County, which came into production in 1983. Exxon Corp. planned a third large natural gas processing plant for southwest Wyoming at Shute Creek in Lincoln County, 65 miles northwest of Rock Springs. The proposed plant is planned to have a capacity to treat 600 million cubic feet of gas daily. As many as 2,200 construction workers would be employed, with a permanent operating work force of about 200. It could produce nearly 2,000 short tons of byproduct sulfur per day. The nearby Amoco and Chevron USA plants were capable of producing 1,200 tons and 1,000 tons, respectively, of byproduct sulfur daily.

The Chevron Chemical Co. phosphate fertilizer plant, planned for a site south of Rock Springs, would use sulfur recovered at Chevron Chemical's Carter Creek gas-processing plant.

METALS

Beryllium.—A small amount of beryllium concentrate was reported produced in Fremont County.

Gold.—Although no gold production was reported in Wyoming in 1983, interest in gold in the State was high. Timberline Minerals explored the Penn Mine about 35 miles northeast of Rawlins in the Seminoe Mountains. Timberline Minerals acquired the mine, adjoining claims, and 10,000 acres surrounding the old mine after the Geological Survey of Wyoming reported finding gold in the area. Kerr-McGee, Minerals Exploration Div., also staked land in the area for gold and other precious minerals. The U.S. Forest Service approved a plan by Goldwest Corp. of Cheyenne for a gold-mining operation in the Cottonwood Creek area of the Bridger-Teton National Forest in northwest Wyoming. Goldwest, exploring the area since 1978, planned to recover gold, platinum, silver, and associated minerals by processing gravel adjacent to Cottonwood Creek. Recreational Gold Camps of America sought a permit to develop 20 temporary camping cabins to house vacationing gold seekers who want to pan for gold in creeks feeding the Sweetwater River near South Pass City. The firm would rent the cabins to vacationers between Memorial Day and Labor Day, then store the cabins during the winter. Gold was discovered in Wyoming in 1842, and a small gold rush occurred in the South Pass area after 1867; however, some minerals people believe that the State never has been properly prospected for gold and silver.

Iron Ore.—Iron ore production in Wyoming in 1983, the State Inspector of Mines reported, was about 20% less than that of 1982. Value increased about 60%. The most important event in iron ore mining in the State, however, was the October 1983 closure of the Atlantic City Mine, the State's last operating iron ore mine. Its owner, United States Steel Corp., said output of the mine was no longer competitive with iron ore from other mines. Status of the mine has been questionable since U.S. Steel began cutting back operations at its Geneva Works near Provo, UT, the sole consumer of the taconite pellets produced at Atlantic City. Production began at the Atlantic City Mine in 1962. By 1969, it was shipping about 1.7 million long tons of taconite pellets per year. Production was temporarily halted twice in 1982 as demand for U.S. produced steel declined. In 1983, attempts were made to reduce costs at Atlantic City. On October 1, operations at the mine were indefinitely suspended, and on December 27, the company announced the closure would become permanent on April 1, 1984. In October 1983, the Geneva Works began receiving iron ore from the Minntac Mine in Minnesota. The total assessed valuation of the Atlantic City Mine, mill, ore, and railroad was more than $21 million, and U.S. Steel paid about $1.5 million in property taxes in 1982. More than 500 workers were affected by the shutdown.

Wyoming's other iron ore mine, CF&I Steel Corp.'s Sunrise Mine in the southeastern part of the State, closed in 1980.

---

[1]State Liaison Officer, Bureau of Mines, Denver, CO.
[2]State geologist and Executive Director, Geological Survey of Wyoming, Laramie, WY.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement (portland):			
Monolith Portland Cement Co.[1]	Box 40 Laramie, WY 82070	Plant	Albany.
Clays:			
American Colloid Co	5100 Suffield Ct. Skokie, IL 60076	Pits and plants	Big Horn, Crook, Weston.
Benton Clay Co	Box 819 Mills, WY 82644	do	Johnson and Natrona.
Dresser Minerals, a division of Dresser Industries Inc.	Box 832 Greybull, WY 82426	do	Big Horn.
Federal Bentonite, a division of Aurora Industries Inc.	609 5th Ave. Belle Fourche, SD 57717	do	Crook and Weston.
International Minerals & Chemical Corp.	Box 460 Belle Fourche, SD 57717	do	Crook.
Kaycee Bentonite Corp	Box 1 Mills, WY 82644	do	Johnson, Natrona, Washakie.
NL Industries Inc., Baroid Div	Box 1675 Houston, TX 77001	do	Big Horn and Crook.
Wyo-Ben Inc	Box 1979 Billings, MT 59103	do	Big Horn and Hot Springs.
Gypsum:			
The Celotex Corp	Box 590 Cody, WY 82414	Surface mine and plant.	Park.
Georgia-Pacific Corp	133 Peachtree St., NE. Atlanta, GA 30303	do	Big Horn.
Wyoming Construction Co.[2]	Box 907 Laramie, WY 82070	Surface mine	Albany.
Iron ore:			
United States Steel Corp	Lander, WY 82520	Open pit mine and plant.	Fremont.
Lime:			
The Great Western Sugar Co.[2]	Box 5308 Denver, CO 80217	Plant	Big Horn.
Holly Sugar Corp	Holly Sugar Bldg. Colorado Springs, CO 80902	Plants	Goshen and Washakie.
Sodium carbonate:			
Allied Chemical Corp	Box 551 Green River, WY 82935	Underground mine and plant.	Sweetwater.
FMC Corp	Box 872 Green River, WY 82935	do	Do.
Stauffer Chemical Co. of Wyoming	Box 513 Green River, WY 82935	do	Do.
Tenneco Minerals Co	Box 1167 Green River, WY 82935	do	Do.
Texasgulf Inc	Box 100 Granger, WY 82934	do	Do.
Stone (crushed):			
Guernsey Stone Co	Box 337 Guernsey, WY 82214	Quarry	Platte.
Morrison-Knudsen Co. Inc	Box 1028 Cheyenne, WY 82001	do	Laramie.
Summit Materials Co	Box 1716 Rapid City, SD 57709	do	Crook.

[1]Also clays and crushed stone.
[2]Also crushed stone.