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Minerals Yearbook

1982

Volume II

AREA REPORTS: DOMESTIC

Prepared by staff of the

BUREAU OF MINES

UNITED STATES DEPARTMENT OF THE INTERIOR • William P. Clark, 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.

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Foreword

With the 1982 Minerals Yearbook, the Federal Government begins its second century of annual reports on the mineral industries. This edition discusses the performance of the worldwide mineral industry during 1982 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 and a chapter on mining and quarrying trends.

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, constructive comments and suggestions by 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: California Division of Mines and Geology, 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 Bureau of Mines and Geology, Idaho Department of Lands.
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, 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 Department of Energy and Minerals.
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: Wyoming Geological Survey.

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 gold, silver, copper, lead, zinc, and tin, 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 of 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, Office of Geographic Statistics.

Table 1.—Value of crude nonfuel mineral production[1] in the United States, by mineral group

(Million dollars)

	Metals	Nonmetals	Total
1980[r]	8,921	16,213	25,134
1981[r]	8,842	16,385	25,227
1982	5,544	14,147	19,691

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

Table 2.—Nonfuel mineral production[1] in the United States

Mineral	1980		1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS						
Antimony ore and concentrate short tons, antimony content	343	W	646	W	503	W
Bauxite thousand metric tons, dried equivalent	1,559	$22,353	1,510	$26,489	732	$12,334
Copper (recoverable content of ores, etc.) metric tons	1,181,116	2,666,931	1,538,160	2,886,440	1,139,563	1,866,895
Gold (recoverable content of ores, etc.) troy ounces	969,782	594,050	r1,379,161	r633,918	1,446,905	543,908
Iron ore, usable (excluding byproduct iron sinter) thousand long tons, gross weight	69,562	2,543,484	72,158	2,914,689	35,751	1,491,705
Iron oxide pigments, crude short tons	62,642	r3,272	67,214	r2,285	67,294	2,702
Lead (recoverable content of ores, etc.) metric tons	550,366	515,189	445,535	358,821	512,425	288,528
Manganiferous ore (5% to 35% Mn) short tons, gross weight	173,887	2,444	r174,760	2,889	31,509	293
Mercury 76-pound flasks	30,657	11,939	27,904	11,549	25,760	W
Molybdenum (content of concentrate) thousand pounds	149,311	1,344,181	118,916	945,540	77,789	514,834
Nickel (content of ore and concentrate) short tons	14,653	W	12,099	W	3,203	W
Silver (recoverable content of ores, etc.) thousand troy ounces	32,329	667,278	r40,683	r427,921	40,239	319,903
Titanium concentrate: Ilmenite short tons, gross weight	593,704	32,041	523,681	37,013	233,063	19,093
Tungsten ore and concentrate thousand pounds of contained W	6,036	50,575	7,815	62,231	3,473	22,062
Vanadium (recoverable in ore and concentrate) short tons	4,806	64,370	5,126	71,496	4,098	52,577
Zinc (recoverable content of ores, etc.) metric tons	317,103	261,671	312,418	306,879	300,274	254,668
Combined value of beryllium, magnesium chloride for magnesium metal, platinum-group metals (1980-81), rare-earth metal concentrate, tin, titanium concentrate (rutile), zircon concentrate, and values indicated by symbol W	XX	141,492	XX	r153,902	XX	154,917
Total	XX	r8,921,000	XX	r8,842,000	XX	5,544,000
NONMETALS (EXCEPT FUELS)						
Abrasive stones[2] short tons	r631	r1,933	r2,501	r1,096	1,285	553
Asbestos metric tons	80,079	30,599	75,618	30,685	63,515	24,917
Asphalt and related bitumens, native: Bituminous limestone, sandstone, gilsonite thousand short tons	1,252	25,030	1,261	27,654	W	W
Barite do.	2,245	65,957	2,849	102,439	1,845	69,522
Boron minerals do.	1,545	366,760	1,481	435,387	1,234	384,597
Bromine thousand pounds	r378,200	95,400	r377,100	90,200	401,100	102,600
Calcium chloride short tons	581,012	47,950	704,691	61,692	e616,513	e61,483
Carbon dioxide, natural thousand cubic feet	1,628,424	2,561	1,577,053	2,607	2,067,500	3,399
Cement:						
Masonry thousand short tons	3,040	188,456	2,738	161,819	2,364	145,172
Portland do.	71,612	3,613,332	68,197	3,515,600	61,080	3,084,439
Clays do.	48,790	898,947	44,379	988,845	35,345	825,064
Diatomite do.	689	100,610	687	113,010	613	107,619
Feldspar short tons	e710,000	e23,200	665,000	21,000	615,000	20,300
Fluorspar do.	92,635	12,611	115,404	18,412	77,017	13,293
Garnet (abrasive) do.	26,909	r1,908	25,451	2,059	27,303	2,321
Gem stones[e]	NA	6,930	NA	7,625	NA	7,150
Gypsum thousand short tons	12,376	103,059	11,497	98,101	10,538	89,131
Helium:						
Crude million cubic feet	299	3,588	175	2,100	W	W
Grade-A do.	1,159	26,657	1,223	31,798	31,248	342,432
Lime thousand short tons	19,010	842,922	18,856	884,197	14,075	696,207
Mica: Scrap do.	116	6,262	133	8,212	106	6,302
Peat do.	788	16,190	757	18,783	730	16,702
Perlite short tons	638,000	16,500	591,000	r17,458	506,000	16,044
Phosphate rock thousand metric tons	54,415	1,256,947	53,624	1,437,986	37,414	950,326
Potassium salts (K_2O equivalent) do.	2,217	353,862	1,908	328,900	1,784	265,600
Pumice thousand short tons	543	4,267	499	4,311	416	3,750
Pyrites thousand metric tons	847	13,812	797	49,160	676	41,943

See footnotes at end of table.

Table 2.—Nonfuel mineral production[1] in the United States —Continued

Mineral	1980		1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS (EXCEPT FUELS)—Continued						
Salt thousand short tons	40,352	$656,164	38,907	r$637,568	37,880	$671,096
Sand and gravel:						
Construction do	763,100	1,996,000	e690,000	e1,928,000	597,170	1,683,201
Industrial do	29,600	293,000	29,980	332,300	28,355	339,725
Sodium sulfate (natural) do	583	36,387	608	43,186	W	W
Stone:[4]						
Crushed do	r980,305	r3,254,572	r872,600	r3,125,000	p790,030	p2,918,300
Dimension do	r1,315	r138,907	1,331	150,461	p1,330	p145,113
Sulfur, Frasch process thousand metric tons	7,400	720,511	5,910	715,683	3,598	434,660
Talc and pyrophyllite thousand short tons	1,473	25,626	1,343	31,497	1,135	27,236
Tripoli short tons	121,233	676	107,330	617	112,928	653
Vermiculite thousand short tons	337	23,483	320	26,181	316	28,508
Combined value of aplite, emery, graphite (1982), helium (Grade-A, 1982), iodine, kyanite, lithium minerals, magnesite, magnesium compounds, marl (greensand), olivine, sodium carbonate (natural), staurolite, wollastonite, and values indicated by symbol W	XX	941,212	XX	933,515	XX	917,358
Total	XX	r16,213,000	XX	r16,385,000	XX	14,147,000
Grand total	XX	r25,134,000	XX	r25,227,000	XX	19,691,000

eEstimated. pPreliminary. 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.

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

Table 3.—Nonfuel minerals produced in the United States and principal producing States in 1982

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., Mo., Ark., Ga	Ill., Mont., Tenn., Wash.
Bauxite	Ark., Ala., Ga.	
Beryllium concentrate	Utah, S. Dak., Colo., Wyo.	
Boron minerals	Calif.	
Bromine	Ark. and Mich.	
Calcium chloride	Mich. and Calif.	
Carbon dioxide (natural)	Colo., N. Mex., Calif.	
Cement	Tex., Calif., Pa., Mich	All other States except Alaska, Conn., Del., Mass., N.H., N.J., N. Dak., R.I., Vt.
Clays	Ga., Tex., Wyo., Calif	All other States except Alaska, Del., Hawaii, R.I., Vt., Wis.
Copper (mine)	Ariz., Utah, N. Mex., Mont	Alaska, Calif., Colo., Idaho, Mich., Mo., Nev., Tenn., Wash.
Diatomite	Calif., Nev., Wash., Oreg.	
Emery	N.Y.	
Feldspar	N.C., Conn., Ga., Calif	Okla. and S. Dak.
Fluorspar	Ill., Tex., Nev.	
Garnet, abrasive	Idaho, N.Y., Maine.	
Gold (mine)	Nev., S. Dak., Utah, Mont	Alaska, Ariz., Calif., Colo., Idaho, N. Mex., Oreg., Wash.
Gypsum	Tex., Okla., Iowa, 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., Calif., Wyo	Colo., Mo., Mont., Nev., N.Y., Tex., Utah, Wis.
Iron oxide pigments (crude)	Mich., Mo., Ga., Va.	
Kyanite	Va. and Ga.	
Lead (mine)	Mo., Idaho, Colo., N.Y	Alaska, Ariz., Calif., Ill., Mont., Nev., N. Mex., Utah, Wash.
Lime	Ohio, Mo., Ky., Pa	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., Miss., N.J., Utah.
Manganiferous ore	Minn. and S.C.	
Marl, greensand	N.J.	
Mercury	Nev.	
Mica, scrap	N.C., N. Mex., S.C., Ga	Conn., Pa., S. Dak.
Molybdenum	Colo., Ariz., Nev., Utah	Calif. and N. Mex.
Nickel	Oreg.	
Olivine	N.C. and Wash.	
Peat	Mich., Fla., Ind., Ill	Calif., Colo., Ga., Iowa, Maine, Mass., Minn., Mont., N.J., N.Y., N.C., N. Dak., Ohio, Pa., Wash., Wis.
Perlite	N. Mex., Ariz., Calif., Idaho	Colo. and Nev.
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., Colo., Ariz.	
Rare-earth metal concentrate	Calif. and Fla.	
Salt	La., Tex., N.Y., Ohio	Ala., Ariz., Calif., Colo., 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., Tex., Calif	All other States except Alaska, Del., Hawaii, Idaho, Ind., Iowa, Maine, Md., Miss., Mont., Nev., N.H., N. Mex., N. Dak., Oreg., S. Dak., Utah, Vt., Va., W. Va., Wyo.
Silver (mine)	Idaho, Ariz., Mont., Utah	Alaska, Calif., Colo., Ill., Mich., Mo., Nev., N. Mex., N.Y., 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., Vt., Ind., N.H	All other States except Alaska, Del., Fla., Ky., La., Maine, Miss., Neb., Nev., N. Dak., W. Va., Wyo.
Sulfur (Frasch)	Tex. and La.	
Talc and pyrophyllite	Mont., Vt., Tex., N.Y	Ark., Calif., Ga., N.C., Oreg., Va., Wash.
Tin	Alaska and Colo.	
Titanium concentrate	Fla., N.Y., N.J.	
Tripoli	Ill., Okla., Ark., Pa.	
Tungsten ore and concentrate	Calif., Colo., Nev., Mont	Idaho.
Vanadium	Colo., Utah, Idaho, Ark.	
Vermiculite	Mont., S.C., Va.	
Wollastonite	N.Y. and Calif.	
Zinc (mine)	Tenn., Mo., N.Y., Pa	Colo., Idaho, Ill., Ky., Mont., N.J.
Zircon concentrate	Fla.	

Table 4.—Value of nonfuel mineral production in the United States and principal nonfuel minerals produced in 1982

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
Alabama	$299,409	21	1.52	Cement, stone (crushed), lime, sand and gravel (construction).
Alaska	112,911	36	.57	Sand and gravel (construction), stone (crushed), gold, tin.
Arizona	1,619,296	1	8.22	Copper, molybdenum, cement, sand and gravel (construction).
Arkansas	256,389	25	1.30	Bromine, cement, stone (crushed), sand and gravel (construction).
California	1,612,193	2	8.19	Cement, boron minerals, sand and gravel (construction), stone (crushed).
Colorado	638,232	10	3.24	Molybdenum, cement, sand and gravel (construction), stone (crushed).
Connecticut	56,076	43	.28	Stone (crushed), sand and gravel (construction), feldspar, sand and gravel (industrial), stone (dimension).
Delaware	[1]3,197	50	.02	Magnesium compounds, sand and gravel (construction).
Florida	1,223,398	4	6.21	Phosphate rock, stone (crushed), cement, sand and gravel (construction).
Georgia	717,973	8	3.65	Clays, stone (crushed), cement, stone (dimension).
Hawaii	46,889	45	.24	Stone (crushed), cement, sand and gravel (construction), lime.
Idaho	300,180	20	1.52	Silver, phosphate rock, lead, gold.
Illinois	389,594	18	1.98	Stone (crushed), cement, sand and gravel (construction), sand and gravel (industrial).
Indiana	215,004	29	1.09	Cement, stone (crushed), sand and gravel (construction), lime.
Iowa	218,637	28	1.11	Stone (crushed), cement, sand and gravel (construction), gypsum.
Kansas	256,016	26	1.30	Cement, salt, stone (crushed), helium (Grade-A).
Kentucky	206,947	30	1.05	Stone (crushed), lime, cement, sand and gravel (construction).
Louisiana	417,667	17	2.12	Sulfur (Frasch), salt, sand and gravel (construction), cement.
Maine	35,439	46	.18	Sand and gravel (construction), cement, stone (crushed), peat.
Maryland	171,457	33	.87	Stone (crushed), cement, sand and gravel (construction), clays.
Massachusetts	89,302	39	.45	Sand and gravel (construction), stone (crushed), lime, stone (dimension).
Michigan	1,035,895	6	5.26	Iron ore, cement, magnesium compounds, salt.
Minnesota	1,110,126	5	5.64	Iron ore, sand and gravel (construction), stone (crushed), stone (dimension).
Mississippi	72,685	42	.37	Sand and gravel (construction), clays, cement, stone (crushed).
Missouri	733,774	7	3.73	Lead, cement, stone (crushed), lime.
Montana	266,594	22	1.35	Copper, silver, gold, cement.
Nebraska	79,557	40	.40	Cement, sand and gravel (construction), stone (crushed), lime.
Nevada	525,900	13	2.67	Gold, molybdenum, barite, diatomite.
New Hampshire	23,294	47	.12	Sand and gravel (construction), stone (dimension), stone (crushed), clays.
New Jersey	132,410	35	.67	Stone (crushed), sand and gravel (industrial), sand and gravel (construction), zinc.
New Mexico	431,813	16	2.19	Potassium salts, copper, cement, gold.
New York	500,353	14	2.54	Stone (crushed), salt, cement, sand and gravel (construction).
North Carolina	257,258	24	1.31	Stone (crushed), phosphate rock, lithium compounds, cement.
North Dakota	12,977	48	.07	Sand and gravel (construction), lime, salt, clays.
Ohio	450,229	15	2.29	Stone (crushed), salt, sand and gravel (construction), lime.
Oklahoma	225,044	27	1.14	Stone (crushed), cement, sand and gravel (construction), sand and gravel (industrial).
Oregon	107,843	38	.55	Stone (crushed), sand and gravel (construction), cement, lime.
Pennsylvania	602,554	12	3.06	Cement, stone (crushed), lime, sand and gravel (construction).
Rhode Island	4,841	49	.02	Sand and gravel (construction), stone (crushed), sand and gravel (industrial), stone (dimension).
South Carolina	194,473	31	.99	Cement, stone (crushed), clays, sand and gravel (construction).
South Dakota	135,673	34	.69	Gold, cement, stone (dimension), sand and gravel (construction).
Tennessee	378,752	19	1.92	Stone (crushed), zinc, pyrites, cement.
Texas	1,554,432	3	7.89	Cement, sulfur (Frasch), stone (crushed), sand and gravel (construction).
Utah	622,499	11	3.16	Copper, gold, potassium salts, cement.
Vermont	50,150	44	.25	Stone (dimension), sand and gravel (construction), stone (crushed), asbestos.
Virginia	263,183	23	1.34	Stone (crushed), cement, lime, sand and gravel (construction).
Washington	172,028	32	.87	Cement, sand and gravel (construction), stone (crushed), diatomite.

See footnotes at end of table.

Table 4.—Value of nonfuel mineral production in the United States and principal nonfuel minerals produced in 1982 —Continued

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
West Virginia	$75,613	41	.38	Cement, stone (crushed), sand and gravel (industrial), salt.
Wisconsin	112,294	37	.57	Stone (crushed), sand and gravel (construction), lime, iron ore.
Wyoming	668,195	9	3.39	Sodium carbonate, clays, iron ore, cement.
Total	19,691,000	XX	100.00	

XX Not applicable.
[1]Incomplete total.

Table 5.—Value of nonfuel mineral production per capita and per square mile in 1982, by State

State	Area (square miles)	1982 population (thousands)	Value of mineral production				
			Total (thousands)	Per square mile		Per capita	
				Dollars	Rank	Dollars	Rank
Alabama	51,609	3,943	$299,409	5,802	26	76	22
Alaska	586,412	438	112,911	193	49	258	9
Arizona	113,909	2,860	1,619,296	14,216	5	566	3
Arkansas	53,104	2,291	256,389	4,828	30	112	16
California	158,693	24,724	1,612,193	10,159	13	65	25
Colorado	104,247	3,045	638,232	6,122	23	210	10
Connecticut	5,009	3,153	56,076	11,195	9	18	47
Delaware	2,057	602	[1]3,197	1,554	44	5	50
Florida	58,560	10,416	1,223,398	20,891	1	117	14
Georgia	58,876	5,639	717,973	12,195	8	127	13
Hawaii	6,450	994	46,889	7,270	18	47	31
Idaho	83,557	965	300,180	3,593	34	311	7
Illinois	56,400	11,448	389,594	6,908	19	34	39
Indiana	36,291	5,471	215,004	5,924	24	39	37
Iowa	56,290	2,905	218,637	3,884	33	75	23
Kansas	82,264	2,408	256,016	3,112	38	106	17
Kentucky	40,395	3,667	206,947	5,123	28	56	27
Louisiana	48,523	4,362	417,667	8,608	16	96	20
Maine	33,215	1,133	35,439	1,067	47	31	40
Maryland	10,577	4,265	171,457	16,210	4	40	36
Massachusetts	8,257	5,781	89,302	10,815	11	15	48
Michigan	58,216	9,109	1,035,895	17,794	2	114	15
Minnesota	84,068	4,133	1,110,126	13,205	7	269	8
Mississippi	47,716	2,551	72,685	1,523	45	28	42
Missouri	69,686	4,951	733,774	10,530	12	148	12
Montana	147,138	801	266,594	1,812	42	333	5
Nebraska	77,227	1,586	79,557	1,030	48	50	29
Nevada	110,540	881	525,900	4,758	31	597	2
New Hampshire	9,304	951	23,294	2,504	40	24	44
New Jersey	7,836	7,438	132,410	16,898	3	18	46
New Mexico	121,666	1,359	431,813	3,549	35	318	6
New York	49,576	17,659	500,353	10,093	14	28	41
North Carolina	52,586	6,019	257,258	4,892	29	43	32
North Dakota	70,665	670	12,977	184	50	19	45
Ohio	41,222	10,791	450,229	10,922	10	42	33
Oklahoma	69,919	3,177	225,044	3,219	36	71	24
Oregon	96,981	2,649	107,843	1,112	46	41	35
Pennsylvania	45,333	11,865	602,554	13,292	6	51	28
Rhode Island	1,214	958	4,841	3,988	32	5	49
South Carolina	31,055	3,203	194,473	6,262	22	61	26
South Dakota	77,047	691	135,673	1,761	43	196	11
Tennessee	42,244	4,651	378,752	8,966	15	81	21
Texas	267,338	15,280	1,554,432	5,814	25	102	18
Utah	84,916	1,554	622,499	7,331	17	401	4
Vermont	9,609	516	50,150	5,219	27	97	19
Virginia	40,817	5,491	263,183	6,448	21	48	30
Washington	68,192	4,245	172,028	2,523	39	41	34
West Virginia	24,181	1,948	75,613	3,127	37	39	38
Wisconsin	56,154	4,765	112,294	2,000	41	24	43
Wyoming	97,914	502	668,195	6,824	20	1,331	1
Total[2] or average	3,615,055	230,904	19,691,000	5,447	XX	85	XX

XX Not applicable.
[1]Incomplete total.
[2]Excludes Washington, D.C. (which has no mineral production), with an area of 67 square miles and a population of 631,000.

Table 6.—Nonfuel mineral production[1] in the United States, by State

Mineral	1980		1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ALABAMA						
Cement:						
Masonry thousand short tons	242	$13,012	193	$10,721	150	$9,086
Portland do	2,491	108,438	2,270	89,216	2,558	104,461
Clays[2] do	2,022	29,832	1,910	25,406	1,323	13,193
Gem stones	NA	1	NA	1	NA	1
Lime thousand short tons	1,128	53,685	1,219	59,454	907	42,380
Sand and gravel:						
Construction do	10,714	23,683	e9,503	e23,340	7,019	17,226
Industrial do	361	1,821	182	864	960	8,096
Stone:						
Crushed do	23,433	82,270	20,706	88,377	p21,200	p89,600
Dimension do	11	2,259	7	2,130	p8	p2,341
Combined value of asphalt (native, 1980-81), bauxite, clays (bentonite), mica (scrap, 1980), phosphate rock, and salt	XX	13,373	XX	14,288	XX	13,025
Total	XX	328,374	XX	r313,797	XX	299,409
ALASKA						
Gem stones	NA	$50	NA	$60	NA	$60
Gold (recoverable content of ores, etc.) troy ounces	12,881	7,890	r26,531	r12,195	30,513	11,470
Lead metric tons	31	29	W	W	W	W
Sand and gravel (construction) thousand short tons	44,911	85,214	e41,000	e75,600	40,832	74,895
Silver (recoverable content of ores, etc.) thousand troy ounces	8	172	2	25	2	17
Stone (crushed) thousand short tons	3,990	19,978	5,359	26,855	p5,100	p25,200
Tin metric tons	W	W	136	1,200	W	W
Combined value of barite (1980), copper (1982), platinum-group metals (1980-81), tungsten ore and concentrate (1980-81), and values indicated by symbol W	XX	1,983	XX	265	XX	1,269
Total	XX	115,316	XX	r116,200	XX	112,911
ARIZONA						
Clays thousand short tons	151	$1,151	148	$1,105	143	$998
Copper (recoverable content of ores, etc.) metric tons	770,118	1,738,908	1,040,813	1,953,142	769,974	1,261,415
Gem stones	NA	3,100	NA	3,250	NA	2,800
Gold (recoverable content of ores, etc.) troy ounces	79,631	48,779	100,339	46,120	61,050	22,949
Gypsum thousand short tons	209	2,017	213	2,594	175	1,205
Lead (recoverable content of ores, etc.) metric tons	162	152	993	800	359	202
Lime thousand short tons	514	23,904	538	29,913	326	17,080
Molybdenum (content of concentrate) thousand pounds	35,668	341,965	35,808	254,345	22,099	100,673
Pumice thousand short tons	9	13	1	3	1	7
Sand and gravel:						
Construction do	24,229	71,838	e20,990	e63,340	19,124	58,375
Industrial do	170	1,936	179	2,455	107	1,617
Silver (recoverable content of ores, etc.) thousand troy ounces	6,268	129,363	8,055	84,728	6,301	50,090
Stone:						
Crushed thousand short tons	6,205	24,780	6,315	26,263	p5,200	p22,200
Dimension do	W	45	W	578	W	p580
Zinc metric tons	W	W	138	135	--	--
Combined value of asbestos (1980-81), barite (1981), cement, perlite, pyrites, salt, tungsten ore and concentrate (1980-81), vanadium (1980-81), and value indicated by symbol W	XX	83,037	XX	93,009	XX	79,105
Total	XX	2,470,988	XX	r2,561,780	XX	1,619,296

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1980 Quantity	1980 Value (thousands)	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
ARKANSAS						
Abrasives short tons	280	$1,686	W	W	1,085	$469
Bauxite thousand metric tons	1,299	19,252	1,242	$22,185	W	W
Clays thousand short tons	1,150	14,402	880	9,333	629	6,658
Gem stones	NA	140	NA	200	NA	200
Lime thousand short tons	175	7,785	149	8,102	W	W
Sand and gravel:						
Construction do	12,518	30,599	e9,146	e22,400	7,076	19,056
Industrial do	500	3,964	642	8,236	881	11,370
Stone:						
Crushed do	20,666	61,399	13,834	47,260	p13,100	p48,500
Dimension do	8	355	7	411	p5	p290
Talc do	W	W	W	W	13	92
Combined value of barite, bromine, cement, gypsum, tripoli, vanadium, and values indicated by symbol W	XX	153,061	XX	153,721	XX	169,754
Total	XX	292,643	XX	r271,848	XX	256,389
CALIFORNIA						
Boron minerals thousand short tons	1,545	$366,760	1,481	$435,387	1,234	$384,597
Cement, portland do	8,797	542,487	7,896	518,966	6,464	401,883
Clays do	2,558	17,766	2,309	19,118	1,762	15,642
Diatomite do	W	W	W	W	340	68,139
Gem stones	NA	200	NA	300	NA	250
Gold (recoverable content of ores, etc.) troy ounces	4,078	2,498	6,271	2,882	10,547	3,965
Gypsum thousand short tons	1,644	12,763	1,456	13,948	1,088	10,614
Lime do	554	29,444	472	26,834	364	23,000
Mercury 76-pound flasks	226	88	85	35	--	--
Perlite thousand short tons	W	W	36	1,044	W	W
Pumice do	58	1,340	98	1,501	59	1,285
Sand and gravel:						
Construction do	112,493	336,045	e107,200	e352,100	81,147	270,995
Industrial do	2,169	27,859	2,150	28,269	2,317	28,703
Silver (recoverable content of ores, etc.) thousand troy ounces	49	1,017	53	560	34	271
Stone:						
Crushed thousand short tons	37,760	118,140	34,560	118,698	p28,500	p105,400
Dimension do	36	1,967	29	1,909	p29	p1,895
Talc do	100	1,863	111	5,855	85	1,699
Combined value of asbestos, calcium chloride, carbon dioxide, cement (masonry, 1982), copper, feldspar, iron ore, lead, magnesium compounds, molybdenum, peat, potassium salts, pyrophyllite (1981), rare-earth metal concentrate, salt, sodium carbonate, sodium sulfate, tungsten ore and concentrate, wollastonite (1981-82), zinc (1981), and values indicated by symbol W	XX	411,619	XX	446,310	XX	293,855
Total	XX	1,871,856	XX	r1,973,716	XX	1,612,193
COLORADO						
Clays thousand short tons	336	$2,223	276	$1,734	201	$1,124
Copper (recoverable content of ores, etc.) metric tons	461	1,041	W	W	575	941
Gem stones	NA	70	NA	80	NA	80
Gold (recoverable content of ores, etc.) troy ounces	39,447	24,164	51,069	23,473	64,584	24,278
Gypsum thousand short tons	227	3,409	203	2,346	184	1,571
Lead (recoverable content of ores, etc.) metric tons	10,272	9,615	11,431	9,207	W	W
Molybdenum thousand pounds	102,498	915,304	73,615	636,037	41,691	360,626
Peat thousand short tons	29	327	33	299	47	275
Sand and gravel:						
Construction do	27,433	74,452	e23,500	e73,300	19,591	60,780
Industrial do	W	W	W	W	222	3,266
Silver (recoverable content of ores, etc.) thousand troy ounces	2,987	61,653	3,009	31,650	1,934	15,378

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1980		1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
COLORADO—Continued						
Stone:						
Crushed thousand short tons	W	W	6,969	$24,083	[p]6,900	[p]$27,800
Dimension do	6	$259	1	64	[p]1	[p]64
Zinc (recoverable content of ores, etc.) metric tons	13,823	11,406	W	W	W	W
Combined value of beryllium concentrate (1982), carbon dioxide, cement, iron ore, lime, perlite, pyrites, salt, tin, tungsten ore and concentrate, vanadium, and values indicated by symbol W	XX	160,592	XX	164,493	XX	142,049
Total	XX	1,264,515	XX	[r]966,766	XX	638,232
CONNECTICUT						
Clays thousand short tons	92	$482	73	$391	56	$329
Lime do	19	1,352	16	1,190	8	568
Sand and gravel:						
Construction do	7,103	18,692	[e]6,500	[e]15,400	4,920	16,388
Industrial do	W	W	W	W	80	1,746
Stone:						
Crushed do	7,977	40,283	[r]6,837	[r]36,745	[p]6,100	[p]32,700
Dimension do	15	723	19	910	[p]20	[p]1,046
Combined value of feldspar, gem stones, mica (scrap), and values indicated by symbol W	XX	4,231	XX	3,985	XX	3,299
Total	XX	65,763	XX	[r]58,621	XX	56,076
DELAWARE						
Sand and gravel (construction) thousand short tons	1,075	$2,398	[e]1,205	[e]$2,959	1,300	$3,197
Total	XX	2,398	XX	2,959	XX	3,197
FLORIDA						
Cement:						
Masonry thousand short tons	285	$22,074	288	$20,757	231	$16,267
Portland do	3,574	182,590	3,518	199,064	2,651	136,190
Clays do	614	[2]24,164	731	[2]35,319	672	[2]31,339
Gem stones	NA	5	NA	6	NA	6
Lime thousand short tons	195	12,434	191	11,343	103	5,828
Peat do	154	2,398	157	2,885	120	1,575
Sand and gravel:						
Construction do	14,412	28,766	[e]14,910	[e]30,600	13,749	30,481
Industrial do	W	W	349	4,419	341	4,257
Stone (crushed) do	66,209	215,972	65,067	226,192	[p]53,100	[p]182,300
Combined value of clays (kaolin), magnesium compounds, phosphate rock, rare-earth metal concentrate, staurolite, titanium concentrates (ilmenite and rutile), zircon concentrates, and value indicated by symbol W	XX	1,020,855	XX	1,197,304	XX	815,155
Total	XX	1,509,258	XX	[r]1,727,889	XX	1,223,398
GEORGIA						
Cement:						
Masonry thousand short tons	89	$5,464	89	$4,392	W	W
Portland do	1,231	55,463	1,150	45,423	W	W
Clays do	8,283	500,555	8,029	553,726	6,773	$475,768
Gem stones	NA	20	NA	20	NA	20
Sand and gravel:						
Construction thousand short tons	4,858	11,898	[e]3,364	[e]8,308	3,166	8,361
Industrial do	W	W	W	W	541	6,793
Stone:						
Crushed do	40,884	162,642	35,730	153,751	[p]34,800	[p]153,500
Dimension do	231	17,466	268	17,894	[p]271	[p]18,510
Talc do	25	116	26	182	20	141
Combined value of barite, bauxite, feldspar, iron oxide pigments (crude), kyanite, mica, peat, and values indicated by symbol W	XX	17,663	XX	17,067	XX	54,880
Total	XX	771,287	XX	[r]800,763	XX	717,973

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1980 Quantity	1980 Value (thousands)	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
HAWAII						
Cement:						
Masonry ____ thousand short tons	13	$960	10	$807	6	$554
Portland ____ do	358	23,722	302	23,024	227	18,122
Sand and gravel (construction) ____ do	1,035	2,855	e459	e1,198	449	1,221
Stone:						
Crushed ____ do	W	W	6,036	31,403	p4,500	p26,600
Dimension ____ do	W	11	(3)	4	(3)	p4
Combined value of gem stones, lime, pumice, salt (1980), and value indicated by symbol W	XX	32,169	XX	589	XX	388
Total	XX	59,717	XX	r57,025	XX	46,889
IDAHO						
Antimony ore and concentrate, antimony content ____ short tons	83	W	432	W	294	W
Clays ____ thousand short tons	27	$301	26	$288	8	$101
Copper (recoverable content of ores, etc.) metric tons	3,103	7,006	4,245	7,966	3,074	5,035
Gem stones	NA	60	NA	75	NA	75
Lead (recoverable content of ores, etc.) metric tons	38,607	36,139	38,397	30,923	W	W
Phosphate rock ____ thousand metric tons	4,991	100,873	5,361	108,964	W	W
Sand and gravel (construction) thousand short tons	5,299	14,203	e3,063	e7,329	2,340	6,258
Silver (recoverable content of ores, etc.) thousand troy ounces	13,695	282,663	16,546	174,033	14,830	117,901
Stone (crushed) ____ thousand short tons	2,007	7,240	1,437	6,206	p1,200	p6,000
Zinc (recoverable content of ores, etc.) metric tons	27,722	22,876	W	W	W	W
Combined value of cement, garnet (abrasives), gold, gypsum, lime, perlite, pumice, sand and gravel (industrial), stone (dimension), tungsten ore and concentrate, vanadium, and values indicated by symbol W	XX	50,734	XX	89,093	XX	164,810
Total	XX	522,095	XX	r424,877	XX	300,180
ILLINOIS						
Cement, portland ____ thousand short tons	1,649	$75,315	1,574	$61,536	1,757	$78,444
Clays[2] ____ do	459	1,919	322	1,540	455	2,305
Gem stones	NA	15	NA	15	NA	15
Peat ____ thousand short tons	79	1,505	46	1,502	W	W
Sand and gravel:						
Construction ____ do	27,094	78,510	e25,150	e68,970	21,557	59,149
Industrial ____ do	4,631	43,822	4,646	49,186	3,989	45,665
Stone:						
Crushed ____ do	53,309	180,656	44,159	165,218	p42,900	p148,300
Dimension ____ do	2	103	2	85	p2	p98
Combined value of barite, cement (masonry), clays (fuller's earth), fluorspar, lead, lime, silver, tripoli, zinc, and value indicated by symbol W	XX	61,436	XX	79,434	XX	55,618
Total	XX	443,281	XX	r427,486	XX	389,594
INDIANA						
Cement:						
Masonry ____ thousand short tons	W	W	252	$10,972	W	W
Portland ____ do	1,769	$73,049	1,538	59,344	1,523	$58,055
Clays ____ do	932	1,930	691	1,602	501	1,221
Gem stones	--	--	NA	1	NA	1
Peat ____ thousand short tons	84	1,414	105	3,140	89	2,112
Sand and gravel:						
Construction ____ do	21,772	51,738	e15,870	e41,330	13,097	34,579
Industrial ____ do	259	1,201	257	1,179	W	W
Stone:						
Crushed ____ do	30,910	92,106	25,349	79,910	p20,300	p65,500
Dimension ____ do	161	14,046	145	13,672	p135	p13,337

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1980		1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
INDIANA—Continued						
Combined value of abrasives (natural), gypsum, lime, and values indicated by symbol W	XX	$52,986	XX	$40,212	XX	$40,199
Total	XX	288,470	XX	r251,362	XX	215,004
IOWA						
Cement:						
Masonry thousand short tons	48	$3,340	41	$3,227	W	W
Portland do	1,998	101,008	1,779	92,099	1,622	$82,225
Clays do	754	2,555	476	2,375	437	2,392
Gem stones	--	--	NA	1	NA	1
Gypsum thousand short tons	1,468	13,136	1,383	12,706	1,177	11,345
Peat do	11	276	10	453	W	W
Sand and gravel (construction) do	12,683	32,722	e10,330	e29,080	10,064	25,618
Stone:						
Crushed do	26,542	92,603	22,424	82,891	p22,600	p88,800
Dimension do	10	509	W	W	W	W
Combined value of lime, sand and gravel (industrial), and values indicated by symbol W	XX	5,727	XX	6,559	XX	8,256
Total	XX	251,876	XX	r229,391	XX	218,637
KANSAS						
Cement:						
Masonry thousand short tons	60	$3,310	51	$2,835	46	$2,628
Portland do	1,835	86,103	1,641	81,792	1,549	79,558
Clays do	886	2,325	915	4,756	664	3,656
Gem stones	--	--	NA	1	NA	1
Helium (Grade-A) million cubic feet	W	W	W	W	790	26,860
Salt[4] thousand short tons	1,572	64,276	1,410	60,148	1,588	71,826
Sand and gravel:						
Construction do	12,124	23,817	e10,500	e21,000	9,720	20,612
Industrial do	W	W	W	W	331	3,635
Stone:						
Crushed do	17,398	54,731	14,143	45,738	p14,400	p41,100
Dimension do	18	937	14	605	p11	p395
Combined value of gypsum, helium (crude, 1980-81), lime, pumice, salt (brine), and values indicated by symbol W	XX	26,094	XX	32,185	XX	5,745
Total	XX	261,593	XX	249,060	XX	256,016
KENTUCKY						
Clays thousand short tons	748	$3,692	490	$2,395	579	$2,039
Gem stones	NA	1	NA	1	NA	1
Sand and gravel:						
Construction thousand short tons	7,767	17,637	e6,939	e16,070	6,499	15,936
Industrial do	W	W	W	247	7	116
Stone (crushed) do	W	W	32,433	108,257	p29,500	p104,300
Combined value of cement, clays (ball clay), lime, zinc (1981-82), and values indicated by symbol W	XX	182,970	XX	81,559	XX	84,555
Total	XX	204,300	XX	r208,529	XX	206,947
LOUISIANA						
Clays thousand short tons	380	$5,841	2380	2$6,338	326	2$6,216
Gem stones	--	--	NA	1	NA	1
Salt thousand short tons	12,662	132,182	12,565	r114,476	12,172	117,569
Sand and gravel:						
Construction do	18,152	62,568	e17,240	e53,550	16,558	50,966
Industrial do	353	3,845	293	4,026	378	4,590
Sulfur (Frasch) thousand metric tons	2,590	W	2,235	W	1,239	W
Combined value of cement, clays (bentonite, 1981-82), gypsum, lime, stone (crushed), and values indicated by symbol W	XX	379,330	XX	r388,005	XX	238,325
Total	XX	583,766	XX	r566,396	XX	417,667

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1980 Quantity	1980 Value (thousands)	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
MAINE						
Clays thousand short tons	78	$174	57	$166	37	$76
Peat do	8	534	W	W	W	W
Sand and gravel (construction) do	6,978	15,434	e7,500	e19,400	6,701	15,118
Stone (crushed) do	1,130	3,969	1,375	5,532	p1,200	p4,000
Combined value of other nonmetals and values indicated by symbol W	XX	16,856	XX	18,271	XX	16,245
Total	XX	36,967	XX	r43,369	XX	35,439
MARYLAND						
Clays[2] thousand short tons	733	$2,267	597	$1,984	405	$1,346
Gem stones	--	--	NA	2	NA	2
Lime thousand short tons	12	497	9	441	7	396
Peat do	4	W	W	W	--	--
Sand and gravel (construction) do	10,732	33,625	e9,500	e31,800	9,720	32,386
Stone:						
Crushed do	18,945	77,431	16,485	74,289	p15,100	p73,500
Dimension do	15	612	34	1,002	p32	p1,001
Combined value of cement, clays (ball clay), and values indicated by symbol W	XX	71,703	XX	65,937	XX	62,826
Total	XX	186,135	XX	r175,455	XX	171,457
MASSACHUSETTS						
Clays thousand short tons	210	$870	259	$1,322	210	$1,115
Lime do	180	10,806	170	10,793	135	9,414
Sand and gravel:						
Construction do	13,925	34,459	e12,500	e31,300	12,003	34,438
Industrial do	W	W	87	W	140	1,615
Stone:						
Crushed do	7,316	36,804	7,997	41,037	p6,900	p33,500
Dimension do	51	7,018	50	8,616	p51	p9,158
Combined value of gem stones, peat, and values indicated by symbol W	XX	1,254	XX	1,669	XX	62
Total	XX	91,211	XX	r94,737	XX	89,302
MICHIGAN						
Cement:						
Masonry thousand short tons	206	$14,292	173	$10,584	136	$8,752
Portland do	4,651	224,685	3,871	180,641	3,254	149,533
Clays do	1,982	7,212	1,610	5,862	1,022	4,370
Gem stones	NA	10	NA	15	NA	15
Gypsum thousand short tons	1,383	8,605	1,066	6,762	682	5,150
Iron ore (usable) thousand long tons, gross weight	15,895	634,355	14,193	W	W	W
Lime thousand short tons	836	36,750	807	36,800	571	26,823
Peat do	253	4,739	237	4,540	241	4,917
Salt do	2,406	104,842	2,321	103,293	2,002	106,303
Sand and gravel:						
Construction do	32,536	73,166	e28,100	e68,050	20,567	47,726
Industrial do	4,062	25,188	4,393	29,787	2,920	21,934
Stone:						
Crushed do	32,121	91,727	30,013	94,324	p20,700	p67,100
Dimension do	7	144	6	129	p4	p110
Combined value of bromine, calcium chloride, copper, iodine, iron oxide pigments (crude), magnesium compounds, silver, and values indicated by symbol W	XX	259,435	XX	899,618	XX	593,162
Total	XX	1,485,150	XX	r1,440,405	XX	1,035,895
MINNESOTA						
Clays thousand short tons	94	$1,206	84	$1,077	W	W
Gem stones	NA	5	NA	5	NA	$5
Iron ore (usable) thousand long tons, gross weight	45,472	1,686,839	50,176	2,062,118	23,715	1,021,056
Lime thousand short tons	162	3,562	155	3,818	133	4,694

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1980		1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MINNESOTA—Continued						
Manganiferous ore ____ short tons	119,029	W	139,571	W	16,307	W
Peat ____ thousand short tons	25	$1,140	25	$940	W	W
Sand and gravel:						
Construction ____ do	25,110	49,180	e23,950	e49,770	20,276	$44,222
Industrial ____ do	W	W	W	W	694	5,903
Stone:						
Crushed ____ do	8,606	21,731	6,995	18,438	p7,100	p20,900
Dimension ____ do	44	14,189	41	14,298	p40	p11,940
Combined values of items indicated by symbol W ____	XX	r4,158	XX	r4,297	XX	1,406
Total ____	XX	r1,782,010	XX	r2,154,761	XX	1,110,126
MISSISSIPPI						
Clays ____ thousand short tons	1,596	$21,714	1,218	$23,309	805	$21,181
Lime ____ do	31	707	--	--	--	--
Sand and gravel (construction) ____ do	11,710	31,606	e10,480	e29,260	9,455	27,115
Combined value of cement, magnesium compounds (1980), sand and gravel (industrial), and stone (crushed) ____	XX	49,913	XX	r39,682	XX	24,389
Total ____	XX	103,940	XX	r92,251	XX	72,685
MISSOURI						
Barite ____ thousand short tons	117	$5,570	185	$9,725	107	$5,703
Cement:						
Masonry ____ do	62	3,117	103	5,495	88	4,855
Portland ____ do	3,515	156,368	3,732	168,567	3,205	120,339
Clays ____ do	1,817	16,798	1,747	18,414	2,383	2,13,409
Copper (recoverable content of ores, etc.) metric tons	13,576	30,655	8,411	15,783	7,941	13,010
Gem stones	NA	15	NA	10	NA	10
Gold (recoverable content of ores, etc.) troy ounces	W	W	--	--	--	--
Iron ore ____ thousand long tons	W	W	W	W	717	W
Lead (recoverable content of ores, etc.) metric tons	497,170	465,393	389,721	313,870	474,460	267,150
Lime ____ thousand short tons	1,667	63,733	W	W	W	W
Sand and gravel:						
Construction ____ do	8,178	19,255	e7,500	e16,900	6,359	14,477
Industrial ____ do	722	7,498	778	8,602	750	8,997
Silver (recoverable content of ores, etc.) thousand troy ounces	2,357	48,653	1,837	19,322	2,241	17,817
Stone (crushed) ____ thousand short tons	48,296	130,254	40,910	116,297	p38,600	p113,300
Zinc (recoverable content of ores, etc.) metric tons	62,886	51,893	52,904	51,966	63,680	54,009
Combined value of asphalt (native, 1980), gold (1980), iron oxide pigments (crude), stone (dimension), and values indicated by symbol W ____	XX	r54,862	XX	r130,317	XX	100,698
Total ____	XX	r1,054,064	XX	r875,268	XX	733,774
MONTANA						
Antimony ____ short tons	260	W	214	W	209	W
Clays ____ thousand short tons	626	$22,200	601	$23,111	2218	2$8,064
Copper (recoverable content of ores, etc.) metric tons	37,749	85,236	62,485	117,257	57,086	93,521
Gem stones	NA	90	NA	100	NA	225
Gold (recoverable content of ores, etc.) troy ounces	48,366	29,627	54,267	24,943	75,171	28,258
Lead (recoverable content of ores, etc.) metric tons	295	276	194	157	661	372
Lime ____ thousand short tons	223	9,001	194	7,621	45	2,331
Sand and gravel (construction) ____ do	6,639	16,057	e5,640	e12,910	5,338	12,794
Silver (recoverable content of ores, etc.) thousand troy ounces	2,024	41,773	2,989	31,437	6,169	49,041

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1980 Quantity	1980 Value (thousands)	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
MONTANA—Continued						
Stone (crushed) thousand short tons	1,962	$6,302	1,582	$5,137	p1,400	p$4,700
Talc do.	312	11,310	W	W	W	W
Zinc (recoverable content of ores, etc.) metric tons	71	59	25	24	W	W
Combined value of barite, cement, clays (fire clay, 1982), graphite (1982), gypsum, iron ore (1981-82), peat, phosphate rock, sand and gravel (industrial), stone (dimension), tungsten ore and concentrate, vermiculite, and values indicated by symbol W	XX	57,619	XX	80,384	XX	67,288
Total	XX	279,550	XX	r303,081	XX	266,594
NEBRASKA						
Clays thousand short tons	154	$456	136	$409	134	$392
Gem stones	NA	W	NA	W	NA	W
Sand and gravel:						
Construction thousand short tons	10,514	22,798	e11,770	e28,310	11,282	28,128
Industrial do.	24	183	19	144	14	105
Stone (crushed) do.	3,775	16,301	3,139	14,024	p3,100	p14,300
Combined value of cement, lime, and values indicated by symbol W	XX	40,736	XX	36,718	XX	36,632
Total	XX	80,474	XX	r79,605	XX	79,557
NEVADA						
Barite thousand short tons	1,918	$47,800	2,482	$79,716	1,575	$52,727
Clays do.	64	2,082	73	2,948	103	2,640
Gem stones	NA	900	NA	1,000	NA	1,200
Gold (recoverable content of ores, etc.) troy ounces	278,495	170,595	524,802	241,220	738,321	277,542
Gypsum thousand short tons	852	8,276	778	6,914	656	4,523
Iron ore thousand long tons	W	W	99	1,490	77	1,119
Lead (recoverable content of ores, etc.) metric tons	26	24	W	W	W	W
Mercury 76-pound flasks	30,431	11,851	27,819	11,514	25,760	W
Molybdenum pounds	--	--	--	--	W	W
Perlite thousand short tons	6	92	W	W	W	W
Sand and gravel (construction) do.	8,439	18,360	e7,065	e15,770	6,027	11,724
Silver (recoverable content of ores, etc.) thousand troy ounces	940	19,402	3,039	31,970	3,142	24,981
Stone (crushed) thousand short tons	W	W	1,343	5,664	p1,300	p4,500
Zinc (recoverable content of ores, etc.) metric tons	2	2	W	W	--	--
Combined value of cement (portland), copper, diatomite, fluorspar, lime, lithium compounds, magnesite, salt, sand and gravel (industrial), talc (1980), tungsten ore and concentrate, and values indicated by symbol W	XX	114,846	XX	r108,453	XX	144,944
Total	XX	394,230	XX	r506,659	XX	525,900
NEW HAMPSHIRE						
Sand and gravel (construction) thousand short tons	6,334	$15,837	e4,528	e$12,990	4,332	$12,593
Stone:						
Crushed do.	590	2,281	665	2,599	p600	p3,100
Dimension do.	103	7,167	89	6,889	p107	p7,500
Combined value of other nonmetals	XX	121	XX	122	XX	101
Total	XX	25,406	XX	r22,600	XX	23,294
NEW JERSEY						
Clays thousand short tons	63	$525	62	$563	63	$566
Gem stones	NA	1	NA	1	NA	1
Peat thousand short tons	20	564	26	1,476	W	W

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1980		1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEW JERSEY—Continued						
Sand and gravel:						
Construction thousand short tons	5,829	$18,578	e9,756	e$26,050	7,940	$25,722
Industrial do.	2,766	26,957	2,305	26,438	2,140	28,151
Stone (crushed) do.	11,830	61,886	10,434	57,819	p10,700	p57,800
Zinc (recoverable content of ores, etc.) metric tons	28,859	23,814	16,198	15,911	16,800	14,248
Combined value of iron ore (1981), magnesium compounds, marl (greensand), stone (dimension), titanium concentrate (ilmenite), and value indicated by symbol W	XX	17,123	XX	20,404	XX	5,922
Total	XX	149,448	XX	r148,662	XX	132,410
NEW MEXICO						
Clays[2] thousand short tons	60	$114	64	$119	60	$112
Copper (recoverable content of ores, etc.) metric tons	149,394	337,328	154,114	289,204	W	W
Gem stones	NA	150	NA	200	NA	200
Gold (recoverable content of ores, etc.) troy ounces	15,847	9,707	65,749	30,221	W	W
Gypsum thousand short tons	182	1,688	166	2,256	198	887
Lead (recoverable content of ores, etc.) metric tons	--	--	W	W	W	W
Manganiferous ore (5% to 35% Mn) short tons	35,198	W	12,741	W	--	--
Peat thousand short tons	2	40	--	--	--	--
Perlite do.	539	14,404	489	14,983	408	13,355
Potassium salts thousand metric tons	1,869	289,011	1,601	261,200	1,497	204,600
Pumice thousand short tons	84	814	93	919	97	809
Sand and gravel (construction) do.	7,050	17,676	e6,496	e19,780	5,616	17,670
Silver (recoverable content of ores, etc.) thousand troy ounces	W	W	1,632	17,170	805	6,397
Stone:						
Crushed thousand short tons	2,581	9,473	4,162	12,485	p2,800	p13,700
Dimension do.	18	91	26	173	p18	p138
Combined value of barite (1980), carbon dioxide, cement, clays (fire clay), helium (Grade-A), lime, mica (scrap), molybdenum, salt, sand and gravel (industrial, 1982), vanadium (1980-81), zinc (1980-81), and values indicated by symbol W	XX	85,113	XX	r47,697	XX	173,945
Total	XX	765,609	XX	r696,407	XX	431,813
NEW YORK						
Clays[2] thousand short tons	596	$2,479	597	$2,310	352	$897
Gem stones	NA	20	NA	30	NA	30
Lead (recoverable content of ores, etc.) metric tons	876	820	968	780	974	549
Peat thousand short tons	43	917	39	811	W	W
Salt do.	5,509	99,395	5,597	103,668	6,205	117,718
Sand and gravel:						
Construction do.	21,918	53,276	e18,280	e45,560	17,524	47,799
Industrial do.	W	W	55	W	45	512
Silver (recoverable content of ores, etc.) thousand troy ounces	21	427	29	303	27	212
Stone:						
Crushed thousand short tons	34,483	120,764	30,681	117,689	p28,700	p132,800
Dimension do.	25	2,414	21	2,291	p22	p2,293
Zinc (recoverable content of ores, etc.) metric tons	33,629	27,750	36,889	36,235	49,351	41,855
Combined value of cement, clays (ball clay), emery, garnet (abrasive), gypsum, iron ore, lime, talc, titanium concentrate (ilmenite), wollastonite, and values indicated by symbol W	XX	187,526	XX	171,554	XX	155,688
Total	XX	495,788	XX	r481,231	XX	500,353

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1980 Quantity	1980 Value (thousands)	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
NORTH CAROLINA						
Clays[2] thousand short tons	2,852	$7,308	2,110	$6,838	1,573	$5,243
Feldspar short tons	e499,600	e15,062	462,864	13,517	428,755	12,255
Gem stones	NA	40	NA	50	NA	50
Mica, scrap thousand short tons	77	4,647	92	6,398	67	4,793
Sand and gravel:						
Construction do	7,837	20,910	e6,294	e18,330	5,198	15,395
Industrial do	1,472	7,825	1,236	10,440	716	4,878
Stone:						
Crushed do	34,764	125,019	28,833	117,092	p27,500	p117,600
Dimension do	55	4,536	30	2,773	p30	p2,814
Talc and pyrophyllite do	W	W	r104	r825	83	1,266
Combined value of cement, clays (kaolin), lithium compounds, olivine, peat (1982), phosphate rock, and value indicated by symbol W	XX	194,986	XX	196,397	XX	92,964
Total	XX	380,333	XX	r372,660	XX	257,258
NORTH DAKOTA						
Gem stones	NA	$2	NA	$2	NA	$2
Peat thousand short tons	W	31	W	36	W	W
Sand and gravel (construction) do	5,173	14,457	e3,000	e6,500	2,347	4,873
Combined value of clays, lime, salt, and values indicated by symbol W	XX	7,886	XX	r8,310	XX	8,102
Total	XX	22,376	XX	r14,848	XX	12,977
OHIO						
Cement:						
Masonry thousand short tons	126	$8,549	105	$7,129	86	$6,170
Portland do	1,625	77,696	1,461	69,517	1,326	59,598
Clays do	2,718	11,516	2,217	10,411	1,451	6,100
Gypsum do	136	1,346	148	1,566	109	1,335
Lime do	2,786	122,817	2,767	127,751	1,666	76,370
Peat do	10	166	10	191	5	144
Salt do	3,228	87,371	3,608	90,254	3,514	90,572
Sand and gravel:						
Construction do	35,462	97,690	e32,240	e95,570	26,311	83,684
Industrial do	1,510	16,601	1,487	20,893	1,223	17,816
Stone:						
Crushed do	42,441	136,929	36,950	125,588	p30,300	p105,200
Dimension do	35	1,558	W	W	W	W
Combined value of abrasives, gem stones, and values indicated by symbol W	XX	101	XX	3,290	XX	3,240
Total	XX	562,340	XX	r552,160	XX	450,229
OKLAHOMA						
Clays thousand short tons	972	$2,249	838	$2,064	752	$1,907
Gem stones	--	--	NA	2	NA	2
Gypsum thousand short tons	1,326	11,230	1,177	9,870	1,254	10,089
Helium:						
Grade-A million cubic feet	349	8,027	49	1,274	--	--
Crude do	23	276	22	264	--	--
Pumice thousand short tons	1	W	1	W	1	W
Sand and gravel:						
Construction do	10,294	23,395	e9,000	e21,700	7,490	17,733
Industrial do	1,587	13,767	1,500	14,317	1,222	13,114
Stone:						
Crushed do	28,173	76,267	29,930	83,407	p30,100	p84,200
Dimension do	16	678	18	738	p18	p968
Combined value of cement, feldspar, iodine, lime, salt, tripoli, and values indicated by symbol W	XX	88,244	XX	100,876	XX	97,031
Total	XX	224,133	XX	r234,512	XX	225,044

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1980		1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
OREGON						
Clays thousand short tons	172	$321	176	$300	149	$212
Gem stones	NA	450	NA	600	NA	500
Gold (recoverable content of ores, etc.) troy ounces	W	W	2,830	1,301	W	W
Nickel (content of ores and concentrates) short tons	14,653	W	12,099	W	3,203	W
Pumice thousand short tons	219	1,318	W	W	W	W
Sand and gravel (construction) do	16,005	47,300	e12,000	e35,100	9,513	30,629
Silver (recoverable content of ores, etc.) thousand troy ounces	1	17	7	79	--	--
Stone:						
Crushed thousand short tons	19,251	49,606	16,482	46,055	p14,200	p41,900
Dimension do	15	231	(3)	5	(3)	p5
Talc and soapstone do	W	W	W	W	(3)	82
Combined value of cement, copper (1981), diatomite, lead (1981), lime, and values indicated by symbol W	XX	52,727	XX	56,107	XX	34,515
Total	XX	151,970	XX	r139,547	XX	107,843
PENNSYLVANIA						
Cement:						
Masonry thousand short tons	324	$20,298	293	$14,799	256	$14,048
Portland do	5,570	237,684	5,150	215,883	4,800	212,945
Clays[2] do	1,650	12,112	1,246	7,497	931	5,616
Gem stones	--	--	NA	5	NA	5
Lime thousand short tons	1,768	84,291	1,690	85,418	1,297	70,902
Mica (scrap) do	3	W	3	134	W	W
Peat do	26	552	25	647	27	669
Sand and gravel:						
Construction do	14,554	55,883	e14,000	e61,100	13,081	55,527
Industrial do	1,049	12,374	W	W	969	13,589
Stone:						
Crushed do	61,143	218,231	53,258	207,821	p50,400	p200,900
Dimension do	65	6,397	51	7,193	p48	p6,354
Tripoli short tons	W	W	1,263	W	W	W
Zinc (recoverable content of ores, etc.) metric tons	22,556	18,613	24,732	24,293	24,762	21,001
Combined value of clays (kaolin) and values indicated by symbol W	XX	1,171	XX	13,966	XX	998
Total	XX	667,606	XX	r638,756	XX	602,554
RHODE ISLAND						
Sand and gravel:						
Construction thousand short tons	2,506	$4,945	e1,332	e$3,985	1,146	$3,671
Industrial do	--	--	W	W	5	52
Stone (crushed) do	203	1,208	141	1,116	p130	p1,100
Combined value of other nonmetals and value indicated by symbol W	XX	17	XX	63	XX	18
Total	XX	6,170	XX	5,164	XX	4,841
SOUTH CAROLINA						
Cement, portland thousand short tons	1,704	$74,539	1,765	$79,407	1,624	$66,385
Clays[2] do	2,211	25,169	1,632	28,600	1,535	28,166
Gem stones	NA	5	NA	10	NA	10
Manganiferous ore thousand short tons	20	W	r22	W	15	W
Sand and gravel:						
Construction do	4,737	13,227	e5,131	e13,240	4,727	13,170
Industrial do	819	9,628	803	10,531	720	10,902
Stone:						
Crushed do	16,107	49,207	14,825	49,830	p14,000	p53,000
Dimension do	12	703	18	1,109	p14	p904
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	22,301	XX	22,989	XX	21,936
Total	XX	194,779	XX	r205,716	XX	194,473

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1980 Quantity	1980 Value (thousands)	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
SOUTH DAKOTA						
Cement:						
Masonry thousand short tons	6	$377	6	$454	4	$383
Portland do	459	23,042	450	23,290	520	27,978
Clays[2] do	169	283	116	209	128	346
Gem stones	NA	50	NA	70	NA	70
Gold (recoverable content of ores, etc.) troy ounces	267,642	163,947	278,162	127,854	185,038	69,558
Mica, scrap thousand short tons	(3)	4	W	W	W	W
Sand and gravel (construction) do	4,209	8,243	e4,285	e9,224	3,816	8,604
Silver (recoverable content of ores, etc.) thousand troy ounces	51	1,058	56	587	26	209
Stone:						
Crushed thousand short tons	3,151	8,942	2,985	9,085	p2,600	p7,400
Dimension do	42	15,035	50	17,543	p48	p16,270
Combined value of beryllium (1981-82), clays (bentonite), feldspar, gypsum, iron ore (1980), lime, and values indicated by symbol W	XX	6,873	XX	6,382	XX	4,855
Total	XX	227,854	XX	r194,698	XX	135,673
TENNESSEE						
Cement:						
Masonry thousand short tons	132	$7,241	66	$3,209	W	W
Portland do	1,304	58,827	974	39,378	763	$36,689
Clays do	1,188	22,844	1,047	23,134	766	20,107
Gem stones	NA	1	NA	5	NA	5
Phosphate rock thousand metric tons	1,582	12,765	1,328	16,201	897	11,596
Sand and gravel:						
Construction thousand short tons	8,676	22,824	e8,830	e24,130	5,051	15,917
Industrial do	244	2,106	1,142	5,610	468	4,826
Stone:						
Crushed do	38,584	126,993	W	W	W	W
Dimension do	10	883	11	1,063	p10	p1,012
Zinc (recoverable content of ores, etc.) metric tons	111,754	92,218	117,684	115,597	121,306	102,882
Combined value of barite, copper, gold (1981), lime, pyrites, silver, and values indicated by symbol W	XX	47,133	XX	r192,822	XX	185,718
Total	XX	393,835	XX	r421,149	XX	378,752
TEXAS						
Cement:						
Masonry thousand short tons	241	$18,310	229	$15,699	236	$16,440
Portland do	9,517	535,690	10,262	567,391	9,732	545,679
Clays do	3,763	27,022	4,172	29,135	4,193	26,497
Gem stones	NA	160	NA	200	NA	200
Gypsum thousand short tons	1,681	14,124	1,783	14,900	1,954	16,681
Helium (Grade-A) million cubic feet	35	805	238	6,188	458	15,572
Lime thousand short tons	1,515	67,075	1,393	67,158	1,125	62,277
Salt do	9,978	93,414	8,397	84,240	7,421	82,805
Sand and gravel:						
Construction do	44,651	139,892	e46,000	e150,000	45,527	154,515
Industrial do	2,054	31,684	2,242	36,992	2,623	45,007
Stone:						
Crushed do	76,483	220,265	72,454	219,086	p68,000	p205,000
Dimension do	37	7,095	42	5,543	p50	p5,822
Sulfur (Frasch) thousand metric tons	4,810	W	3,674	W	2,360	W
Talc and pyrophyllite thousand short tons	401	4,295	282	4,127	205	3,024
Combined value of asphalt (native, 1980-81), fluorspar (1981-82), helium (crude), iron ore, magnesium chloride, magnesium compounds, sodium sulfate, and values indicated by symbol W	XX	574,820	XX	r551,751	XX	374,913
Total	XX	1,734,651	XX	r1,752,410	XX	1,554,432

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1980		1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
UTAH						
Clays thousand short tons	365	$1,517	290	$2,296	[2]183	[2]$994
Copper (recoverable content of ores, etc.) metric tons	157,775	356,251	211,276	396,471	189,090	309,778
Gem stones	NA	70	NA	80	NA	80
Gold (recoverable content of ores, etc.) troy ounces	179,538	109,978	227,706	104,663	174,940	65,762
Gypsum thousand short tons	287	2,612	300	2,705	231	2,363
Iron ore (usable) thousand long tons, gross weight	1,307	18,540	691	W	W	W
Lead (recoverable content of ores, etc.) metric tons	W	W	1,662	1,338	W	W
Lime thousand short tons	259	13,293	333	16,679	286	15,121
Perlite do.	(3)	2	(3)	4	--	--
Salt do.	1,157	19,373	1,072	21,775	1,227	23,210
Sand and gravel:						
Construction do.	8,906	17,234	e8,212	e54,550	7,579	14,920
Industrial do.	W	W	22	286	W	W
Silver (recoverable content of ores, etc.) thousand troy ounces	2,203	45,476	2,883	30,321	4,342	34,522
Stone:						
Crushed thousand short tons	2,954	12,123	2,840	12,157	p2,500	p9,800
Dimension do.	3	272	3	280	p3	p280
Zinc (recoverable content of ores, etc.) metric tons	W	W	1,576	1,548	--	--
Combined value of asphalt (native), beryllium concentrate, carbon dioxide (natural, 1980-81), cement, clays (fuller's earth, 1982), magnesium compounds, molybdenum, phosphate rock, potassium salts, sodium sulfate, tungsten ore and concentrate (1980-81), vanadium, and values indicated by symbol W	XX	166,883	XX	174,729	XX	145,669
Total	XX	763,624	XX	r819,882	XX	622,499
VERMONT						
Sand and gravel (construction) thousand short tons	1,900	$4,171	e3,196	e$7,254	3,218	$6,854
Stone:						
Crushed do.	1,320	4,787	1,319	5,144	p1,200	p5,300
Dimension do.	169	23,649	207	30,756	p202	p29,446
Talc do.	318	2,753	W	W	W	W
Combined value of other nonmetals and values indicated by symbol W	XX	7,277	XX	10,919	XX	8,550
Total	XX	42,637	XX	r54,073	XX	50,150
VIRGINIA						
Clays thousand short tons	762	$3,172	502	$2,016	422	$2,237
Gem stones	NA	15	NA	20	NA	20
Iron oxide pigments short tons	W	W	W	W	1,269	372
Lead (recoverable content of ores, etc.) metric tons	1,563	1,463	1,607	1,294	--	--
Lime thousand short tons	824	33,872	804	35,984	641	29,118
Sand and gravel (construction) do.	8,264	29,508	e7,109	e24,470	6,978	28,522
Stone:						
Crushed do.	44,615	167,839	37,071	152,630	p35,200	p142,300
Dimension do.	27	2,287	4	1,130	p4	p1,130
Zinc (recoverable content of ores, etc.) metric tons	12,038	9,934	9,731	9,558	--	--
Combined value of aplite, cement, gypsum, kyanite, sand and gravel (industrial), talc, vermiculite, and values indicated by symbol W	XX	57,216	XX	r52,178	XX	59,484
Total	XX	305,306	XX	r279,280	XX	263,183

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State—Continued

Mineral	1980		1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
WASHINGTON						
Cement:						
Masonry thousand short tons	W	W	15	$1,284	W	W
Portland do	1,546	$89,208	1,560	100,845	1,154	$75,988
Clays do	[2]301	[2]1,571	[2]263	[2]1,524	251	1,829
Gem stones	NA	150	NA	200	NA	200
Sand and gravel:						
Construction thousand short tons	19,019	46,731	e16,870	e42,130	15,190	40,295
Industrial do	W	W	304	3,358	242	2,809
Silver thousand troy ounces	W	W	67	709	W	W
Stone:						
Crushed thousand short tons	11,085	W	9,516	25,619	p8,600	p23,800
Dimension do	6	248	15	2,378	p14	p2,375
Talc do	--	--	--	--	8	20
Combined value of barite (1982), clays (fire clay, 1980-81), copper (1981-82), diatomite, gold, gypsum, lead (1980 and 1982), lime, olivine, peat, stone (1980), tungsten ore and concentrate (1981), and values indicated by symbol W	XX	69,454	XX	30,461	XX	24,712
Total	XX	207,362	XX	r208,508	XX	172,028
WEST VIRGINIA						
Clays[2] thousand short tons	291	$642	220	$502	210	$583
Sand and gravel (construction) do	2,728	11,454	e651	e2,601	751	3,392
Stone (crushed) do	9,766	36,305	7,885	28,399	p5,900	p22,700
Combined value of cement, clays (fire clay), lime, salt, sand and gravel (industrial)	XX	57,885	XX	56,046	XX	48,938
Total	XX	106,286	XX	r87,548	XX	75,613
WISCONSIN						
Iron ore (usable) thousand long tons, gross weight	679	W	W	W	263	W
Lime thousand short tons	357	$17,287	326	$17,548	312	$17,685
Peat do	11	535	e 10	535	9	W
Sand and gravel:						
Construction do	21,067	38,025	e18,210	e34,522	14,515	29,218
Industrial do	947	9,546	1,100	13,180	788	9,662
Stone:						
Crushed do	20,603	49,245	15,189	39,962	p11,400	p36,100
Dimension do	45	4,501	40	4,259	p37	p2,644
Combined value of abrasive stone, cement, clays (1980), peat (1982), and values indicated by symbol W	XX	33,151	XX	41,749	XX	16,985
Total	XX	152,290	XX	r151,755	XX	112,294
WYOMING						
Clays thousand short tons	3,081	$71,512	3,855	$100,926	2,561	$73,696
Gem stones	NA	190	NA	250	NA	250
Gypsum thousand short tons	312	2,731	299	2,625	283	2,805
Sand and gravel:						
Construction do	5,454	12,523	e3,680	e10,120	3,382	10,279
Industrial do	W	W	--	--	--	--
Stone (crushed) do	4,374	14,835	3,224	9,858	p2,300	p7,300
Combined value of beryllium concentrate (1982), cement, iron ore, lead (1981), lime, silver (1981), sodium carbonate, zinc (1981), and value indicated by symbol W	XX	658,755	XX	644,279	XX	573,865
Total	XX	760,546	XX	r768,058	XX	668,195

eEstimated. pPreliminary. 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 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 7.—Mineral production[1] in the islands administered by the United States

(Thousand short tons and thousand dollars)

Area and mineral	1980		1981		1982	
	Quantity	Value	Quantity	Value	Quantity	Value
American Samoa: Stone	11	199	6	127	NA	NA
Guam: Stone	529	2,163	332	W	NA	NA
Virgin Islands: Stone	W	W	W	W	NA	NA

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

(Thousand short tons and thousand dollars)

Mineral	1980		1981		1982	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement	1,482	102,872	1,226	105,420	986	81,822
Clays	291	677	200	474	162	298
Lime	27	4,131	34	3,884	37	1,906
Sand and gravel	NA	NA	NA	NA	NA	NA
Stone	24,046	104,179	20,578	98,263	NA	NA
Total[2]	XX	211,859	XX	208,041	XX	84,026

NA Not available. 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 9.—U.S. exports of principal minerals and products, excluding mineral fuels

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS				
Aluminum:				
Ingots, slabs, crude—short tons	344,161	$526,646	401,174	$476,186
Scrap—do	r241,161	236,204	214,299	157,666
Plates, sheets, bars, etc—do	263,672	625,181	193,837	440,373
Castings and forgings—do	8,930	40,482	7,180	41,156
Aluminum sulfate—metric tons	25,296	3,439	6,121	1,280
Other aluminum compounds—do	48,049	37,174	36,329	26,663
Antimony, metals and alloys, crude—short tons	324	908	830	1,711
Bauxite including bauxite concentrate—thousand metric tons	41	8,090	49	8,545
Beryllium—pounds	78,189	3,094	134,013	3,696
Bismuth, metals and alloys—do	78,703	708	52,758	371
Cadmium—metric tons	239	332	11	126
Chromium:				
Ore and concentrate:				
Exports—thousand short tons	71	5,893	8	1,574
Reexports—do	67	9,575	57	9,172
Ferrochromium—do	14	10,361	5	5,081
Cobalt (content)—thousand pounds	834	16,462	596	7,690
Copper:				
Ore, concentrate, composition metal, unrefined (copper content)—metric tons	166,293	231,181	200,157	225,261
Scrap—do	50,078	70,106	54,419	63,484
Refined copper and semimanufactures—do	127,613	517,950	115,147	438,219
Other copper manufactures—do	18,451	37,464	17,591	32,787
Ferroalloys not elsewhere listed:				
Ferrophosphorus—short tons	7,463	2,031	4,031	1,402
Ferroalloys, n.e.c—do	6,358	8,439	4,980	8,481
Gold:				
Ore and base bullion—troy ounces	1,199,421	570,549	1,333,210	498,139
Bullion, refined—do	5,237,585	2,501,337	1,637,184	590,947
Iron ore—thousand long tons	5,546	244,685	3,178	150,522
Iron and steel:				
Pig iron—short tons	16,274	1,960	54,333	3,784
Iron and steel products (major):				
Steel mill products—do	2,903,863	2,275,267	1,842,313	1,601,431
Other steel products—do	443,796	1,138,745	342,406	913,111
Iron and steel scrap:				
Ferrous scrap including rerolling materials, ships, boats, other vessels for scrapping—thousand short tons	6,524	653,118	6,925	622,711

See footnotes at end of table.

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

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
METALS —Continued				
Lead:				
Ore and concentrate — metric tons	33,043	$18,958	29,104	$10,135
Pigs, bars, anodes, sheets, etc — do	23,320	25,996	55,629	48,818
Scrap — do	59,419	22,388	51,752	17,254
Magnesium, metal and alloys, scrap, semimanufactured forms, n.e.c — short tons	34,855	90,853	39,613	104,845
Manganese:				
Ore and concentrate — do	65,064	5,132	28,560	2,510
Ferromanganese — do	14,925	12,477	10,311	7,517
Silicomanganese — do	3,941	2,172	2,952	1,532
Metal — do	2,523	3,980	2,948	3,861
Molybdenum:				
Ore and concentrate (molybdenum content) — thousand pounds	51,350	406,816	49,783	232,214
Metals and alloys, crude and scrap — do	2,641	9,763	697	2,317
Wire — do	543	9,030	632	9,072
Semimanufactured forms, n.e.c — do	165	4,768	190	4,762
Powder — do	270	2,820	426	2,356
Ferromolybdenum — do	455	2,983	255	1,035
Compounds — do	7,328	40,686	12,441	41,806
Nickel:				
Alloys and scrap including unwrought metal, ingots, bars, sheets, anodes, etc — short tons	37,671	259,712	49,729	257,182
Catalysts — do	3,890	25,601	2,874	19,654
Wire — do	660	8,262	481	6,011
Semifabricated forms, n.e.c — do	r4,615	40,093	3,945	32,248
Platinum-group metals:				
Ore and scrap — troy ounces	212,426	61,409	423,576	84,095
Palladium, rhodium, iridium, osmiridium, ruthenium, osmium (metal and alloys including scrap) — do	259,745	61,136	262,764	41,057
Platinum (metal and alloy) — do	391,194	179,344	175,805	57,682
Rare earths: Ferrocerium and alloys — short tons	11	117	27	264
Selenium — thousand pounds	133	668	259	749
Silicon:				
Ferrosilicon — short tons	15,768	12,136	14,932	11,996
Silicon carbide, crude and in grains (includes reexports) — do	r11,510	11,148	6,979	8,374
Silver:				
Ore, concentrate, waste, sweepings — thousand troy ounces	12,772	151,090	12,594	102,768
Bullion, refined — do	15,131	181,380	12,876	105,977
Tantalum:				
Ore, metal, other forms — thousand pounds	303	20,520	618	20,113
Powder — do	97	19,999	115	16,231
Tin:				
Ingots, pigs, bars, etc.:				
Exports — metric tons	2,361	31,053	5,769	84,454
Reexports — do	3,719	55,505	3,311	47,896
Tinplate and terneplate — do	345,718	220,993	217,841	118,870
Titanium:				
Ore and concentrate — short tons	7,297	2,099	21,682	1,280
Unwrought and scrap metal — do	3,595	9,506	4,496	8,192
Intermediate mill shapes and mill products, n.e.c — do	6,049	159,454	3,600	100,608
Pigments and oxides — do	62,432	66,402	74,122	82,068
Tungsten (tungsten content):				
Ore and concentrate — thousand pounds	175	1,150	672	3,387
Carbide powder — do	1,213	18,158	1,214	14,059
Alloy powder — do	2,138	32,207	1,327	17,239
Vanadium:				
Ore and concentrate (vanadium content) — do	111	575	114	626
Pentoxide, etc — do	692	2,012	3,163	6,808
Ferrovanadium — do	869	4,397	653	3,436
Zinc:				
Slabs, pigs, or blocks — metric tons	323	812	341	547
Sheets, plates, strips, other forms, n.e.c — do	1,500	3,226	995	2,351
Waste, scrap, dust (zinc content) — do	35,049	25,452	19,059	13,818
Semifabricated forms, n.e.c — do	1,538	3,230	1,891	3,549
Ore and concentrate — do	54,232	29,280	77,289	32,534
Zirconium:				
Ore and concentrate — thousand pounds	23,260	3,838	22,023	3,268
Oxide — do	1,565	2,254	2,033	5,420
Metals, alloys, other forms — do	1,361	35,015	1,756	43,952
NONMETALS				
Abrasives (includes reexports):				
Industrial diamond, natural or synthetic:				
Powder or dust — thousand carats	28,471	65,777	30,625	66,934
Other — do	2,297	30,978	1,930	22,525
Diamond grinding wheels — do	694	7,706	473	5,714
Other natural and artificial metallic abrasives and products	NA	113,016	NA	101,631

See footnotes at end of table.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS —Continued					
Asbestos:					
Exports:					
Unmanufactured	metric tons	64,126	$21,349	58,525	$19,543
Products	do	NA	144,531	NA	126,704
Reexports:					
Unmanufactured	do	293	159	246	170
Products	do	NA	599	NA	1,163
Barite: Natural barium sulfate	short tons	62,187	9,947	48,533	6,510
Boron:					
Boric acid	do	46,184	24,602	35,030	19,082
Sodium borates, refined	do	227,543	e58,000	193,096	e50,000
Calcium:					
Other calcium compounds including precipitated calcium carbonate	do	25,659	11,713	31,282	15,613
Chloride	do	32,794	13,004	55,057	11,065
Dicalcium phosphate	do	55,862	33,434	61,308	36,454
Cement: Hydraulic and clinker	do	302,777	31,564	202,366	27,456
Clays:					
Kaolin or china clay	thousand short tons	1,412	155,999	1,296	146,989
Bentonite	do	862	64,537	668	54,713
Other	do	877	72,378	655	65,998
Diatomite	do	162	32,933	141	29,863
Feldspar, leucite, nepheline syenite	thousand pounds	28,050	1,110	21,600	989
Fluorspar	short tons	11,261	1,194	10,573	1,084
Gem stones (includes reexports):					
Diamond	thousand carats	3,215	854,100	2,683	638,655
Pearls		NA	5,856	NA	4,247
Other		NA	101,649	NA	106,105
Graphite, natural	short tons	11,344	4,433	10,335	4,099
Gypsum:					
Crude, crushed or calcined	thousand short tons	157	14,590	123	13,319
Manufactures, wallboard and plaster articles		NA	20,844	NA	16,231
Helium	million cubic feet	389	17,084	378	19,735
Lithium compounds:					
Lithium carbonate[1]	thousand pounds	NA	NA	10,910	13,506
Lithium hydroxide	do	6,040	9,542	5,250	8,931
Other lithium compounds	do	22,946	29,415	8,738	12,791
Lime	short tons	28,429	3,996	22,541	3,199
Magnesium compounds:					
Magnesite, dead-burned	do	20,926	4,727	12,869	2,721
Magnesite, crude, caustic-calcined, lump or ground	do	36,683	14,559	23,125	10,925
Mica:					
Sheet, waste, scrap, ground	do	10,920	3,437	11,147	3,182
Manufactured		NA	7,000	NA	5,499
Mineral-earth pigments, iron oxide, natural and synthetic	short tons	4,967	11,704	9,065	17,795
Nitrogen compounds (major)	thousand short tons	8,371	1,397,786	7,806	1,178,740
Phosphate rock	thousand metric tons	10,554	419,999	9,735	383,554
Phosphatic fertilizers:					
Superphosphates	do	r1,520	245,341	1,148	158,140
Ammonium phosphates	do	3,942	789,770	3,707	678,685
Elemental phosphorus	metric tons	r27,946	r42,749	15,084	25,125
Pigments and compounds: Zinc oxide (metal content)	thousand metric tons	1	1,112	--	--
Potash:					
Potassium chloride	metric tons	700,420	r80,680	691,040	56,710
Potassium sulfate	do	79,600	16,095	140,000	27,648
Pumice and pumicite	short tons	e1,000	NA	e1,000	NA
Quartz, crystal:					
Cultured	thousand pounds	125	4,600	115	3,500
Natural	do	e127	e490	69	380
Salt:					
Crude and refined	thousand short tons	r1,046	r17,429	1,001	16,647
Shipments to noncontiguous territories	do	71	9,145	65	8,451
Sand and gravel:					
Construction:					
Sand	do	613	6,298	631	5,397
Gravel	do	652	2,454	497	2,680
Industrial: Sand	do	1,132	27,984	818	26,320
Sodium compounds:					
Sodium sulfate	do	124	12,980	111	12,162
Sodium carbonate	do	1,051	121,107	1,109	140,616
Stone:					
Crushed	do	3,598	25,949	2,065	19,026
Dimension	do	rNA	r20,698	NA	18,678
Sulfur, crude	thousand metric tons	1,392	187,407	961	122,143
Talc, crude and ground	thousand short tons	311	15,095	232	12,957
Total		XX	r17,618,070	XX	12,769,065

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

Table 10.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
METALS				
Aluminum:				
Metal, short tons	710,656	$990,869	679,375	$858,017
Scrap, do.	81,994	79,141	74,338	54,240
Plates, sheets, bars, etc, do.	142,512	308,677	214,343	416,033
Aluminum oxide (alumina), thousand metric tons	3,978	837,932	3,183	770,444
Antimony:				
Ore and concentrate (antimony content), short tons	5,168	9,095	2,769	4,289
Sulfide including needle or liquated, do.	106	249	88	188
Metal, do.	2,631	6,569	1,900	3,893
Oxide, do.	12,170	19,922	10,433	18,045
Arsenic:				
White (As_2O_3 content), do.	18,958	13,126	16,092	15,241
Metallic, do.	323	2,079	150	1,044
Bauxite, crude, thousand metric tons	12,802	NA	10,122	NA
Beryllium ore, short tons	2,138	2,002	2,652	3,215
Bismuth, metal and alloys, gross weight, pounds	2,436,249	4,883	2,026,245	3,206
Cadmium: Metal, metric tons	3,090	13,369	2,305	4,684
Calcium:				
Metal, pounds	235,436	751	333,054	967
Chloride, short tons	86,865	4,088	60,623	3,010
Cesium compounds, pounds	24,415	1,049	16,647	799
Chromium:				
Ore and concentrate (Cr_2O_3 content), thousand short tons	368	49,948	209	29,670
Ferrochromium (gross weight), do.	428	213,611	141	77,495
Ferrochromium-silicon, do.	11	r5,224	7	3,322
Metal, do.	4	24,626	2	10,078
Cobalt:				
Metal, thousand pounds	13,906	238,820	11,610	137,652
Oxide (gross weight), do.	444	5,375	362	2,560
Salts and compounds (gross weight), do.	1,249	4,969	1,340	2,650
Columbium ore, do.	1,882	10,102	910	2,765
Copper (copper content):				
Ore and concentrate, metric tons	39,132	56,548	118,055	141,478
Matte, do.	2,718	3,232	4,042	3,609
Blister, do.	30,124	68,083	97,374	142,249
Refined in ingots, etc, do.	330,625	582,085	258,439	394,654
Scrap, do.	27,002	40,705	28,076	35,281
Ferroalloys not elsewhere listed, includes spiegeleisen, short tons	7,055	38,730	7,115	21,896
Gallium, kilograms	5,536	2,472	5,199	1,958
Germanium, do.	22,350	12,328	12,459	9,287
Gold:				
Ore and base bullion, troy ounces	487,675	214,927	682,661	242,885
Bullion, do.	4,164,476	1,942,560	4,237,669	1,650,719
Hafnium, pounds	5,310	126	--	--
Indium, thousand troy ounces	461	3,152	686	2,186
Iron ore, thousand long tons	28,328	947,977	14,501	470,847
Iron and steel:				
Pig iron, short tons	468,125	71,013	321,702	48,940
Iron and steel products (major):				
Steel mill products, do.	19,898,371	10,247,660	16,536,292	8,947,132
Other products, do.	822,396	954,618	744,790	1,342,878
Scrap including tinplate, thousand short tons	556	62,126	468	37,572
Lead:				
Ore, flue dust, matte (lead content), metric tons	27,206	20,196	18,945	8,784
Base bullion (lead content), do.	449	340	19	28
Pigs and bars (lead content), do.	100,108	87,026	94,855	58,633
Reclaimed scrap, etc. (lead content), do.	2,661	2,220	4,834	1,755
Sheet, pipe, shot, do.	474	726	467	694
Magnesium:				
Metal and scrap, short tons	6,122	10,182	3,652	5,732
Alloys (magnesium content), do.	625	2,652	955	3,889
Sheets, tubing, ribbons, wire, other forms (magnesium content), do.	150	4,804	177	5,982
Manganese:				
Ore (35% or more contained manganese), do.	639,141	42,643	237,759	16,160
Ferromanganese, do.	671,178	226,618	492,708	154,490
Ferrosilicon-manganese (manganese content), do.	r84,900	49,754	41,121	21,471
Metal, do.	8,343	8,419	5,226	5,213
Mercury:				
Compounds, pounds	37,258	273	37,974	269
Metal, 76-pound flasks	12,408	5,005	8,916	3,003

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
METALS —Continued				
Molybdenum:				
Ore and concentrate (molybdenum content) thousand pounds	1,988	$9,911	3,115	$13,429
Waste and scrap (gross weight) do	NA	2,674	NA	1,474
Metal:				
Unwrought (molybdenum content) do	153	2,893	67	1,370
Wrought (gross weight) do	93	2,557	79	1,959
Ferromolybdenum (gross weight) do	1,175	6,353	1,665	6,308
Material in chief value molybdenum (molybdenum content) do	1,651	9,574	2,749	12,143
Compounds (gross weight) do	5,164	18,052	4,772	13,030
Nickel:				
Ore short tons	513	42	--	--
Pigs, ingots, shot, cathodes do	123,141	747,920	82,297	446,850
Plates, bars, etc do	3,864	36,897	5,120	50,348
Slurry do	r94,786	223,060	58,568	105,633
Scrap do	5,226	17,496	4,300	13,349
Powder and flakes do	14,124	93,325	12,132	72,845
Ferronickel do	69,853	119,321	21,352	28,215
Oxide do	4,330	21,779	3,144	13,461
Platinum-group metals:				
Unwrought:				
Grains and nuggets (platinum) troy ounces	1,891	862	3,298	1,120
Sponge (platinum) do	888,995	424,780	689,647	305,356
Sweepings, waste, scrap do	235,379	58,462	339,095	42,236
Iridium do	11,110	6,203	19,402	9,242
Palladium do	1,114,313	142,180	1,039,210	98,285
Rhodium do	73,738	45,847	68,968	36,284
Ruthenium do	180,438	6,833	133,798	5,395
Other platinum-group metals do	44,337	16,455	23,429	7,501
Semimanufactured:				
Platinum do	179,321	83,972	114,028	42,515
Palladium do	116,548	13,717	60,760	5,159
Rhodium do	1,733	657	1,005	459
Other platinum-group metals do	1,814	288	1,066	384
Rare-earth metals:				
Ferrocerium and other cerium alloys short tons	92	1,249	95	1,092
Monazite do	8,233	3,158	7,940	3,070
Metals including scandium and yttrium pounds	3,750	168	7,094	139
Rhenium:				
Metal including scrap do	580	574	176	88
Ammonium perrhenate do	9,089	3,297	5,193	803
Selenium and selenium compounds (selenium content) do	686,887	7,766	765,731	7,711
Silicon:				
Metal (over 96% silicon content) short tons	29,636	58,034	26,338	52,195
Ferrosilicon do	155,648	80,317	76,732	40,343
Silver:				
Ore and base bullion thousand troy ounces	9,769	100,422	12,530	91,638
Bullion do	75,921	837,174	96,917	786,154
Sweepings, waste, doré do	8,425	90,853	8,010	49,287
Tantalum ore thousand pounds	1,952	57,726	1,297	16,286
Tellurium (tellurium content) pounds	83,671	1,811	36,600	906
Thallium do	882	87	2,827	103
Tin:				
Concentrate (tin content) metric tons	232	2,975	1,961	21,544
Dross, skimmings, scrap, residue, tin alloys, n.s.p.f. do	2,583	3,387	3,068	4,364
Tinfoil, powder, flitters, etc	NA	8,666	NA	12,288
Tin scrap and other tin-bearing material excluding tinplate scrap	NA	rNA	NA	NA
Tin compounds metric tons	170	2,098	321	2,667
Titanium:				
Ilmenite[1] short tons	505,042	36,215	596,211	41,630
Rutile do	202,373	59,024	163,325	39,610
Metal do	11,637	139,801	3,713	40,680
Ferrotitanium and ferrosilicon titanium do	615	1,582	152	263
Pigments do	124,906	127,396	138,922	146,569
Tungsten ore and concentrate (tungsten content) thousand pounds	11,752	91,195	7,778	46,748
Vanadium (vanadium content):				
Ferrovanadium do	1,968	13,288	1,339	8,065
Vanadium pentoxide do	669	3,344	238	1,063
Vanadium-bearing materials do	4,870	11,751	2,225	5,194

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

Mineral		1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
METALS —Continued					
Zinc:					
Ore (zinc content)	metric tons	245,710	$110,253	66,809	$27,132
Blocks, pigs, slabs	do	612,007	549,326	456,233	370,773
Sheets, etc	do	332	472	700	694
Fume (zinc content)	do	184	61	11	6
Waste and scrap	do	5,782	2,578	2,653	1,232
Dross and skimmings	do	7,629	4,090	7,104	3,134
Dust, powder, flakes	do	7,993	9,519	5,864	6,925
Manufactures		NA	438	NA	540
Zirconium:					
Ore including zirconium sand	short tons	91,108	8,378	68,465	6,144
Metal, scrap, compounds	do	1,647	22,122	1,243	15,431
NONMETALS					
Abrasives:					
Diamond (industrial)	thousand carats	20,404	110,510	19,127	85,837
Other		NA	188,667	NA	159,211
Asbestos	metric tons	337,618	103,893	241,737	64,925
Barite:					
Crude and ground	thousand short tons	1,946	108,599	2,344	120,518
Witherite	short tons	99	87	333	126
Chemicals	do	22,309	11,938	23,857	13,163
Boron:					
Boric acid	do	1,124	763	4,362	1,903
Calcium borate, crude[2]	do	98,100	15,202	39,000	6,386
Cement: Hydraulic and clinker	thousand short tons	3,997	151,240	2,929	110,886
Clays	short tons	33,314	7,895	24,245	4,514
Cryolite	do	7,188	4,679	6,218	4,266
Feldspar:					
Crude	do	108	44	48	24
Ground and crushed	do	98	18	--	--
Fluorspar	do	826,783	104,938	543,723	67,665
Gem stones:					
Diamond	thousand carats	r4,409	2,201,262	4,636	1,917,612
Emeralds	do	2,298	131,560	2,167	120,809
Other		NA	433,428	NA	346,031
Graphite	short tons	68,708	23,998	56,491	20,712
Gypsum:					
Crude, ground, calcined	thousand short tons	7,595	39,605	6,720	36,285
Manufactures		NA	12,115	NA	17,361
Iodine, crude	thousand pounds	6,099	36,231	4,728	27,709
Lime:					
Hydrated	short tons	65,717	3,471	60,108	3,305
Other	do	438,623	18,092	288,266	13,503
Lithium:					
Ore	do	(3)	(3)	15	5
Compounds	do	280	1,845	133	568
Magnesium compounds:					
Crude magnesite	do	12	r2,236	3	306
Lump, ground, caustic-calcined magnesia	do	12,065	2,177	13,959	2,055
Refractory magnesia, dead-burned, fused magnesite, dead-burned dolomite	do	76,810	23,114	59,519	14,588
Compounds	do	35,382	6,241	44,797	7,965
Mica:					
Uncut sheet and punch	thousand pounds	11,558	2,747	7,185	1,790
Scrap	do	r(4)	23	992	47
Manufactures	do	664	3,059	724	2,936
Mineral-earth pigments, iron oxide pigments:					
Ocher, crude and refined	short tons	r152	r83	31	20
Siennas, crude and refined	do	98	42	112	46
Umber, crude and refined	do	5,919	944	3,768	649
Vandyke brown	do	1,070	340	423	153
Other natural and refined	do	r969	r967	880	576
Synthetic	do	31,453	16,539	20,641	11,886
Nepheline syenite:					
Crude	do	2,780	25	316	16
Ground, crushed, etc	do	503,320	11,504	455,280	13,735
Nitrogen compounds (major) including urea	thousand short tons	4,844	610,574	4,841	681,368
Peat:					
Fertilizer-grade	short tons	291,732	37,955	309,467	38,605
Poultry- and stable-grade	do	50,198	6,845	60,533	7,752
Phosphates, crude	thousand metric tons	r16	r673	(4)	1,302
Phosphatic materials:					
Fertilizer and fertilizer materials	do	16	3,112	8	1,672
Elemental phosphorus	do	(4)	1,247	(4)	1,017
Other	do	92	r15,471	41	6,459

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS —Continued				
Pigments and salts:				
Lead pigments and compounds ____ metric tons	15,186	$15,233	12,904	$10,613
Zinc pigments and compounds ____ do ____	38,615	33,501	35,721	30,932
Potash ____ do ____	7,903,300	750,400	6,337,900	575,400
Pumice:				
Crude or unmanufactured ____ short tons	2,954	70	2,887	102
Wholly or partly manufactured ____ do ____	89,329	601	118,228	699
Manufactured, n.s.p.f ____	NA	126	NA	104
Quartz crystal (Brazilian pebble) ____ thousand pounds	389	233	417	245
Salt ____ thousand short tons	r4,319	r44,523	5,451	56,184
Sand and gravel:				
Industrial sand ____ do ____	r4	621	89	2,523
Other sand and gravel ____ do ____	333	1,987	185	1,479
Sodium compounds:				
Sodium bicarbonate ____ do ____	3	680	7	1,360
Sodium carbonate ____ do ____	12	1,625	18	2,410
Sodium sulfate ____ do ____	275	19,135	394	28,758
Stone:				
Crushed ____ do ____	r3,036	r8,896	1,664	10,570
Dimension ____	NA	r132,904	NA	169,908
Calcium carbonate fines ____ thousand short tons	270	4,577	192	5,811
Strontium:				
Mineral ____ short tons	49,699	3,206	33,075	2,057
Compounds ____ do ____	r4,644	r3,730	1,943	1,850
Sulfur and compounds, sulfur ore and other forms, n.e.s ____ thousand metric tons	2,522	209,766	1,905	164,885
Talc, unmanufactured ____ thousand short tons	27	4,562	27	5,215
Total ____	XX	r28,810,755	XX	24,399,414

rRevised. NA Not available. XX Not applicable.
[1]Includes titanium slag averaging about 70% TiO_2. For detail, see Titanium chapter.
[2]Owing to a change of reporting, 1982 calcium borate, crude, imports are not comparable with those of previous years.
[3]Revised to zero.
[4]Less than 1/2 unit.

Table 11.—Comparison of world and U.S. production of selected nonfuel mineral commodities

(Thousand short tons unless otherwise specified)

Mineral	1981			1982[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	63,356	646	1	59,304	503	1
Arsenic trioxide[2] do	30,912	W	NA	29,465	W	NA
Bauxite[3] thousand metric tons	85,474	1,510	2	74,441	732	1
Beryl[2] short tons	3,257	W	NA	3,158	W	NA
Bismuth thousand pounds	7,457	W	NA	7,161	W	NA
Chromite	11,736	--	--	10,907	--	--
Cobalt (content of ore and concentrate) short tons	33,372	--	--	27,650	--	--
Columbium-tantalum concentrate (gross weight) thousand pounds	78,413	NA	NA	75,715	NA	NA
Copper (content of ore and concentrate) thousand metric tons	8,175	1,538	19	7,964	1,140	14
Gold (content of ore and concentrate) thousand troy ounces	41,227	1,379	3	42,713	1,447	3
Iron ore (gross weight) thousand long tons	843,204	73,174	9	783,032	35,433	5
Lead (content of ore and concentrate) thousand metric tons	3,343	446	13	3,451	512	15
Manganese ore (35% or more Mn, gross weight)	25,952	--	--	24,754	--	--
Mercury thousand 76-pound flasks	214	28	13	204	26	13
Molybdenum (content of ore and concentrate) thousand pounds	241,097	139,900	58	200,339	83,050	41
Nickel (content of ore and concentrate)	785	12	2	670	3	(4)
Platinum-group metals[2] thousand troy ounces	6,923	7	(4)	6,454	8	(4)
Silver (content of ore and concentrate) do	362,308	40,683	11	372,528	40,239	11
Tin (content of ore and concentrate) metric tons	252,575	W	NA	241,114	W	NA
Titanium concentrates (gross weight):						
Ilmenite	4,010	509	13	3,371	228	7
Rutile	409	W	NA	381	W	NA
Tungsten ore and concentrate (contained tungsten) thousand pounds	108,481	7,948	7	98,926	3,354	3
Vanadium (content of ore and concentrate) short tons	38,683	5,126	13	36,498	4,098	11
Zinc (content of ore and concentrate) thousand metric tons	5,657	312	6	6,047	300	5
METALS, SMELTER BASIS						
Aluminum (primary only)	16,614	4,948	30	14,626	3,609	25
Cadmium metric tons	17,242	1,603	9	16,140	1,007	6
Cobalt short tons	28,237	447	2	21,706	508	2
Copper smelter (primary and secondary)[5] thousand metric tons	8,297	1,378	17	8,153	1,021	13
Iron, pig	557,333	73,755	13	500,026	43,342	9
Lead, smelter (primary and secondary)[6] thousand metric tons	5,029	1,139	23	5,075	1,088	21
Magnesium (primary only)	326	143	44	273	99	36
Nickel[7]	769	49	6	683	45	7
Selenium[8] thousand pounds	2,871	555	19	2,684	536	20
Steel, raw	777,359	[9]120,828	16	708,269	[9]74,577	11
Tellurium[8] thousand pounds	230	W	NA	213	W	NA
Tin metric tons	247,260	[10]2,000	1	241,164	[10]3,500	1
Zinc (primary and secondary) thousand metric tons	6,112	397	6	5,881	302	5
NONMETALS						
Asbestos do	**4,480**	**76**	**2**	**4,311**	**64**	**1**
Barite	**9,057**	**[11]2,849**	**31**	**7,887**	**[11]1,845**	**23**
Boron minerals	**2,820**	**1,481**	**53**	**2,530**	**1,234**	**49**
Bromine thousand pounds	**753,494**	**[11]377,097**	**50**	**837,790**	**[11]401,100**	**48**
Cement, hydraulic	**983,250**	**[12]72,932**	**7**	**982,670**	**[12]64,341**	**7**
Clays:						
Bentonite[8]	**7,474**	**[11]4,947**	**66**	**5,717**	**[11]3,245**	**57**
Fuller's earth[8]	**2,123**	**[11]1,656**	**78**	**2,200**	**[11]1,683**	**77**
Kaolin[8]	**22,695**	**[11]7,660**	**34**	**21,041**	**[11]6,362**	**30**
Corundum	**24**	--	--	**21**	--	--
Diamond thousand carats	**42,557**	--	--	**45,166**	--	--

See footnotes at end of table.

Table 11.—Comparison of world and U.S. production of selected nonfuel mineral commodities —Continued

(Thousand short tons unless otherwise specified)

Mineral	1981			1982[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						
Diatomite	1,627	[11]687	42	1,531	[11]613	40
Feldspar[2]	3,463	665	19	3,416	615	18
Fluorspar	5,568	115	2	5,003	77	2
Graphite	633	--	--	607	W	NA
Gypsum	84,076	11,497	14	80,616	10,538	13
Iodine, crude thousand pounds	26,516	W	NA	25,955	W	NA
Lime (sold or used)	129,426	[12]18,890	15	123,404	[12]14,112	11
Magnesite	12,356	W	NA	12,268	W	NA
Mica (including scrap and ground) thousand pounds	737,895	500,000	68	624,602	404,000	65
Nitrogen, N content of ammonia	81,573	15,619	19	80,078	12,742	16
Peat	387,226	686	[4]	408,190	721	[4]
Perlite	1,572	[11]591	38	1,481	[11]506	34
Phosphate rock thousand metric tons	137,524	53,624	39	122,633	37,414	31
Potash (K_2O equivalent) do	27,046	2,156	8	26,230	1,784	7
Pumice[3]	13,734	499	4	12,871	416	3
Salt	187,781	[11 12]38,915	21	186,005	[11 12]37,896	20
Sodium compounds, natural and manufactured:						
Sodium carbonate	30,895	8,281	27	30,572	7,819	26
Sodium sulfate	6,056	1,077	18	5,784	895	15
Strontium[3] short tons	131,016	--	--	122,158	--	--
Sulfur, all forms thousand metric tons	53,563	12,145	23	50,660	9,787	19
Talc and pyrophyllite	7,955	1,343	17	7,595	1,135	15
Vermiculite[3]	576	320	56	564	316	56

[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 1982 was $299.4 million, a decrease of $14.4 million from that of 1981; the decrease continued a downward trend that started in 1980. Output of most nonfuel minerals declined; cement, crushed stone, lime, sand and gravel, and clays were the major commodities produced in the State.

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

Trends and Developments.—Adverse economic conditions continued to impact severely on most industries within the State, leaving Alabama with one of the highest unemployment rates in the Nation.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	193	$10,721	150	$9,086
Portland	do	2,270	89,216	2,558	104,461
Clays[2]	do	1,910	25,406	1,323	13,193
Gem stones		NA	1	NA	1
Lime	thousand short tons	1,219	59,454	907	42,380
Sand and gravel:					
Construction	do	e9,503	e23,340	7,019	17,226
Industrial	do	182	864	960	8,096
Stone:					
Crushed	do	20,706	88,377	p21,200	p89,600
Dimension	do	7	2,130	p8	p2,341
Combined value of asphalt (native, 1981), bauxite, clays (bentonite), phosphate rock, and salt		XX	14,288	XX	13,025
Total		XX	r313,797	XX	299,409

eEstimated. pPreliminary. rRevised. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Autauga	W	[3]	
Baldwin	W	W	Clays.
Barbour	W	W	Clays, bauxite.
Bibb	W	W	Clays, stone (crushed).
Blount	W	W	Cement, stone (dimension).
Calhoun	W	W	Clays, stone (crushed).
Cherokee	$153	[3]	
Chilton	W	W	Clays.
Clarke	W	[3]	
Clay	14	[3]	
Coffee	89	[3]	
Colbert	W	W	Stone (crushed), asphalt (native).
Conecuh	W	[3]	
Coosa	1,048	$1,422	Stone (crushed).
Crenshaw	71	W	Sand and gravel (industrial).
Dale	W	[3]	
Dallas	1,576	115	Clays.
De Kalb	848	630	Stone (crushed).
Elmore	W	W	Clays.
Escambia	466	[3]	
Etowah	W	W	Stone (crushed).
Fayette	W	[3]	
Franklin	W	W	Stone (crushed), stone (dimension).
Geneva	366	[3]	
Greene	W	[3]	
Hale	45	[3]	
Henry	W	W	Bauxite, clays.
Jackson	W	W	Stone (crushed).
Jefferson	W	W	Cement, stone (crushed), clays.
Lamar	W	[3]	
Lawrence	571	1,348	Stone (crushed).
Lee	W	3,166	Do.
Limestone	W	W	Phosphate rock.
Lowndes	W	W	Clays.
Macon	1,950	158	Sand and gravel (industrial).
Madison	W	W	Stone (crushed), clays.
Marengo	W	W	Cement, stone (crushed).
Marion	359	124	Clays.
Marshall	W	W	Stone (crushed), clays.
Mobile	W	20,148	Cement, stone (crushed), clays, sand and gravel (industrial).
Monroe	185	712	Stone (crushed).
Montgomery	W	12	Clays.
Morgan	W	4,014	Stone (crushed).
Randolph	W	1,723	Do.
Russell	W	568	Clays.
St. Clair	W	25,671	Cement, clays, stone (crushed).
Shelby	101,739	104,861	Lime, cement, stone (crushed), clays.
Sumter	W	W	Clays.
Talladega	15,029	16,015	Stone (crushed), stone (dimension).
Tuscaloosa	W	W	Sand and gravel (industrial).
Walker	W	W	Clays.
Washington	W	W	Salt.
Wilcox	213	117	Stone (crushed).
Undistributed[4]	203,650	109,652	
Sand and gravel (construction)	XX	e23,340	
Total[5]	328,374	313,797	

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, Pickens, Pike, Tallapoosa, and Winston.

[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 that cannot be assigned to specific counties and values indicated by symbol W.

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

The State had an unemployment rate of 15.9% at yearend compared with 11.0% in 1981. To help alleviate the condition, the State sold a $520 million bond issue to finance major construction projects and create an estimated 20,000 jobs by 1983. According to the Federal Reserve Bank of Atlanta,[3] recovery in the State will be slow because the concentration of manufacturing is dependent upon the construction and automotive industries. Most of the State's nonfuel mineral industry is dependent on construction and manufacturing. General construction declined throughout the year, but residential construction activity increased at yearend. Alabama's commercial construction has been weak since 1979; road construction was stronger than other States in the southeast, partially as a result of the $520 million bond issue.

Table 3.—Indicators of Alabama business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,669.0	1,713.0	+2.6
Unemployment	do	178.0	247.0	+38.8
Employment (nonagricultural):				
Mining[1]	do	15.8	16.6	+5.1
Manufacturing	do	362.0	337.0	-6.9
Contract construction	do	63.9	57.2	-10.5
Transportation and public utilities	do	72.1	71.2	-1.2
Wholesale and retail trade	do	271.7	267.5	-1.5
Finance, insurance, real estate	do	59.6	58.9	-1.2
Services	do	211.2	215.7	+2.1
Government	do	291.3	290.9	-.1
Total nonagricultural employment[1]	do	1,347.6	1,315.0	-2.4
Personal income:				
Total	millions	$32,189	$33,833	+5.1
Per capita		$8,217	$8,581	+4.4
Construction activity:				
Number of private and public residential units authorized		10,410	9,557	-8.2
Value of nonresidential construction	millions	$373.0	$328.1	-12.0
Value of State road contract awards	do	$260.0	$211.8	-18.5
Shipments of portland and masonry cement to and within the State	thousand short tons	1,064	994	-6.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$313.8	$299.4	-4.6
Value per capita, resident population		$80	$76	-5.0
Value per square mile		$6,058	$5,802	-4.2

[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.

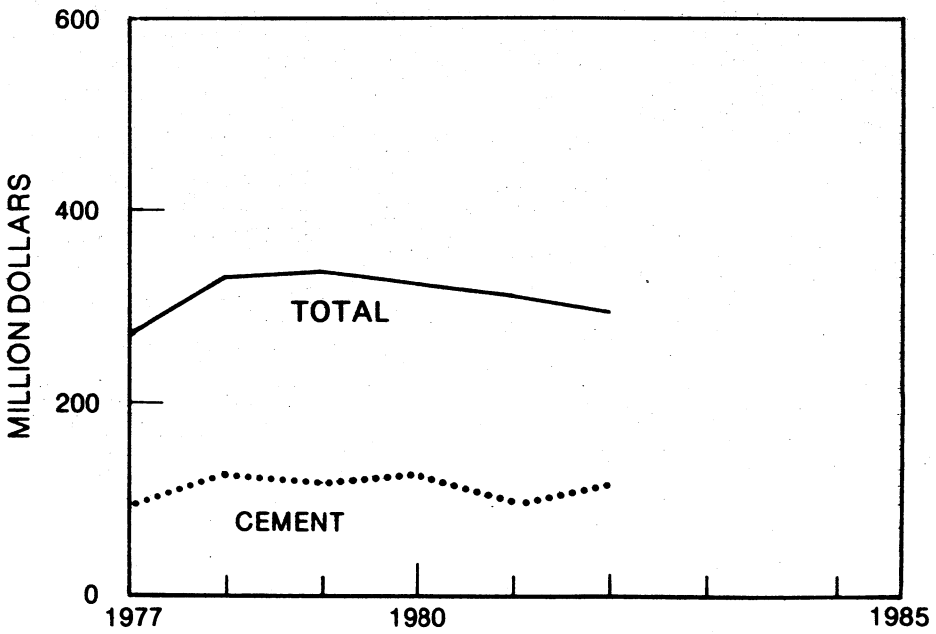

Figure 1.—Value of cement and total value of nonfuel mineral production in Alabama.

Although economic conditions continued to be unfavorable for many of the State's mineral producers, a number of companies announced plans to construct new or to expand existing facilities. The Alabama Development Office (ADO), in its 1982 report of new and expanding industries, announced 118 expansions, totaling $282 million in mineral-related fields, as follows: bituminous coal mining, 10 expansions, with a total investment of $78 million; oil and gas, 3 expansions, with a total investment of $23 million; mining and quarrying of nonmetallic minerals, 7 expansions, with a total investment of $1.6 million; stone, clays, glass, and concrete products, 47 expansions, with a total investment of $129.4 million; and primary metals, 51 expansions, with a total investment of $50 million. The number of expansions were the same as that in 1981, but total value was much lower.

The State's primary metal industries were hard hit in 1982, continuing a trend started in 1979. Depressed markets for steel products and high levels of imports impacted on the State's steel, foundry, and ferroalloy industries. United States Steel Corp. closed its Fairfield Works during the year, with indications it would not start up until late 1983. Republic Steel Corp.'s Gadsden plant operated at about 40% of capacity. Other foundries and ferroalloy plants either closed or reduced output. Reduced demand for aluminum and high energy costs resulted in the shutdown of both aluminum reduction plants in the State—Reynolds Metals Co., Listerhill, and Revere Copper & Brass Inc., Scottsboro. Aluminum Co. of America (Alcoa) also shut down its alumina plant in Mobile. Although increased defense spending could increase steel plate demand in 1983, antiquated equipment could leave Alabama's metal industry vulnerable to imports. At one time during the year, steel imports were 37% of the market in the gulf region, but by yearend imports had decreased.

The Alabama State Docks at the Port of Mobile handled over 29 million tons of material during fiscal year 1982. Bulk material shipments comprised the major activity at the facility, with iron ore, ilmenite, and bauxite, three of the major materials handled. These ores were vital to the operation of many heavy industries in the State. Adverse economic conditions resulted in less imports in 1982 of iron ore and bauxite compared with those of 1981. Bauxite imports ceased in February with the shutdown of Alcoa's alumina facility in Mobile. Major imports through the State Docks facilities included iron ore (996,241 tons), bauxite (121,755 tons), manganese ore (28,791 tons), magnesite (62,592 tons), and ilmenite (136,591 tons). Other minerals handled included oyster shell, gypsum, gravel, cement, and limestone. In addition to direct handling of raw materials, shipments through private facilities included 350,843 tons, mostly iron ore.

Construction continued on the Tennessee-Tombigbee Waterway, with crushed stone and sand and gravel operators providing required raw materials. With the project 82% complete, the market for construction aggregate began to decline in 1982 and is expected to drop significantly in 1983. Approximately 130 miles of the 234-mile project were open. Total construction expenditures through 1982 were about $1.4 billion.

With work on the waterway nearing an early completion date of 1985, expansion projects at the State Docks were being coordinated to handle anticipated cargo moving down the waterway. Since 1971, the State Docks has expended more than $226 million, mostly in preparation for the opening of the waterway. Many nonfuel mineral operations are expected to utilize the waterway to expand their market areas because of the lower transportation costs.

United States Steel continued construction of a $650 million seamless pipe mill at the Fairfield Works. The mill, with a capacity of 600,000 tons of pipe per year, is expected to be completed late in 1983, and will have twice the capacity of any other single mill of United States Steel. Products will include tubing, drill pipe, casing, and standard and line pipe.

Work continued on conversion of the old Sloss blast furnaces in Birmingham into an industrial museum. The blast furnaces date back to 1881, and were shut down in late 1970 when tougher environmental regulations were passed. Jim Walter Resources Inc. donated the property to the city for use as a museum. A $3 million bond issue was approved in 1977 for renovation, and the museum was expected to open in 1983.

The Hall Chemical Co., Wickliffe, Ohio, started construction of a catalyst reclamation plant in Mobile's Theodore industrial area. The $40 million facility will recover cobalt, nickel, molybdenum, tungsten, sulfur, vanadium, and alumina from hydrotreating and hydroforming catalysts used in the processing of high-sulfur crudes. Con-

struction is expected to take 2 years. Hall also operates a facility in Arab, Marshall County, where it recovers cobalt, manganese, and nickel salts.

Legislation and Government Programs.—The Geological Survey of Alabama announced the appointment of a new State geologist and oil and gas supervisor who became the sixth State geologist in the Survey's 134-year history. The Survey was rededicated to a program that focuses on the prudent development and use of the mineral, water, and energy resources of the State.

During the year, the Survey conducted investigations and published 22 major geologic, hydrologic, and/or biologic bulletins in addition to 5 open-file reports. Work continued on the preparation of a new State geologic map. Emphases were mainly on oil and gas development, coal mapping, and other energy-related projects, but significant activity was conducted in the nonfuel mineral area. The Mineral Resources Div. conducted preliminary assessments of the uranium and gibbsite potential in east Alabama and completed the seismotectonic hazard study of the New Madrid earthquake area of northwestern Alabama. Work also continued on the county mineral resources mapping program and a report on the limestone resources of the State. The Water Resources Div.'s investigations accounted for a large percentage of the Survey's overall effort in 1982. Cooperative studies continued with U.S. Geological Survey (USGS), including data collection and participation in an acid rain project. Major program emphasis was on evaluation of aquifers in southeastern Alabama and completion of an inventory of injection wells in the State. The Geologic Div. continued work on the seismic monitoring of northern Alabama and on the assessment of the oil and uranium potential of the Chattanooga shale. The Environmental Div. conducted energy-related studies, prepared an environmental atlas on sensitive areas in coastal Alabama, and a water-quality and biological study of the Alabama River.

During the 1982 regular session, the State legislature passed the Alabama Environmental Management Act, creating the Alabama Department of Environmental Management (ADEM), which was subsequently signed into law. The department, in the executive branch, will have control over the State's air, land, and water resources, and is designated as the control agency for purposes of Federal environmental law. State agencies engaged in these activities were transferred to ADEM on October 1, 1982. These include the Alabama Air Pollution Control Commission, Water Improvement Commission, Water Well Standards Board, Coastal Area Board, and applicable functions of the State Health Department.

The U.S. Bureau of Land Management announced that $222,325 in mineral revenues was given to the State in fiscal year 1982. The Federal Government divides bonuses, rentals, and royalties received from Federal mineral leasing activites on public lands equally with the States in which the minerals occur. The Bureau of Land Management also announced the results of the first round of regional competitive Federal coal lease sales in Alabama. Thirteen parcels were sold (nine surface and four underground), covering 10,184 acres, with bids totaling $1,088,280. In addition to bonus bids, lessees must pay an annual rental fee of $3 per acre, plus a royalty for the coal removed. The royalty rate was set at 12-1/2% for surface-mined coal and 8% for underground coal.

USGS analyzed the mineralogy of bentonite in Alabama as part of an appraisal of the bentonite resources in the Gulf Coastal Plain. In a joint effort between the U.S. Bureau of Mines and the USGS, two mineral resource studies were completed on RARE II areas in the State. Several studies were also underway on energy resources and regional geology. Publications during the year included a map depicting mines, quarries, and sample locations in and near the Sipsey Wilderness (MF-1288-C), synthesized flood frequency of urban streams (OP 82-0683), and the hydrology of area 21, eastern coal province (OF 82-0679), which includes areas in Alabama.

The Mineral Resources 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. It continued research in mineral exploration, mining, processing, utilization, and conservation. Primary emphases were on energy related projects, but nonfuel research was conducted on preparation of magnesium alloys for modular iron production, characteristics of subsidence, and surface mining blasting effects on underground mining. Reports were prepared on the recovery of graphite, mica, vanadium, and trace elements from graphite schists, and phosphorus removal from Birmingham iron

ores. Planned nonfuel research at the end of the year included preparation of intercolated graphite, beneficiation of low-grade alluvial aggregates, and beneficiation and product testing of bentonite clays. The institute also conducted and cosponsored several short courses on mineral-related subjects.

In fiscal year 1982, the U.S. Bureau of Mines had contracts in the State involving research activities. Wyle Laboratories, Huntsville, was the predominant contractor with seven contracts totaling over $400,000. Research activities centered on noise control and machine redesign concepts.

The U.S. Bureau of Mines Tuscaloosa Research Center was involved in several mineral-related projects in Alabama. Among them were (1) testing of underclays associated with coal seams for possible use in alumina refractories, (2) detection of coal mine roof fall hazards utilizing electromagnetic sensors, (3) dewatering of coal-clay wastes using an improved flocculation technique, (4) evaluation of gibbsite in the saprolites of eastern Alabama as a substitute for bauxite in refractories, (5) development of chemical binders to increase mine roof stability, and (6) basic clay testing in cooperation with various State agencies. Other U.S. Bureau of Mines activities involved methane control studies and the measured effectiveness of methane drainage activities in advance of mining, both in underground coal mines in Alabama.

U.S. Bureau of Mines research resulted in several publications directly related to the mineral industry in Alabama. These were RI 8636, "Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant;" RI 8669, "Degasification of the Mary Lee Coalbed, Brookwood, Ala.;" IC 8898, "Site-Specific and Regional Geologic Considerations for Coalbed Gas Drainage;" and IC 8905, "Acid Mine Drainage: Control and Abatement Research."

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for the bulk of the value of Alabama's total nonfuel mineral production. In general, construction minerals output decreased because of reduced construction activities, but reduction in primary metal and automotive output also adversely impacted on nonfuel minerals production. ADO reported that 54 operations involved with the nonmetallic minerals industries expanded to some degree in 1982 at an estimated expenditure of $131 million.

Abrasives (Manufactured).—Artificial abrasives were manufactured by one company in Madison County. Abrasive-grade, high-purity fused aluminum oxide was produced by Norton Co. in Huntsville.

Cement.—Cement manufacturing is one of the oldest industries in Alabama; the first commercial operations began in 1895. Cement accounted for over one-third of the value of nonmetallic minerals produced. Nationally, Alabama ranked sixth and eighth in the production of masonry and portland cement, respectively. Production and value of portland cement increased, while that of masonry cement decreased.

Portland cement was produced at six plants in the State, two in Jefferson County, and one each in Morengo, Mobile, St. Clair, and Shelby Counties. Major end uses for portland cement were ready-mix concrete, concrete products, building materials, and highway construction.

Table 4.—Alabama: Portland cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	6	6
Production	2,218,312	2,677,233
Shipments from mills:		
Quantity	2,269,844	2,558,394
Value	$89,216,474	$104,460,929
Stocks at mills, Dec. 31	287,025	359,595

Table 5.—Alabama: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	5	5
Production	194,540	146,268
Shipments from mills:		
Quantity	192,539	150,358
Value	$10,721,342	$9,086,207
Stocks at mills, Dec. 31	24,777	23,316

Principal raw materials used in making cement included cement rock, limestone, chalk, clays, sand, shale, and iron ore. Allied Products Co. purchased the Alpha Portland Cement Industries Inc.'s Birmingham plant, which closed late in 1981. After

conversion to coal, the plant resumed making cement in May 1982.

Martin Marietta Corp.'s Calera plant started producing oil well cement for offshore and onshore drilling applications in Louisiana, Mississippi, and Alabama. The cement is manufactured to stringent specifications that assure pumpability to extreme depths without loss of fluidity or strength. Lehigh Portland Cement Co. added a 4,000-horsepower finish mill system at its Leed's operation that went online during the year.

In July, ASARCO Incorporated closed its asbestos cement pipe manufacturing plant of its subsidiary, Capco Pipe Co., at Ragland.

Ideal Basic Industries Inc. dedicated its Cris Dobbins cement plant at Theodore in April. The plant and its quarry near Monroeville cost more than $300 million and has a rated capacity of 1.5 million tons per year. The dry-process plant, located in deep water just south of Mobile, first shipped cement in October 1981, and was expected to serve customers in the gulf coast region. Limestone was barged from the company's Gaillard Quarry near Monroeville on the Alabama River, about 90 miles north of the plant. Eighteen barges and three tugs transport raw material to the plant, which requires about 3 million tons per year of limestone, sand, and clays.

Clays.—In 1982, Alabama's clay industry produced common clay, fire clay, kaolin, and bentonite. Output and value of all clays decreased. The State ranked fourth nationally in the production of bentonite, and fifth in common clay, fire clay, and kaolin. Clay ranked fifth in mineral value in Alabama in 1982. During the year, 22 companies mined clay at 39 pits in 18 counties. Ninety percent of all clay production came from the top 17 producing pits.

Common clay was mined by 14 companies at 21 pits in 13 counties; leading counties were Jefferson, Shelby, and Walker. Production and value decreased 17.8% and 7.9%, respectively, reflecting the downturn in construction activities. Major uses were brick, cement, and concrete block.

Henry Brick Co., Selma, will spend $1.5 million to convert its two brickmaking facilities from natural gas to wood. Energy costs have increased from 20% to 45% of manufacturing costs. Completion is scheduled for 1983. With demand down, only one of the two facilities operated during the year.

Fire clay was mined by three companies at five pits in Calhoun and Shelby Counties. Production and value decreased 65.1% and 63.9%, respectively, reflecting the downturn in the foundry industry. One operation was mixing clay with ground furnace brick for use as a refractory.

Kaolin was mined by 4 companies at 12 pits in Barbour, Henry, and Marion Counties in southeastern Alabama. Production and value decreased 67.5% and 61.9%, respectively. Major uses were in firebrick and other refractories. Kaolin occurs in association with bauxite deposits, which are also mined for refractory uses.

American Colloid Co. mined bentonite at its operations in Lowndes County for use in the foundry industry and drilling muds. Bentonite was the only clay that maintained production in 1982. The majority of the material was ground to 200 mesh, with the balance to 150 mesh, to meet market demand.

Six clay operations announced expansions through ADO totaling $3.3 million. Companies involved in expansions were Dickey Clay Co. (Bessemer), Donoho Clay Co. (Anniston), General Shale Corp. (Huntsville), A. P. Green Refractories Co. (Birmingham), Henry Brick Co. (Selma), and Tombigbee Lightweight Aggregate Corp. (Livingston).

Lime.—Alabama ranked sixth nationally in the production of lime, which was the third leading commodity, according to value, in the State in 1982. Lime, produced by calcining limestone, was reported from five plants in Shelby County. Output decreased 25.6%, and dropped below 1 million tons for the first time since 1975. Major uses were in paper manufacture and water purification.

Mica.—Mining of scrap mica by Western Mica Co., in Randolph County, ceased in 1980. The facility in Heflin continued to grind ore from out of the State. The fine-ground mica was used primarily as an additive in paints.

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

Use	1981		1982	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Paper and pulp	334,375	$16,481	299,815	$14,251
Water purification	157,721	7,486	108,904	4,936
Mason's lime	18,990	1,126	10,567	663
Sugar refining	5,395	290	7,543	383
Other[1]	702,790	34,069	480,623	22,147
Total	1,219,271	[2]59,454	907,452	42,380

[1]Includes acid water neutralization, animal and human food, aluminum and bauxite, copper ore concentration, electric steel, magnesia from seawater or brine, oil well drilling, open-hearth steel (1981), other ore concentration, other chemical and industrial uses, other construction lime, petroleum refining, road stabilization, sewage treatment, soil stabilization, and tanning.
[2]Data do not add to total shown because of independent rounding.

Mullite (Synthetic).—Synthetic mullite, a product of sintering a mixture of aluminous and siliceous material, was produced by Harbison Walker Refractories Co. at Eufaula. Output was used primarily for the manufacture of refractories with demand down because of the depressed steel industry in the State.

Perlite (Expanded).—Two plants, W. R. Grace & Co., Birmingham, and National Gypsum Co., Mobile, produced expanded perlite from ore shipped in from out of State. Production decreased, while value increased from that of 1981. The material was used for formed products, horticulture purposes, and concrete aggregate.

Phosphate Rock.—Alabama was one of seven States producing 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 increased slightly, but value decreased from that of 1981. Mining was terminated in July 1982.

Salt.—Alabama ranked 10th nationally in the production of salt. Olin Corp., in Washington County, produced salt from brine wells by solution mining at a near-surface salt dome. Production and value decreased while value increased. The salt was used in chemical manufacture, chiefly caustic soda, chlorinated organics, and sodium chlorate and hypochlorite.

Sand and Gravel.—Alabama produced both construction and industrial sand and gravel in 1982. Production was from 55 companies operating 76 pits in 26 counties.

Construction.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Construction sand and gravel ranked fourth in terms of mineral value in Alabama; production decreased from that of 1981. Many sand and gravel facilities operated intermittently during the year, depending on proximity of construction activities. Construction sand and gravel was produced at 66 operations in 24 counties. Leading counties were Mobile, Montgomery, Elmore, and Franklin. The major portion of sand and gravel was shipped by truck, with lesser amounts transported by rail and water. The top 26 producing companies, with 31 operations, produced 85% of the construction sand and gravel; no individual pit produced over 1.5 million tons. Two sand and gravel operations announced expansion plans through ADO totaling $725,000. Companies involved in expansion were Dirt Inc. (Mobile), and Waugh Sand & Gravel Inc. (Montgomery).

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	3,260	$8,102	$2.49
Gravel	NA	NA	NA	2,837	7,811	2.75
Sand and gravel (unprocessed)	NA	NA	NA	922	1,314	1.43
Total or average	e9,503	e$23,340	e$2.46	7,019	[1]17,226	2.45
Industrial sand	182	864	4.75	960	8,096	8.43
Grand total or average	e9,685	e24,204	e2.50	7,979	[1]25,323	3.17

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

Table 8.—Alabama: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,985	$10,655	$2.67
Plaster and gunite sands	W	W	2.40
Concrete products	372	1,100	2.96
Asphaltic concrete	1,026	2,657	2.59
Road base and coverings	947	1,830	1.93
Fill	650	892	1.37
Snow and ice control	W	W	3.47
Other	41	93	2.27
Total[1] or average	7,019	17,226	2.45

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Data may not add to totals shown because of independent rounding.

Industrial.—Seven companies produced industrial sand and gravel with output increasing over that of 1981. Industrial sand and gravel was used for molds and cores. The Globe Metallurgical Div. of Interlake Inc. began operating a quartzite pit in Autauga County. The operation, which can produce 100,000 tons of gravel per year, supplies Globe's silicon alloy plant in Selma. Part of the output from the pit was also sent to Globe's other plant in Beverly, Ohio.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented in 1981 new canvassing procedures for its surveys of stone producers. Beginning with the collection of 1982 production data, the survey of stone producers will be conducted for odd-numbered years only. Therefore, this chapter contains only preliminary estimates for crushed and dimension stone production. The preliminary estimates for even-numbered years will be revised the following year.

Crushed.—Crushed stone ranked second in mineral value in Alabama, with output at about the same level as that of 1981. Material mined included limestone, marble, granite, sandstone, and oyster shell. Nationally, Alabama led in output of crushed marble, and ranked third in production of oyster shell. Crushed stone was used primarily in cement manufacture, in concrete, and as a road base. Shipments were mainly by truck; leading producing counties were Shelby, Jefferson, and Colbert.

Some operations in northwestern Alabama completed commitments to the Tennessee-Tombigbee Waterway and reduced output; several quarries were closed or operated intermittently throughout the year. Oyster shell output dropped when Ideal opened its new cement plant in Theodore. The new plant uses limestone instead of oyster shell, which was used in Ideal's old cement plant. With large inventories of shell, dredging operations in Mobile Bay

were curtailed.

Vulcan Materials Co.'s Scottsboro quarry contracted with the Tennessee Valley Authority to supply 1.5 million tons of stone over a 5-year period to the nearby Widows Creek steamplant for use in SO_2 removal.

Dolcito Quarry Co., Tarrant City, completed a new crushing and screening plant and renovation of existing facilities, which included new crushing, grinding, and bagging equipment. Most of the work was financed through a $4.5 million bond issue by the Industrial Development Board of the City of Tarrant. Dolcito produced a high-magnesium dolomitic limestone aggregate for construction and other uses in the Birmingham area.

ADO reported three other expansions of crushed stone operations totaling $350,000. Companies involved included Dolime Minerals Co. (Brierfield), Covington Stone Co. (Fort Payne), and Wade Sand and Gravel Co. (Birmingham).

Dimension.—Production and value of dimension stone increased over that of 1981. Material mined included marble and limestone; Alabama ranked fourth nationally in output of dimension marble. Dimension marble was quarried in Talladega County, while dimension limestone was mined from an underground operation in Franklin County. The blocks were processed primarily to produce cut and sawed stone. Some sales of rough blocks were also reported.

Sulfur (Recovered Elemental).—Alabama ranked fourth nationally in output of recovered sulfur. Two companies recovered sulfur from two petroleum refineries in Mobile and Tuscaloosa Counties. Two companies recovered sulfur from natural gas processing plants in Escambia and Washington Counties. Exxon Co., Hunt Oil Co., Phillips Petroleum, and Union Oil Co. sold 440,000 metric tons valued at $46.1 million, an increase of 8.9% in quantity and 11.7% in value over that of 1981.

Talc.—Cyprus Industrial Minerals Co. ground talc from Montana at its plant in Talladega County, near Alpine. The product was used primarily in pharmaceuticals and various cosmetic preparations. During the year, a research and development facility was constructed adjacent to the plant. Under consideration were plans to conduct an exploration program to develop a local source of talc.

Vermiculite (Exfoliated).—W. R. Grace, Jefferson County, exfoliated vermiculite at its plant in Irondale from crude ore shipped into the State. The material was used in concrete aggregate, block, loose insulation, and as a sand conditioner.

METALS

Primary metal production was among the most important industries in the State. The four leading counties were Colbert, Jefferson, Madison, and Etowah. The State's metal industries were hard hit in 1982, continuing a downward trend started in 1979. The high level of unemployment in the State was attributed primarily to the decrease in output of primary metals.

Aluminum.—Alabama was one of 17 States that produced primary aluminum; output and sales decreased significantly. Revere Copper & Brass Inc., Scottsboro, and Reynolds Metals Co., Sheffield, produced primary aluminum from alumina shipped in from several out-of-State sources. Reduced demand for aluminum, and high energy costs resulted in shutdowns of both aluminum reduction plants. Reynolds closed their last potline early in the year for an indefinite period, citing large inventories. Revere closed its plant in June, and in October filed for reorganization under Chapter 11 of the Bankruptcy Code. Revere cited weak markets and high operating costs, principally energy costs. Alcan Aluminum Corp. stated it was no longer interested in acquiring Revere's Scottsboro mill. Late in the year, Asarco sold its interest in Revere to Bear, Stearns & Co.

Ford Motor Co. began phasing out operations at its aluminum-casting plant in Sheffield. The phase out is expected to be completed by the end of 1983.

Alcoa closed its Mobile alumina facility early in the year. The plant was in the last year of a $100 million expansion. Reasons for the shutdown were an over-supply of alumina and the high cost of operations.

Bauxite.—Alabama ranked second in the Nation in bauxite production. Four companies mined bauxite in Barbour and Henry Counties for use in refractories and chemical manufacture. Production and value decreased significantly from that of 1981. Dresser Industries Inc. announced plans to build a $10 million facility in Eufaula to produce ceramic proppants for use in the petroleum industry. The facility will use locally mined bauxite and bauxitic clay and is scheduled to begin production in 1983.

Ferroalloys.—Alabama ranked third in the Nation in shipments of ferroalloys. Shipments and value decreased 17.7% and 19.6%, respectively. Products included ferromanganese, ferrosilicon, silicomanganese,

and silicon metal. Many of the ferroalloy facilities operated at 30% to 50% of capacity, with International Minerals & Chemical Corp., Bridgeport, shutting down in November. Autlan Manganese Corp., Mobile, operated only 3 months in 1982 because of weak manganese markets. Reynolds Metals Co., Sheffield, reopened its silicon furnace in May, after being shut down for over a year. The furnace has a rated capacity of about 800 tons per month. Reynolds, which previously produced silicon metal for internal consumption, began selling in the open market. Three expansion plans were announced through ADO totaling $778,000; companies involved were Autlan Manganese Corp., Mobile; Globe Metallurgical Div., Selma; and International Minerals & Chemical Corp., Bridgeport.

Gold.—Although no gold was produced in the State in 1982, interest in old gold mining areas in eastern Alabama remained at a high level. Several individuals and companies conducted exploration at various levels of activity during the year.

Iron and Steel.—Alabama ranked 11th in the Nation in the production of pig iron, with output dropping drastically. Jim Walter Resources, Birmingham; Republic Steel Corp., Gadsden; and United States Steel, Fairfield, were the major producers. Production and sales decreased with nearly all producers either shutting down or reducing output during the year. The depressed market for steel products and the high levels of imports into the gulf area impacted on the State's steel and foundry industries.

Despite the depressed market, United States Steel continued construction on its $650 million seamless pipe mill at Fairfield, with completion scheduled for late 1983. The Fairfield steelmaking facilities were shut down in mid-year, with indications it will not start up until completion of the new pipe mill. Republic Steel Corp. operated at about 40% of capacity, and late in the year closed down its blast furnaces. In addition, Jim Walter Resources shut down its blast furnace in midyear. Several minimills in the Birmingham area also curtailed operations during the year.

Slag.—Alabama was one 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 typically used as road base, fill material, and asphaltic concrete aggregate. Output of both types of slag decreased, with value increasing.

Ferrous Foundries.—Iron and steel foundries in Alabama were a significant industry that affected the southeastern region. Raw materials utilized included scrap, coal, limestone, and sand; nearly all of which came from sources in the region. The Alabama Directory of Mining and Manufacturing listed 47 gray iron foundries, 26 steel foundries, 7 steel investment foundries, and 2 malleable iron foundries. In 1982, ADO reported 21 expansions throughout the industry, totaling $11.8 million. Most foundries, like other segments of the primary metals area, were adversely affected by the national recession.

Rutile (Synthetic).—Kerr-McGee Corp. operated its 110,000-ton-per-year synthetic rutile plant in Mobile. Ilmenite, imported from Australia, was processed into synthetic rutile and shipped to the company's Hamilton, Miss., plant for processing to titanium dioxide pigment for use in paints, plastics, and other products.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, Ala.
[2]State geologist, Geological Survey of Alabama, Tuscaloosa, Ala.
[3]Federal Reserve Bank of Atlanta. Economic Review. February 1983, pp. 50-58.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Alumina:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Mobile.
Aluminum smelters:			
Revere Copper & Brass Inc	Box 191 Rome, NY 13440	do	Jackson.
Reynolds Metals Co	Reynolds Metals Bldg. Richmond, VA 23218	do	Colbert.
Bauxite:			
Didier-Taylor Refractories Corp	Box 568 Eufaula, AL 36027	Mine and plant	Barbour and Henry.
Eufaula Minerals Co	Box 556 Eufaula, AL 36027	do	Barbour.
A. P. Green Refractories Co., a subsidiary of United States Gypsum Co.	Mexico, MO 65265	do	Do.
Harbison-Walker Refractories Co. Inc., a division of Dresser Industries Inc.	Dale Rd. Route 1, Box 58 Eufaula, AL 36027	do	Do.
Cement:			
Citadel Cement Corp	2700 Cumberland Pkwy., NW. Atlanta, GA 30339	Plant	Marengo.
Ideal Basic Industries Inc.[1]	850 17th St. Denver, CO 80202	Plants	Mobile.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Cement—Continued			
Lehigh Portland Cement Co	800 2d Ave., South Leeds, AL 35094	Plant	Jefferson.
Martin Marietta Corp.[2]	6801 Rockledge Dr. Bethesda, MD 20819	do	Shelby.
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 36101	do	Chilton, Elmore, Montgomery.
Tombigbee Lightweight Aggregate Corp., a division of Breeko Industries Inc.	Box V Livingston, AL 35470	do	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	Plant	Shelby.
Cheney Lime & Cement Co	Allgood, AL 35013	do	Do.
Martin Marietta Corp.[3]	15 20th St., South Birmingham, AL 35233	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:			
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.
Thackston, C. T	Box 3211 Montgomery, AL 36109	do	Montgomery.
Stone:			
Allied Products Co	Box 628 Alabaster, AL 35007	Quarries	Shelby.
Citadel Cement Corp	2625 Cumberland Pkwy., NW. Atlanta, GA 30339	Quarry	Marengo.
Hoover Inc	Box 17346 Nashville, TN 37217	Quarries	Colbert and Jackson.
Southern Stone Co. Inc.[4]	Box C200 Birmingham, AL 35283	do	Bibb, Colbert, Lee, Shelby.
Vulcan Materials Co.[5]	Box 7324-A Birmingham, AL 35223	do	Calhoun, Colbert, Etowah, Franklin, Jackson, Madison, Shelby.
Talc:			
Cyprus Industrial Minerals Co	Alpine, AL 35014	Plant	Talladega.

[1]Also clays and stone.
[2]Also lime, stone, and clays.
[3]Also cement, clays, and stone.
[4]Also sand and gravel.
[5]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 1982 was $112.9 million. In 1981, the value was $116.2 million. The decrease in the 1982 value was due to decreases in the values reported for construction sand and gravel, crushed stone, gold, and silver. There was no reported production of platinum-group metals or tungsten in 1982. Alaska ranks 36th in the United States in reported nonfuel mineral production.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$60	NA	$60
Gold (recoverable content of ores, etc.) troy ounces	r26,531	r12,195	30,513	11,470
Sand and gravel (construction) thousand short tons	e41,000	e75,600	40,832	74,895
Silver (recoverable content of ores, etc.) thousand troy ounces	2	25	2	17
Stone (crushed) thousand short tons	5,359	26,855	p5,100	p25,200
Tin metric tons	136	1,200	W	W
Combined value of copper (1982), lead, platinum-group metals (1981), tungsten ore and concentrate (1981), and value indicated by symbol W	XX	265	XX	1,269
Total	XX	r116,200	XX	112,911

eEstimated. pPreliminary. 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 Alaska, by region[1]

(Thousands)

Region	1980	1981[2]	Minerals produced in 1981 in order of value
Alaska Peninsula	--	W	Stone (crushed).
Cook Inlet-Susitna	$3,702	W	Stone (crushed), gold.
Copper River	317	W	Gold, stone (crushed), silver.
Kenai Peninsula	578	W	Gold, silver.
Kodiak	W	$1,200	
Kuskokwim	W	W	Gold, platinum, silver.
Northern Alaska	13	(3)	
Seward Peninsula	W	W	Gold, silver, tin.
Southeastern Alaska	12,874	W	Stone (crushed).
Yukon River	6,736	W	Gold, stone (crushed), silver, lead, tungsten.
Undistributed[4]	91,097	39,400	
Sand and gravel (construction)	XX	e75,600	
Total	[5]115,316	116,200	

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

[1]No nonfuel mineral production was reported in Aleutian Islands, Bering Sea, Bristol Bay, and Northwestern Alaska regions.

[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 that cannot be assigned to specific regions and items indicated by symbol W.

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

Table 3.—Indicators of Alaska business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	194.0	207.0	+6.7
Unemployment	do	18.0	21.0	+16.7
Employment (nonagricultural):				
Mining[1]	do	8.6	9.1	+5.8
Manufacturing	do	13.0	11.1	-14.6
Contract construction	do	12.5	14.5	+16.0
Transportation and public utilities	do	18.0	18.4	+2.2
Wholesale and retail trade	do	32.7	35.7	+9.2
Finance, insurance, real estate	do	8.7	9.4	+8.0
Services	do	32.8	35.0	+6.7
Government	do	57.5	61.2	+6.4
Total nonagricultural employment[1]	do	[2]183.7	194.4	+5.8
Personal income:				
Total	millions	$5,661	$6,655	+17.6
Per capita		$13,749	$15,200	+10.6
Construction activity:				
Number of private and public residential units authorized		4,514	7,994	+77.1
Value of nonresidential construction	millions	$204.1	$245.1	+20.1
Value of State road contract awards	do	$120.0	$111.8	-6.8
Shipments of portland cement to and within the State	thousand short tons	137	171	+24.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$116.2	$112.9	-2.8
Value per capita, resident population		$319	$258	-19.1
Value per square mile		$217	$193	-11.1

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.

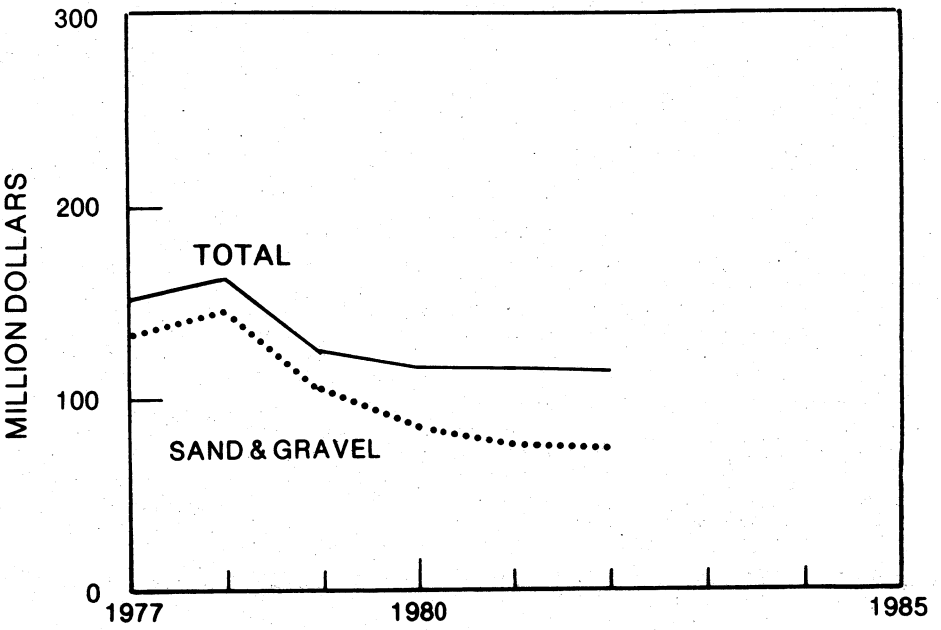

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Alaska.

Trends and Developments.—Depressed economic conditions have severely restricted the exploration and development funds available to many mining companies. The 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) reflect the effects of current economic conditions. Summarized results of the State surveys are available in "Alaska's Mineral Industry, 1982." This is the second annual report, produced jointly by the Alaska Department of Commerce and Economic Development, Office of Mineral Development, and the Alaska Department of Natural Resources (DNR), DGGS, detailing activities of the mineral industry in Alaska.

State surveys indicate exploration expenditures were about $45 million in 1982, a sharp decrease from the estimated $76 million in 1981. Development expenditures in 1982 were about $41.6 million, an increase of 68% over the estimated amount in 1981. Gold production was estimated at 174,900 troy ounces, up from 134,000 troy ounces in 1981. Placer mines produced almost all of the gold. Most of the silver produced was recovered with the placer gold. About 15,000 new mining claims were filed in 1982, down from over 27,000 claims filed in 1981. Many of the companies reduced their claim holdings and did annual assessment work only on claims they considered the most valuable. A larger proportion of the new claims filed were for precious metals in placers and in lode deposits.

Several companies formerly interested primarily in base metals and energy minerals have increased their exploration efforts and expenditures in the search for precious metals. DNR and the U.S. Bureau of Land Management (BLM) are each endeavoring to make more land available for mineral leasing and entry by mining claim locations. Native regional corporations are increasing their mineral exploration activities by contracting and forming joint ventures with major mining companies and acquiring investment interests in promising mineral operations.

Several companies have severely reduced or terminated their mineral activities and interest in Alaska, including Phillips Petroleum Co., Union Carbide Corp., Mapco Inc., Inspiration Development Co., and United States Steel Co. Companies that have open-

ed offices this year in Anchorage include Gulf Mineral Resources Co., Hazen Research Inc., and North American Exploration Inc.

Exploration Activities.—Expenditures for exploration and development in 1982 were estimated at $45.6 million and $41.6 million, respectively, by the State. In 1981, the estimated amounts were $76.3 million for exploration and $24.7 million for development. Information compiled by a consultant indicates the combined expenditures total about $100 million and are difficult to segregate into exploration and development funds. Estimates of diamond-drill footage ranged from about 200,000 to 220,000 feet.

Alaska Asbestos Co. continued exploration and development on the Slate Creek and Champion Creek asbestos deposits about 50 miles southwest of Eagle. Drill-indicated reserves are over 60 million tons containing from 5% to 6% chrysotile fiber. At least two other promising prospects are known. Development drilling recovers cores 12 inches in diameter. A bulk sample made up of 75 tons of these cores has been shipped to a laboratory in Toronto, Canada, for beneficiation testing and other purposes. A large sample has been sent to Australia to determine if a wet-milling process in use there is suitable for processing the Alaska Asbestos deposits.

NANA Regional Corp. Inc. (NANA) is investigating the possibility of developing a barite mining and processing venture to supply drilling mud material to Arctic petroleum drilling operations. It is considering mining a barite-lead-zinc-silver ore from a property belonging to a mining company, recovering a barite product and a sulfide concentrate, and returning the sulfides to the claim owner.

There is renewed exploration interest in sources of certain types of garnet for use as an abrasive and also as a filter medium. The garnet lode deposit east of Wrangell and several of the garnet-bearing beach sand deposits are being investigated as possible sources of these commodities.

Ground limestone is an important commodity in Alaskan agriculture because of the preponderance of acid soils. Limestone deposits south of Paxson were being explored as a possible source of material for the new barley farms in the Delta area. A deposit on the Kenai Peninsula is being investigated as a source of limestone for the farms on the peninsula and in the Matanuska-Susitna area.

Economic sources of construction sand and gravel are an increasing concern in most city and village areas and on the North Slope. The more accessible deposits are being depleted. City and borough zoning and restrictions imposed by coastal management programs, tidelands use plans, area-wide land use management plans, and environmental regulations have increased interest in identifying sources of this commodity. Aggregate barged to Bethel from Birch Creek Crossing was $100 to $125 per cubic yard. DGGS is identifying upland sites that could supply the Kuskokwim Delta area with less costly sources of this commodity. Petroleum activities on the North Slope require large amounts of sand and gravel for construction of roads, drill pads, site foundations, airports, and offshore islands for drilling platforms. Development of new oilfields and the need for an increasing number of offshore drilling islands require continuing exploration for new, large, and available gravel deposits as close as possible to the new construction.

A limited amount of exploration was conducted for chromium in northern Alaska and in the Yuki River area, southwest of Ruby. Bear Creek Mining Co. did some work on evaluating the cobalt content present in parts of its Ruby Creek deposit, north of Bornite. Announcement of cobalt values in the Windy-Craggy deposit in the Canadian Yukon Territory, northeast of Yakutat, has caused some exploration interest in copper-bearing sulfide deposits in Alaska north and west of Haines.

Active exploration for copper deposits and copper-zinc-silver deposits was mostly confined to the work needed to fulfill annual work requirements on unpatented claims. This work required large expenditures for most of the companies that have major deposits and large blocks of claims. The Anaconda Minerals Co., Bear Creek, Sunshine Mining Co., and Cominco American Inc. used diamond drilling, geochemistry, geophysics, and geologic mapping in work on their claims in the Ambler area and along the south flank of the Brooks Range. Resource Associates of Alaska Inc. (RAA) and Anaconda continued exploration of their deposits in the eastern Alaska Range, in the Delta district. These deposits contain values in copper, lead, silver, and gold. Geneva Pacific Corp. explored the Binocular and other prospects in the Wrangell Mountains, east of McCarthy. It did diamond drilling and used geophysics on

its copper-silver deposits. Exxon Minerals Co. used geological mapping, geochemistry, geophysics, and diamond drilling to evaluate the large block of claims located late in 1981. These claims extend easterly from the head of Twelve Mile Arm on Prince of Wales Island, in southeastern Alaska.

Many of the larger gold placer operators used churn drill exploration to evaluate and extend reserves ahead of mining. Several miners also used test pits where conditions were favorable. On the Seward Peninsula, Noranda Exploration Inc. churn drilled a placer prospect on Mud Creek. Rhinehard Berg and Thor Wetlesen drilled placer deposits near Candle. Placid Oil Co. drilled on Quartz Creek. Several other companies also conducted exploration programs for gold placers. Anaconda terminated exploration at the Big Hurrah lode mine. Several lode gold deposits were actively explored in the eastern interior region. St. Joe American Corp. continued work on the Ryan lode deposit, using a sonic drill. This property is on Ester Dome, west of Fairbanks. Tri-Con Mining Inc., as operator, did underground exploration and development work at the Grant Mine for the owner, Silverado Mines Ltd. The Grant Mine is east of Ryan lode on Ester Dome. Tri-Con also carried out test pitting and trenching programs for Silverado on the Nolan and Thompson Pup placers near Wiseman and the Frying Pan Creek placer in the Circle district. Mohawk Oil Ltd. continued exploratory work at the Eagle Creek claims, about 11 miles north of Fairbanks. Mohawk also prospected for gold and located claims near Cleary, north of Fairbanks. Placid continued drilling and underground sampling on its lode property near Cleary. Alaska Mineral Services explored lode claims at Cleary Summit. UNC Teton Exploration Drilling Ltd. and RAA, in a joint venture, explored for gold, silver, and other metals in the Fairbanks and Delta areas.

Enserch Exploration Inc. conducted lode exploration activities at the Independence Mine west of Palmer, at the Hirst-Chichagof Mine north of Sitka, and at a placer property on Chunilna Creek, north of Willow. Exploration Ventures Co. did some exploratory work at its Chichagof Mine and evaluation and metallurgical work on tailings at the property. Placid continued underground and surface exploration at lode gold properties in the Sherman Creek and Eagle River areas north of Juneau. Noranda investigated gold prospects in the Hawk Inlet to Funter Bay area on Admiralty Island, on Douglas Island, and a few miles north of Juneau. Occidental Minerals Corp. did some geologic mapping, geochemistry, and shallow diamond drilling at the Treadwell property on Douglas Island, west of Juneau. Juneau Mining Co. continued sampling and metallurgical test work on tailings from the old Alaska Gastineau mill. The company arranged financing, ordered equipment, and plans to have a tailings retreatment plant operating in 1983. Mapco did assessment requirements on lode claims near Hollis, on Prince of Wales Island, and on the Sweetheart prospect east of Gilbert Bay. Hyak Mining Co. continued work at the old Jualin Mine on Johnson Creek, north of Juneau. Hyak is exploring a zone of low-grade gold mineralization that is in the hanging wall of the quartz veins mined by the former operators.

Alaska Apollo Gold Mines Ltd. (formerly Catalina Energy & Resources Ltd.) continued diamond drilling at the Apollo and Sitka Mines on Unga Island, in the Alaska Peninsula region. RAA explored for precious metals on lands belonging to the Aleut Corp. and the Bristol Bay Native Corp.

The Red Dog deposit is about 90 miles north of Kotzebue. Cominco, the operator, has delineated drill-indicated reserves of 85 million tons averaging 17.1% zinc, 5% lead, and 2.4 ounces of silver per ton. In 1982, Cominco drilled about 15,000 feet of core holes to further define the deposit. Metallurgical tests are being run on bulk samples. Sites for milling and other facilities are being investigated and evaluated. Environmental baseline data are being collected and compiled. Possible transportation routes and port sites are being studied. Cominco also did some exploratory work on its Sue claims near the Wulik River, west of the Red Dog. The necessary work was done on the Lik deposit, westerly from the Sue, by GCO Minerals Co., Houston International Minerals Corp., and WGM Inc. Northgate Exploration Ltd. has carried out an appraisal of the Step Mountain and Reef Ridge lead-zinc properties formerly held by Patino Inc.

Exploration at the Quartz Hill molybdenum deposit was at a reduced scale. U.S. Borax and Chemical Co., a subsidiary of the British RTZ Co., the operator for Pacific Coast Molybdenum Co., ran four diamond drills this season and drilled about 20,000 feet of core holes. The drilling filled in geological and evaluation information on

the deposit, explored for construction materials, and provided engineering information for proposed plant and facility sites. Final environmental impact statements for the access road and bulk sampling were published by the Forest Service, U.S. Department of Agriculture. Borax let a contract for the 9.5-mile road to South Coast Inc. of Ketchikan. Construction started late in August and about one-third of the road was completed by the end of the working season in November. The road should be completed, and the 5,000-ton bulk sample mined and shipped in 1983.

Inspiration completed the exploration drilling necessary to fulfill annual work and other obligations of the Yakobi Island and Mirror Harbor nickel-copper-cobalt claims, relinquished its option, and returned the property to Aleco Inc. Orbex Resources Inc. did detailed geologic mapping and ran geophysical surveys at the Salt Chuck Mine. It reported that several drill targets had been identified. The mine formerly produced copper concentrates with values in gold, palladium, and platinum. Platinum-group-metal potential of the deposit interests Orbex. The deposit is west of the head Kasaan Bay on Prince of Wales Island.

Noranda Mining Inc. did exploration diamond drilling to get required information for validating several known silver-gold-zinc-lead deposits on Greens Creek Joint Venture claims. Other exploration provided engineering data on sites for a tailings dam and impound area, mill and other surface plant units, and proposed roads from Youngs Bay to the Hawk Inlet dock area and from Hawk Inlet up Greens Creek to the mine. This project is on Admiralty Island, about 18 miles west of Juneau.

Silverstar Mining Co. did the minimum amount of exploratory work to satisfy assessment requirements. Silverstar has been shipping selected silver-gold ore from its Granite Mountain properties, on the upper Kotsina River, in the Wrangell Mountains. Alaska Sylveinia Mines accomplished some exploration but did not ship silver-lead ore out for smelting. Sylveinia's deposit is on Bishop Creek, in the Kaiyuh Hills south of Galena.

Lost River Mining Co. explored for placer tin in the Cape Creek area and western Seward Peninsula. Anaconda and Placid explored for lode tin and tungsten on the western Seward Peninsula. Anaconda's promising greisen-type tin deposit at Kougarok Mountain received a high level of exploration effort. This deposit is 10 or 15 miles westerly from Taylor. Another greisen area west of Kougarok was being explored. Patino prospected for tin near Bettles on lands of Doyon Ltd.

Bear Creek continued exploration on a massive sulfide deposit near Sheep Creek, east of Healy in the Bonnifield district. This copper-zinc-lead-silver deposit has tin-bearing zones similar to those at the Sullivan Mine in British Columbia, Canada. Houston International prospected and explored scheelite-bearing tungsten deposits near the North Fork of the Salcha River, southeast of Chena Hot Springs. Cominco and Mankomen Explorations Inc. jointly explored for tungsten on Mankomen's MEX group of 144 claims. This deposit area is on the ridge east of Clearwater Creek about 10 miles north of the Denali Highway and about 12 miles west of the Maclaren River. Some exploration took place on tungsten-gold deposits northeast of Fairbanks at Gilmore Dome and in the Steele Creek-First Chance area.

Employment.—A State survey indicates nonfuel mining activities seasonally employed at least 2,300 people. About 300 of these were employed by the sand and gravel and the stone industries. A separate survey for the Office of Mineral Development estimated between 1,900 and 2,000 persons were directly employed by placer mining.

Legislation and Government Programs.—About 30 bills of interest to the minerals industries were introduced in the Alaska Legislature, and several became new laws. Problems arising from a provision of the Statehood Act, section 6i, specifying leasing of minerals on certain State lands instead of acquisition under the mining claims location system have apparently been solved. A $15 million appropriation was made available for minerals industry loans. The mining loan base became a revolving fund and should become virtually self-sustaining. A safety advisory council was established to develop a mine safety program that will meet Federal Mine Safety and Health Administration requirements and recommend the program to the 1983 legislature.

The Alaska Surface Mining Reclamation and Control Act became law, and the proposed regulations have been published. The act and regulations should be studied carefully by nonfuel mineral interests because the act will probably become a model for regulation of nonfuel surface mining. This

act was tailored to coal mining. New local coastal management programs are being prepared and accepted as they conform to the Federal Coastal Zone Management Act. A series of tidelands area plans are being initiated in southeast Alaska by DNR, as mandated by a State law. The coastal management programs and the tidelands area plans can control plant and facility siting, tailings disposal, transportation corridors, and shipping facilities in coastal areas and often for considerable distances inland. In some instances, they may have a "go or no go" control over a proposed mining operation. BLM opened 275,000 acres in the Minchumina Lake area and nearly 3 million acres along the Richardson Highway, south of the Alaska Range, for mineral leasing. The State has reopened about 350,000 acres along the route of the proposed Alaska Highway natural gas line to mineral entry. This reopening still leaves a pipeline corridor 1 mile in width closed to entry.

The Steese and White Mountain Conservation areas contain an estimated 7,500 mining claims. Most of these claims were located for copper, gold, lead, molybdenum, silver, tungsten, zinc, and uranium. Claimants had the right of access until September 1982 to perfect discoveries on their claims. After that date, BLM will determine access.

A study of the Kantishna Hills and Dunkle Mine areas, in Denali National Park, was required by the Alaska National Interest Lands Conservation Act. The Alaska Land Use Council is responsible for the study and has designated DNR and the National Park Service as coleaders of an interagency team. The final report on the study is to be completed and ready for Congressional consideration in December 1983.

The Mining and Mineral Resources and Research Institute at the University of Alaska in Fairbanks, which was created under title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Alaska Sand and Gravel Co. constructed and is operating the first cement plant in Alaska. This multimillion-dollar facility will blend and grind clinker and gypsum shipped in from the Seattle area to produce the three basic types of cement most used in Alaska. Initial output will be mostly Type I, for general construction uses, and some Type III, high-early-strength cement. Oil well cement may be produced later. Most of the cement will be used by the producer in its ready-mix concrete operations until the plant approaches its rated capacity of 40,000 tons per year.

Gem Stones.—The value of gem stones reported in 1982 was $60,000; the same value was reported in 1981. Jade was produced in the Jade Mountain area, east of Kotzebue, by NANA, from its land and in lesser amounts from privately owned claims. Soapstone for carving was produced from the Talkeetna Mountains, near Palmer. Epidote crystals and other mineral specimens were recovered from claims in the Green Monster Mountain area on Prince of Wales Island. Brown coral was recovered in coastal waters and used in the production of rings, pins, necklaces, earrings, and other jewelry items. Various clays and selected glacial rock flour materials were used by local manufacturing and hobby potters and ceramics producers. Aggregates of rather large quartz crystals were recovered by individuals from several localities and are usually marketed through shops catering to the tourist trades.

The estimated value of gem stones produced is over $200,000.

Sand and Gravel.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Construction sand and gravel production in 1982 was 40.8 million tons valued at $74.9 million, about the same as in 1981. There was no reported production of industrial sand and gravel in 1981 or 1982. Alaska ranked third in the United States in amount and value produced in 1982. A survey by the State estimated the value of 1981 production at $91 million. Ace Construction Co., northeast of Fairbanks, produces sand and gravel from old dredge tailings and unmined ground on a patented mining claim. Its preparation plant prepares various sizes of aggregate and recovers placer gold as a coproduct.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	NA	NA	NA	662	$2,128	$3.21
Gravel	NA	NA	NA	2,279	8,206	3.60
Sand and gravel (unprocessed)	NA	NA	NA	37,891	64,561	1.70
Total or average	e41,000	e$75,600	e$1.84	40,832	74,895	1.83

eEstimated. NA Not available.

Table 5.—Alaska: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,367	$5,934	$4.34
Plaster and gunite sands	W	W	7.75
Concrete products	W	W	4.34
Asphaltic concrete	1,938	2,358	1.22
Road base and coverings[1]	1,498	3,442	2.30
Fill	35,956	62,758	1.75
Snow and ice control	37	176	4.78
Other	37	226	6.11
Total[2] or average	40,832	74,895	1.83

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (cement).
[2]Data may not add to totals shown because of independent rounding.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its survey of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and finalized the following year.

Crushed stone production in 1982 was 5.1 million tons valued at $25.2 million. This was slightly below the 5.4 million tons valued at $26.9 million produced in 1981.

METALS

Gold.—Reported gold production in 1982 was 30,500 troy ounces valued at about $11.5 million. It is estimated that individual producers reported less than 20% of the actual production of gold in Alaska in 1982.

The best estimate of gold production in 1982 is at least 174,900 troy ounces. This figure was derived by the State's analysis of information it received from (1) 40 consultants familiar with activities in 37 mining districts, (2) 280 returned questionnaires and other volunteered information, (3) information from 107 mechanized operators, which represent about one-third of the total operations, and (4) estimates of total gold-silver bullion refined statewide, provided by precious metal refiners, that are consistent with specific totals from other sources. The State summary shows that 319 mechanized operators and 20 smaller recreational ventures produced an estimated 174,900 ounces of gold. Mechanized operations decreased from an estimated 410 in 1981. In 1981 the State estimated gold production at over 134,000 troy ounces.

Lode mines produced a few thousand ounces of gold. In the Chandalar district, the mill on Little Squaw Gold Mining Co. property recovered over 1,200 troy ounces of gold from the lode mine ores during a run of 38 days. Enserch and Starkey Wilson, co-owners of the Independence Mine in the Willow Creek district, completed a new access decline to the old haulage level and built a new mill rated at about 140 tons of ore per day.

The mill operated from August 21 to about November 19. Mining and milling operations were suspended until "start-up problems" can be corrected, according to a

press release by Enserch. Tri-Con operated the Grant Mine for Silverado, at Ester Dome, west of Fairbanks. Ore recovered during underground exploration and development was milled and some tailings were re-treated. Bedrock Mining Co. continued producing native gold and concentrates from a cleanup operation at the Alaska Juneau mill. Taku Joint Venture recovered a gravity concentrate and native gold from selected sand tailings near the old mill. Several small lots of higher grade ore and concentrates were shipped to smelters. Small amounts of copper and lead were recovered and credited to the shippers.

Placer gold was produced by mines ranging in size from a few hundred pounds per day of beach skimmings and small recreational hydraulic dredges with capacities of a few cubic yards per shift through small to very large-scale bulldozer, hydraulic, dragline, loader, and backhoe operations, to 9-cubic-foot bucketline dredges capable of handling up to 10,000 cubic yards per day. The difficulties of obtaining a reliable estimate of gold production from these varied operations is illustrated by the response of less than 30 producers to the U.S. Bureau of Mines' several hundred canvass forms mailed out and by replies to the State's about 1,200 questionnaires mailed to mining and exploration companies. About 600 of the questionnaires were unclaimed and about 300 were answered. The Alaska Department of Revenue issued over 870 mining licenses. All but about 60 of the licensees were classified as individual or company placer miners and placer prospectors.

The State's summary gives the best available distribution of placer and lode production and operating mines. The northern region contains at least 16 placers and 1 lode mine. The region, which includes the Chandalar, Koyukuk, Noatak-Kiana, and Shungnak districts, produced an estimated 9,500 ounces of gold. In the Chandalar district, Little Squaw leased its placer ground to Jan Drew Holdings Ltd. and its lode mines and mill to Chandalar Development Associates. Jan Drew mined on Tobin Creek, and Chandalar mined and milled ore from the Mikado and other veins. Wild River Ventures operated an underground placer mine near Wiseman. Wild River mined in permafrost through the winter months and sluiced the stockpiled gravel and operated a surface mine in the summer, when surface water is available. Other operators mined on at least 10 other creeks.

The western region covers the Seward Peninsula and the Hughes and Ruby districts. An estimated 34 placer operations produced at least 34,500 ounces of gold. Alaska Gold Co. operated Dredge No. 5 on the Third Beach, northeast of Nome, and Dredge No. 6 on the Submarine Beach, west of the Nome airport. These dredges use 9-cubic-foot buckets. Alaska Gold's 7-cubic-foot dredge in the Hogatza River area, west of Hughes, also operated the entire season, from May into November. Several smaller dredges operated on the Ungalik River, near the head of Norton Bay, and east of the Seward Peninsula. Greatland Exploration Ltd. mined on the Second Beach, east of Nome, using bulldozers, draglines, and sluiceboxes. Other placers were mined in several areas on the peninsula. Individual operators worked the Nome beach. Up to 100 people per day used the usual hand-scale methods.

In the eastern interior region, 201 major operators produced an estimated 88,500 ounces of gold, about one-half of Alaskan output. This region extends from the Manley-Eureka area, in the Hot Springs district, easterly to the Canadian boundary, and generally from the north slope of the Alaska Range northerly to Fort Yukon. The State summary shows at least seven placer mines recovered over 4,000 ounces of gold each, and many smaller mines recovered several hundred to several thousand ounces. The Circle district was the most active in Alaska, with 38 large mechanized mines, several small hydraulic operations, and at least 120 recreational mines. The Livengood placer was one of the largest and most productive in the Tolovana and Rampart districts, northwest of Fairbanks. It is a joint venture operated by Canadian Natural Resources Inc. Other productive districts were Fairbanks with 26 mines, Hot Springs (Manley-Eureka) with 30 mines, Forty Mile with 26 mines, Kantishna with 13 mines, and Bonnifield with 5 or more mines.

The southwestern region's 26 mines recovered 19,200 ounces of gold. These mines were in the Tolstoi, Flat, Innoko, Crooked Creek, Nyac, and Dillingham areas. Northland Gold Dredging Ltd. operated its 6-cubic-foot dredge on the Tuluksak River throughout the season. A 4-cubic-foot dredge was run by Tuluksak Dredging Ltd. in the Nyac area, about 65 miles east of Bethel. Access to this area is by aircraft. The Nyac landing field is about 5,000 feet long. Supplies are flown in from Anchorage and fuel is flown in from Bethel. Twelve flights by C-130 Hercules aircraft were

made into Nyac in 1982 to supply the two dredges. Power for the operations is generated by one 500-kilowatt hydroelectric plant supplemented by two 200-kilowatt and one 270-kilowatt diesel-driven generators.

An estimated 22,150 ounces of gold was recovered by 25 placer mines and 2 lode mines in the south-central region. The lode producers were the Independence Mine in the Willow Creek district and the Wagner Mine being developed in the Valdez Creek district. In 1982, production and operations decreased in the Yentna, Nelchina, and Kenai Peninsula districts but increased in the Valdez Creek and Willow Creek districts and eastern Alaska Range area.

The Hall-Yentna Mining Co. operation in the Cache Creek area was discontinued. It was the largest mine in the Yentna district in 1981. Territorial Corp., a subsidiary of Ranchers Exploration and Development Corp., apparently had a successful operating season at its Slate Creek placer mine in the Chistochina district, about 25 miles northeast of Paxson. Several placer mines were active on Dan Creek and on other creeks in the Nizina district, near McCarthy. Most of this district is in the Wrangell-St. Elias National Park and Preserve.

In the southeastern and Alaska Peninsula regions, the State estimated five operators recovered about 1,000 ounces of gold. The State listed two principal placer operators in the Porcupine River area west of Haines. In this area, there were eight mining licenses issued by the Department of Revenue and six Alaska placer permits (water quality) granted by the Alaska Department of Environmental Conservation. Gold from lode sources was recovered by two operators working on mill cleanup and retreatment of selected tailings from the old Alaska Juneau Mine. Some placer activity occurred in the Alaska Peninsula region but it is poorly documented.

Table 6.—Alaska: Reported placer production of gold

Year	Mines producing	Material[1] treated (thousand cubic yards)	Gold recovered		
			Troy ounces	Value (thousands)	Average value per cubic yard
1978	21	1,455	18,599	$3,600	$2.474
1979	14	778	6,675	2,053	2.639
1980	21	973	11,386	6,975	7.169
1981[r]	21	3,257	26,432	12,149	3.730
1982	20	3,264	30,181	11,345	3.476

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

Iron and Steel.—There was no reported production of ferrous metals or slags. Occasional southbound barges carrying ferrous metals were observed. The loads contained compacted bodies and other motor vehicle parts and scrap obtained from railroads and cannery and minesites. Most of these barges were going to the Seattle-Tacoma area. No reports are available on the quantities, types, or specific destinations of these ferrous materials. There are no foundries advertising their services in Alaska.

Mercury.—A lode mine north of Dillingham, in the Bristol Bay area, produced some mercury. No mercury production was reported to the U.S. Bureau of Mines.

Platinum-Group Metals.—No production was reported to the U.S. Bureau of Mines for 1982. The State summary lists the value of platinum production at $150,000. The dredge on the Salmon River, in the Goodnews Bay district, sustained ice and flooding damage during the winter and early spring of 1981-82 and operated for a very short time after repairs were completed.

Silver.—Silver was recovered almost entirely as a byproduct of gold production. Most of the silver was naturally alloyed with placer gold. Small amounts of silver were recovered from smelter shipments of silver-bearing mill concentrates and selected crude ore. A small lot of gold-silver ore was reported from a mine in the Wrangell Mountains. Alaska Silveinia Mines is now holding exploration ore at its Bishop Creek lode mine while the owner investigates possible economic methods to produce doré bullion at the property. The mine is in the Kaiyuh district south of Galena, an area where access and shipping is difficult and expensive. The State estimates 22,000 ounces of silver were recovered in 1982. The statewide average recovery ratio is about 112 parts of silver to 888 parts of gold, or about 12.6 ounces of silver for each 100 ounces of gold.

Tin.—Lost River produced and marketed cassiterite concentrates from its tin placer

on Cape Creek, north of Tin City on the Seward Peninsula. Lost River was the only reporting tin producer. A gold placer operator in the Manley-Tofty area, Hot Springs district, usually recovers and markets tin concentrates produced as a byproduct of sluicing operations.

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

Table 7.—Principal producers

Commodity and company	Address	Type of activity	Region
Cement:			
Alaska Aggregate Corp	7800 Lake Otis Parkway Anchorage, AK 99502	Grinding only	Cook Inlet-Susitna.
Gold:			
Alaska Gold Co	Box 64 Nome, AK 99762	Placer-dredge	Seward Peninsula and Yukon River.
Ault Enterprises	Box 82330 Fairbanks, AK 99708	Placer	Do.
Canadian Natural Resources Inc	Box 467 Fairbanks, AK 99707	do	Do.
Little Squaw Gold Mining Co	Box 184 Spokane, WA 99210	Lode, placer	Do.
Northland Gold Dredging Ltd	8740 Hartzell Rd. Anchorage, AK 99507	Placer-dredge	Kuskokwim River.
Ruby Mining Co	Box 1 Ruby, AK 99726	Placer	Yukon River.
Territorial Corp	Box 6217 Albuquerque, NM 87197	do	Copper River.
Sand and gravel:			
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.
Central Paving Products	1301 East 64th Ave. Anchorage, AK 99502	Pit	Do.
Fairbanks Sand and Gravel Inc	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:			
Aleutian Constructors	Box 4D Anchorage, AK 99509	Quarry	Do.
Ketchikan Ready Mix and Quarry Inc	Box 8100 Ketchikan, AK 99901	do	Southeastern Alaska.
Morrison Knudsen Co. Inc	Box 7808 Boise, ID 83709	do	Various.
City of Sitka	Box 79 Sitka, AK 99835	do	Southeastern Alaska.
U.S. Forest Service, Region 10	Box 1628 Juneau, AK 99802	do	Southeastern Alaska, and various.
Yutan Construction Co	Box 1775 Fairbanks, AK 99707	do	Yukon River.
Tin:			
Lost River Mining Co	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 plunged from $2.6 billion in 1981 to $1.6 billion in 1982 principally because of the slowdown in copper production and its coproduct and/or byproduct metals molybdenum, silver, and gold. However, Arizona retained its first ranking among the States in value of minerals produced. The State also continued to rank first in value of copper production with 67.6% of the Nation's output, second in molybdenum with 20% of the national total, second in silver with 16% of domestic production, but dropped to sixth in gold with 4% of that production.

Metal production fell to $1.43 billion in 1982, compared with $2.34 billion in 1981. As a percent of the total value of nonfuel mineral production in the State, the metals group declined to 89% in 1982 from 91.4% in 1981.

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

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
Clays thousand short tons	148	$1,105	143	$998
Copper (recoverable content of ores, etc.) metric tons	1,040,813	1,953,142	769,974	1,261,415
Gem stones	NA	3,250	NA	2,800
Gold (recoverable content of ores, etc.) troy ounces	100,339	46,120	61,050	22,949
Gypsum thousand short tons	213	2,594	175	1,205
Lead (recoverable content of ores, etc.) metric tons	993	800	359	202
Lime thousand short tons	538	29,913	326	17,080
Molybdenum (content of concentrate) thousand pounds	35,808	254,345	22,099	100,673
Pumice thousand short tons	1	3	1	7
Sand and gravel:				
Construction do	e20,990	e63,340	19,124	58,375
Industrial do	179	2,455	107	1,617
Silver (recoverable content of ores, etc.) thousand troy ounces	8,055	84,728	6,301	50,090
Stone:				
Crushed thousand short tons	6,315	26,263	p5,200	p22,200
Dimension do	W	578	W	p580
Zinc metric tons	138	135	--	--
Combined value of asbestos (1981), barite (1981), cement, perlite, pyrites, salt, tungsten ore and concentrate (1981), and vanadium (1981)	XX	93,009	XX	79,105
Total	XX	r2,561,780	XX	1,619,296

eEstimated. pPreliminary. 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).

In the nonmetals group, the leading commodities, in descending order of value, included portland cement, construction sand and gravel, crushed stone, lime, masonry cement, gem stones, industrial sand, and gypsum. All materials in the group declined in output; however, increases in value of production were noted for perlite, pumice, pyrite, salt, and dimension stone. Arizona ranked first in the Nation's gem stone production with 40% of the total.

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

(Thousands)

County	1980	1981[1]	Minerals produced in 1981 in order of value
Apache	$2,560	W	Sand and gravel (industrial), stone, clays.
Cochise	30,651	$34,433	Copper, lime, stone, silver, gold, sand and gravel (industrial), lead.
Coconino	W	2,812	Stone.
Gila	236,730	292,459	Copper, molybdenum, silver, gold, lime, stone, asbestos, barite, lead, zinc, clays.
Graham	483	13	Stone, pumice.
Greenlee	321,206	349,173	Copper, gold, silver, stone, lime.
Maricopa	48,164	1,893	Salt, stone, lime, clays, gold, copper, silver.
Mohave	74,908	65,078	Molybdenum, copper, silver, stone, lead, zinc, gold, vanadium.
Navajo	1,298	[2]	
Pima	1,043,374	955,793	Copper, molybdenum, cement, silver, gold, stone, lead, clays, zinc, tungsten.
Pinal	484,290	597,995	Copper, molybdenum, gold, silver, stone, gypsum, lime, perlite, sand and gravel (industrial), lead, pyrites, tungsten, clays, zinc.
Santa Cruz	264	[2]	
Yavapai	214,803	192,969	Copper, cement, lime, molybdenum, silver, stone, gold, clays, gypsum, lead.
Yuma	W	W	Gold, sand and gravel (industrial), lead, silver, copper, zinc.
Undistributed[3]	12,259	5,817	
Sand and gravel (construction)	XX	[e]63,340	
Total[4]	2,470,988	2,561,780	

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]County distribution for construction sand and gravel is not available; total State value shown separately under Sand and gravel (construction).

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

[3]Includes value of nonfuel mineral production that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

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

Table 3.—Indicators of Arizona business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,265.0	1,324.0	+4.7
Unemployment	do.	78.0	131.0	+67.9
Employment (nonagricultural):				
Mining[1]	do.	25.0	18.1	-27.6
Manufacturing	do.	160.6	152.2	-5.2
Contract construction	do.	72.0	64.1	-11.0
Transportation and public utilities	do.	54.4	55.1	+1.3
Wholesale and retail trade	do.	253.3	254.2	+.4
Finance, insurance, real estate	do.	60.7	61.9	+2.0
Services	do.	215.3	221.0	+2.6
Government	do.	199.5	201.1	+.8
Total nonagricultural employment[1]	do.	1,040.8	[2]1,029.3	-1.1
Personal income:				
Total	millions	$27,286	$29,180	+6.9
Per capita		$9,765	$10,201	+4.5
Construction activity:				
Number of private and public residential units authorized		33,637	36,839	+9.5
Value of nonresidential construction	millions	$702.9	$698.7	-.6
Value of State road contract awards	do.	$115.0	$135.0	+17.4
Shipments of portland cement to and within the State	thousand short tons	1,479	1,245	-15.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$2,561.8	$1,619.3	-36.8
Value per capita, resident population		$944	$566	-40.0
Value per square mile		$22,525	$14,216	-36.9

[p]Preliminary.
[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.

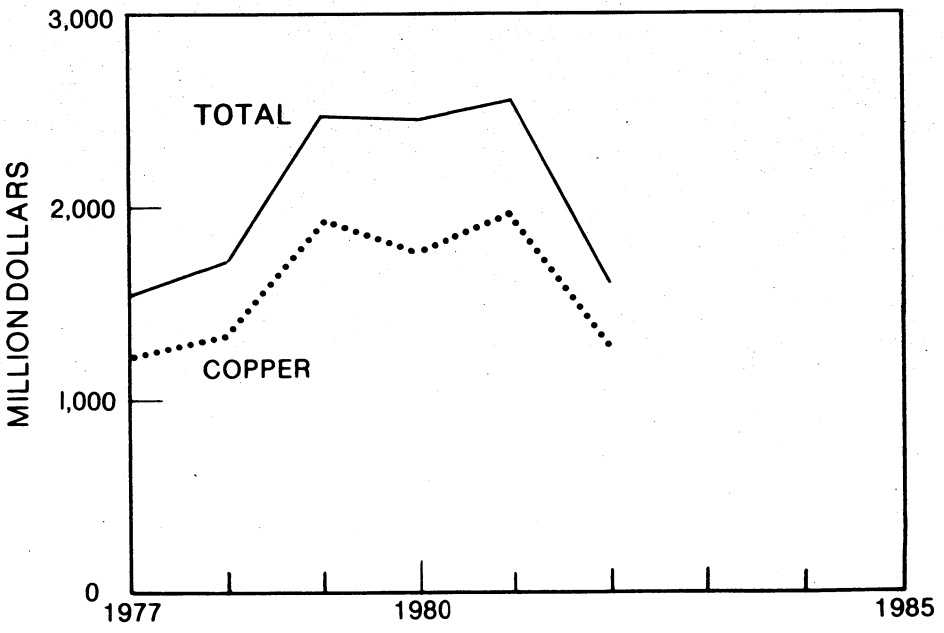

Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Arizona.

Trends and Developments.—In contrast to the record copper production in 1981, Arizona's output sank as the automotive and construction industries, the major markets for the metal, continued to decline and the recession deepened. The State's copper producers curtailed production through layoffs, reduced work schedules, and complete shutdowns. Virtually every operation was affected. By contrast, many foreign Government-owned copper producers continued operating at maximum levels, adding to the market surplus and further depressing copper prices.

Arizona's copper production fell to its lowest point since 1975, molybdenum to its lowest point since 1976, silver to its lowest point since 1980, and gold to its lowest point since 1893. The downturn in metal production was directly related to the sharply reduced copper production and significantly contributed to the severe drop in the value of nonfuel mineral output in the State.

The respite from oil company mergers and acquisitions of copper operations reflected the losses petroleum interests sustained from previous takeovers and from fewer attractive targets. One major change in the copper industry, however, was Newmont Mining Corp.'s agreement in principle to purchase the Cities Service Co.'s Miami copper operations after Occidental Petroleum Co. acquired the latter. A second development was the Anaconda Minerals Co. and AMAX Inc.'s decision to place their equally owned Anamax Mining Co. properties south of Tucson on the market.

Industrial mineral production declined as the recession and high interest rates affected housing and construction. Principal commodities affected by this decline included cement, clay, gypsum, lime, perlite, sand and gravel, stone, and vermiculite. The downtime in copper also was reflected in a drop in lime production.

Exploration Activities.—Exploration for gold and silver continued in 1982, but at a somewhat reduced rate. Ranchers Exploration and Development Corp., as manager and general partner of Ranchers Gold and Silver Exploration Program 1980, announced in late 1982 a joint venture with American Copper and Nickel Co. for gold exploration on 4,600 acres known as Mystic I in the Hieroglyphic Mountains northwest of Phoenix, Maricopa County. Initially, American Copper was to manage the venture with the right to receive a 50% interest in the property by funding up to $1.66 million for exploration and development over the next 3 years. Earlier, high-grade ore was reportedly discovered in several drill holes on this property. The new venture will not affect the adjacent 17,000-acre Mystic II property owned by Ranchers. The firm continued to evaluate possible methods of obtaining funds for a major exploration program on the Mystic II property.

During 1982, the Phelps Dodge Corp., Small Mines Div., examined and sampled nearly 200 properties; 2 were leased and bulk samples were obtained for metallurgical testing. A diamond-drilling program was underway at the old United Verde Extension Mine (Daisy) in Jerome, which was leased for its gold potential.

The Casa Grande project of The Hanna Mining Co. and Getty Oil Co. was being held in abeyance until the copper market improved. Hanna, however, continued evaluating and studying the ore body. Developing the estimated 350 million tons of 1% copper ore could require an investment of at least $400 million.

Stan West Mining Corp. explored for precious and base metals in the Big Bug mining district, Yavapai County. In 1982, the development program at the McCabe unit consisted of shaft sinking, drifting, and underground drilling. By acquiring the mineral rights to the old Iron King Mine, the firm also completed its holding along the McCabe-Gladstone belt. In 1982, exploration on portions of the property included geological mapping, soil sampling, and a deep-penetration pulse electromagnetic survey. The Iron King, a massive sulfide mine, was operated from the 1890's to 1968.

Other exploration projects were also underway, financed by smaller domestic mining companies and by Canadian interests.

Legislation and Government Programs.—On April 23, 1982, the Governor of Arizona signed into law three bills the State legislature passed to aid unemployed workers and the slumping copper and other industries. The maximum unemployment insurance benefit was raised from $95 to $115 per week; however, the minimum qualifying wage was raised from $725 to $1,000 per quarter. A second measure replaced the 2.5% tax on the value of processed ore with a 2.5% tax on the value of ore when extracted from the ground. Loss of revenue to the State was estimated to be $10 to $20 million over the next 3 years. Under the third bill, for setting property or ad valorem taxation, mines will be assessed at 38% of their full cash value in 1983; thereafter, the ratio will be dropped every 2

years until 1990 when it would reach 25%, the same ratio at which other commercial and industrial properties are assessed. In 1982, mines were assessed at 52% of their full cash value.

The Mining and Mineral Resources and Research Institute at the University of Arizona in Tucson, which was created under Title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Beryllium.—North American Industries opened a beryl ore-buying station for miners and prospectors in Phoenix. Acquired later in the year by Bimetals Recovery Systems, the company planned to purchase a clean, handsorted ore of at least 10% beryllium oxide in any amount at a rate of $0.55 per pound. Establishing the ore-buying station was expected to spur beryl production by small mine operators who had been hampered by the processor's minimum 10-ton requirement.

Copper.—After a record high in 1981, Arizona copper production declined 26% in 1982 to its lowest point since 1975; value of that production dropped to the 1977 level. As copper markets sank, the average producer's wirebar delivered price of copper slid from $0.85 per pound in 1981 to $0.74 in 1982. Three mines, shut down in late 1981, remained closed throughout the year, eight mines were closed for extended periods, and the remainder worked on a reduced schedule. In 1981, Arizona's copper industry employed approximately 22,800 workers with a total payroll of $564 million; during 1982, however, average employment dropped to 16,500 and the payroll figure fell to $387 million.[2]

Compared with 197,069,041 metric tons treated in 1981, 123,561,881 metric tons of material was treated in 1982. Of the total output, 588,411 metric tons of copper was recoverable from 115,326,946 metric tons of ore treated by concentration and 155 metric tons of copper was recoverable from processing 88,259 metric tons of direct-smelting ore. Another 26,477 metric tons of copper was electrowon from heap-leaching solutions, and 95,877 metric tons was electrowon or precipitated from vat-leaching solutions.

Copper was produced at 33 operations in the following counties, in descending order of output: Pima, Pinal, Gila, Greenlee, Yavapai, and Cochise. Of these, 17 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 terms of short tons unless otherwise noted.

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

The Cyprus Bagdad operation, 120 miles northwest of Phoenix, Yavapai County, included the Cyprus Bagdad open pit copper mine, a 54,000-ton-per-day concentrator, and a solvent extraction-electrowinning plant (SX-EW). Cyprus Bagdad concentrates were shipped to the Phelps Dodge smelter at Hidalgo, N. Mex. Because of low copper prices, copper production and work hours for the company's 924 employees were cut 10%, beginning July 25. Other cost-control measures included a wage-hiring freeze and a reduction in stripping operations. Flood-control equipment, capable of pumping more than 12,000 gallons of water per minute from the mine, was installed. Part of the runoff water was carried to the concentrator reclaim system. In cooperation with the Bureau of Land Management, ranchers, and others, Cyprus Bagdad participated in a project to restore Burro Creek vegetation that had been wiped out by flooding and overgrazing.

At the Cyprus Pima open pit copper mine and 32,500-ton-per-day concentrator, about 16 miles south of Tucson, production was curtailed beginning February 1, 1982, when 175 workers were laid off and most of its remaining 550 employees placed on a 4-day workweek. Copper and molybdenum production was reduced 43%. On June 4, open pit operations were halted, another 265 workers were laid off, and the mill was fed from low-grade stockpiled ore. Pima concentrates, normally sent to Douglas, were shipped to the Phelps Dodge smelter at Hidalgo, and copper output was reduced another 43%. On October 1, the company shut down the rest of its operations, idling indefinitely 208 of the 300 employees held over from the June layoff. The remaining

workers began to mothball the mine and mill for completion by July 1, 1983. Maintenance expenses were estimated to be $1 million per month. At yearend, another 50 workers were laid off; and a skeleton force was retained for custodial and maintenance duties.

Cyprus Pima estimated the mine has about 120 million tons of ore as reserves and could operate another 8-1/2 years.[3]

Cyprus Johnson, an open pit-heap leach copper property with a SX-EW plant, 20 miles east of Benson, Cochise County, operated throughout the year with a normal complement of 75 employees.

Anamax, owned equally by AMAX and Anaconda, 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 installation 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 oxide ores, and a uranium oxide extraction plant. Anamax's share of ores from the Eisenhower Mining Co.'s Eisenhower (Palo Verde) property was treated at the Twin Buttes sulfide concentrator. In 1982, most of AMAX's copper concentrates from the Twin Buttes Mine were sold to Nippon Mining Co. Ltd. of Japan and Norddeutsche Affinerie AG of the Federal Republic of Germany. Anamax ranked first in copper production with approximately 17% of the State's total.

Anamax reported substantial losses in 1982 because of depressed prices for copper and for the coproduct and/or byproduct metals, molybdenum, silver, and uranium recovered from the Twin Buttes ores. On April 23, 1982, 86 workers were laid off, and again, on June 2, an additional 87 were terminated; together with the 172 released in the fall of 1981 and those leaving by attrition, these layoffs dropped the number of workers to 1,109 from the 1,540 normally employed. The mine continued on a 5-day, 2-shift basis; and the metallurgical operations continued on a 7-day, 3-shift schedule. On October 22, 1982, AMAX and Anaconda signed an agreement to sell their Anamax properties, including the Twin Buttes Mine and the Helvetia deposit in the Santa Rita Mountains 40 miles south of Tucson. Anaconda has had its share of Anamax for sale since 1979, when the Federal Trade Commission ordered its disposal by October 1984 as a condition of Arco's takeover of Anaconda.

At yearend, AMAX was reevaluating ore reserve estimates in the light of sustained, depressed copper prices. According to the 1982 AMAX 10K Annual Report submitted to the Securities and Exchange Commission, yearend ore reserves at the Twin Buttes deposit were approximately 275 million tons of sulfide ore with an average grade of 0.64% copper and approximately 33 million tons of oxide ore with an average grade of 0.93% copper. The Helvetia deposit was estimated to contain 320 million tons of sulfide ore grading 0.64% copper and 20 million tons of oxide grading 0.55% copper. The Peach Elgin ore body, in the same area, was an estimated 23 million tons of mixed ore grading 0.75% copper.[4]

A land swap between Anamax and the National Forest Service and an environmental impact study of the Helvetia area was underway in 1982.

Under an Anamax and ASARCO Incorporated general partnership, Eisenhower Mining mined the Eisenhower (Palo Verde) copper deposit 6.5 miles north of the Twin Buttes Mine between Asarco's Mission and San Xavier Mines. Asarco operated the mine; ores from each partner's interest in the property either were crushed and then treated at Asarco's Mission concentrator or transported over a 6.5-mile conveyor system for treatment at the Anamax Twin Buttes concentrator. According to the Asarco 1982 annual report, reserve estimates of the partnership's Eisenhower deposit (as of December 31, 1982) were 128,667,000 tons containing 0.14 ounce per ton of silver and 0.65% copper. Asarco estimated its share of reserves to be 31.5 million tons of 0.79% copper and 0.21 ounce per ton of silver.

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; and the Sacaton open pit mine and 11,000-ton-per-day concentrator, about 5 miles north of Casa Grande, Pinal County. The company's Silver Bell open pit mine and concentrator, 38 miles northwest of Tucson, were placed on standby in December 1981; only the precipitate plant was operated in 1982. Concentrates were treated at the Asarco-owned 180,000-ton-per-year smelter at Hayden, Gila County, where blister copper was produced and copper anodes were cast for shipment to its refinery at Amarillo, Tex.

The 1982 Asarco annual report posted production as follows at its Arizona proper-

ties: Mission treated 5,325,000 tons of ore in 1982 and recovered 33,800 tons of copper, 702,000 ounces of silver, and 152,000 pounds of molybdenum.

Sacaton treated 4,165,000 tons of ore and recovered 20,900 tons of copper, 154,000 ounces of silver, and 2,499 ounces of gold in 1982.

Silver Bell recovered 5,200 tons of copper from concentrates and precipitates and 11,000 ounces of silver from concentrates in 1982.

San Xavier ores processed through the Mission concentrator totaled 2,517,000 tons and 12,800 tons of copper, 156,000 ounces of silver, and 30,000 pounds of molybdenum were recovered in 1982.

In its 1982 10K Report, as of December 31, Asarco estimated reserves at its Arizona properties as follows: San Xavier, 161.7 million tons of 0.51% copper and 0.08 ounce of silver per ton; Mission, 84.8 million tons of 0.75% copper and 0.17 ounce of silver per ton; Silver Bell, 22.7 million tons of 0.68% copper and 0.07 ounce of silver per ton; and Sacaton, 20.8 million tons of 1.04% copper and 0.05 ounce of silver per ton.

Suffering the worst financial year in its history, Asarco reported a $74 million net earnings loss in 1982, compared with a gain of $50 million in 1981. Because of its integrated operations, the company chose to operate some mines at a loss rather than lose feed for its smelter and refineries through closings. Also, discretionary capital expenditures and new projects were deferred, mining plans were altered to improve productivity, and reductions were made in hourly and salaried personnel. At its Arizona properties in 1982, Asarco laid off 137 Mission employees and dropped 105 through attrition, leaving approximately 700; at least 42 Sacaton employees were released, leaving about 229 workers at yearend. Approximately 247 workers were idled at the Silver Bell property in December 1981; of 175 company-owned houses, 100 were sold, 46 were still occupied, and the remainder were to be boarded up by yearend 1982. At the Hayden smelter, of 540 workers employed in 1981, 450 remained in 1982; and, on November 1, because of new furnace construction, another 50 were idled.

Asarco continued modernizing its $132.6 million Hayden smelter, which included installing a $21 million oxygen flash furnace of the type Inco Ltd., Canada, designed. The technology, used for the first time in the United States, was expected to be more efficient and more amenable to environmental control than the present roaster and reverberatory furnaces to be replaced. A matte grade of 53% to 57% copper was to be obtained with the new furnace, compared with the 40% copper from the old facilities. In addition, the one flash furnace will have a 1,600-ton-per-day production level, whereas the total capacity of the No.'s 2 and 4 reverberatory furnaces was 2,000 tons per day. Sulfur dioxide emissions from the oxygen flash furnace will be more suitable for capture and conversion to sulfuric acid, which can be sold for use in leaching operations and for fertilizer manufacture.

By yearend, the plant to produce oxygen for the furnaces was 40% complete, the facility to remove particles from furnace emissions was 60% complete, and the sulfuric acid plant was 95% complete. Other installations included a water-treatment plant; new dryers to replace 12 roasters; a $1 million computer system to be used primarily for monitoring the furnaces, power, water, acid, oxygen plant, and for control at the oxygen plant; and monitoring wells to check seepage from evaporation ponds. Completion of the project was targeted for October 1983 and, in accordance with its 1981 Environmental Protection Agency (EPA) agreement with Asarco, in full operation by April 1984.[5]

The facilities at Hayden were partly financed by tax-exempt, pollution-control bonds issued by the Industrial Development Authority of Gila County.

The Miami operations of Cities Service 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, Gila County; and at Miami, another SX-EW plant for treating leach solutions from the old Miami copper mine where underground mining was terminated in 1959. In late June, the leaching-precipitation facilities at the old Copper Cities Mine were put on caretaker status with only water-pollution abatement equipment continuing to operate.[6] Concentrates from the Pinto Valley Mine provided about 70% of the feed for the nearby Inspiration Consolidated Copper Co. smelter.

During 1982, Cities Service employed a normal complement of about 1,000 workers at Miami until June 27 when the annual 2-week vacation was extended to 5 weeks; then, on August 2, the company laid off

indefinitely about 600 workers and shut down the Pinto Valley open pit mine and concentrator for the rest of the year. The remaining 400 workers, mostly salaried, were placed on a 32-hour, 4-day workweek to operate the leaching facilities on the Pinto Valley waste dumps, the Miami Mine, and the two SX-EW plants.

On December 1, 1982, Newmont announced an agreement in principle to purchase the Cities Service Miami copper operations for $75 million cash, and on December 3, Occidental Petroleum completed acquisition of Cities Service in a merger arrangement that began in August 1982. According to the Newmont 1982 annual report, certain cash profits Miami copper operations generated between January 1, 1983, and September 30, 1984, were to be shared equally by Newmont and Cities Service, and certain cash losses in that period would be offset by sales from a 60-million-pound copper inventory to be acquired at the closing. Any remaining inventories at the end of the third quarter of 1984 would be shared on a profit-sharing formula. In addition, up to $30 million may be payable to Newmont out of future cash profits of the copper operations on a formula basis entitling Cities Service to receive a 20% share after Newmont had recovered its full investment. The acquisition was to be completed the first quarter of 1983.

Annual production capacity of Cities Service's Miami operations was estimated to be 70,000 tons of copper in concentrates, plus more than 10,000 tons of copper cathodes recovered at the two electrowinning plants. Newmont disclosed plans to process the Pinto Valley concentrates at its 150,000-ton-per-year San Manuel smelter after the Cities Service tolling contract with Inspiration expires in 1984.

Development at the Miami East underground copper mine continued until June 27, 1982, when the project was suspended until economic conditions improve. By mid-January 1982, an underground haulage ramp was completed from the 2900 level to the 3300 level. Corkscrew-shaped, the 13- by 13-foot ramp was driven more than 4,000 feet starting simultaneously from the 2900 and 3300 levels and meeting halfway. A new mining machine removed ore without drilling and blasting and, also, would allow the safe removal of low-grade material beyond the normally mined periphery of the ore body. The 5-million-ton ore body, averaging 3% copper, was estimated to be about 250 feet wide, 1,100 feet long, and 450 feet thick.[7] About 12,000 tons per year of copper production was expected to be recovered from the deposit for 13 years.

Duval Corp., a subsidiary of Pennzoil Co., operated the Sierrita open pit copper-molybdenum mine about 30 miles south of Tucson, Pima County. The adjacent Esperanza copper-molybdenum open pit property in Pima County and the Mineral Park surface mine 15 miles northwest of Kingman were shut down December 14, 1981, and remained closed throughout 1982. Copper, however, was recovered at leaching and precipitation facilities at both operations during the year. In a normal year, ores at each mine were processed through concentrators; Sierrita had a design capacity of 82,500 tons per day, Esperanza 15,000 tons per day, and Mineral Park 19,000 tons per day. The Copper Leach Electrolysis and Regeneration hydrometallurgical plant, which treated 32% of Duval's copper production in 1981, was shut down on April 1, 1982, while more advanced equipment was installed at an estimated cost of $11 million. Copper concentrates and precipitates from the Sierrita Mine were treated at the Asarco Hayden smelter and shipped to Japan.

The Pennzoil 1982 annual report showed that Duval's combined copper production at its operating properties in Arizona and Nevada dropped from 246,770,000 pounds in 1981 to 116,053,000 pounds in 1982; molybdenum coproduct production fell from 21,855 pounds in 1981 to 9,752 pounds in 1982. Byproduct silver output declined in 1982. The decline in production was partly attributed to closing the two Arizona properties and Duval's Copper Basin Mine in Nevada during 1982.

According to the Pennzoil 1982 annual report, as of December 1982 combined ore reserves at Duval's Arizona and Nevada properties were an estimated 434 million tons of ore containing 0.286% copper and 0.036% molybdenum.

After a 3-1/2-month shutdown beginning in mid-December 1981, Duval reopened the Sierrita Mine on March 29, 1982, to fulfill its sales commitment for copper and molybdenum. Of 2,505 workers normally employed, 1,355 had been furloughed in December 1981. In the March recall, 1,525 workers were rehired and a 32-hour workweek was adopted. On July 1, however, because of continuing weakness in copper and molyb-

denum markets, 650 workers were laid off, and production at Sierrita was reduced from 80,000 tons of ore per day in the spring to 42,000 tons.

Unit costs at the Sierrita operation remained fairly constant through productivity improvements in 1982. Stripping was cut back, and redesigned molybdenum roasting facilities allowed double the amount of molybdenum to be roasted at a lower operating cost.

During the year, a large-scale portable ore-crushing system was being installed at the Sierrita pit. Designed by the company's subsidiary, Duval Technology, Engineering, & Construction Co., the system, built at a cost of about $14 million (exclusive of mainline conveyors), was expected to save $8 to $10 million annually in haulage costs. After the new system was fully tested, Duval expected to convert permanent in-pit crushers to a three-crusher system and to eliminate as many as 30 giant trucks each costing about $850,000. The complete crushing unit consisted of a portable apron feeder; a 700-ton, 5-story, electric-powered gyratory crushing unit; and a discharge conveyor. Ore was passed to the main belt systems equipped with portable, extendable drive stations and, thence, out of the pit. A crawler-type, diesel-powered transporter unit was assembled to move the system from site to site. Capable of lifting 1,200 tons, the transporter was designed to travel fully loaded 0.5 mile per hour up a 12% grade and to cover 1,000 feet in 48 hours. The system might be moved every 6 to 9 months.[8]

Inspiration, a subsidiary of Plateau Holdings Inc. (owned equally by Hudson Bay Mining and Smelting Co. Ltd., Toronto, Canada, and Minerals and Resources Corp. Ltd., Bermuda), operated the Joe Bush and Thornton open pit mines in the Inspiration area and a heap leach at the Upper and Lower Ox Hide surface mines 8 miles west of Inspiration, Gila County. On January 2, 1982, the Christmas open pit mine and concentrator, 35 miles south of Inspiration, Gila County, were shut down indefinitely, and during the year, activities were suspended in the Live Oak-Red Hill open pit area near Inspiration. The company's principal plants in the Miami-Inspiration area included crushing facilities, a 20,000-ton-per-day concentrator, a smelter with an annual capacity of 120,000 tons of blister copper, a sulfuric acid plant, a vat-leaching plant, a solvent-extraction plant, an electrowinning and electrorefining tank house, and a continuous cast rod-fabricating plant. Under toll contract, Inspiration smelts copper-bearing materials and provides some refining and rod-fabricating services for other copper producers.

As of December 31, 1982, the company reported 165 million tons of 0.53% copper in proven reserves and 27 million tons of 0.58% copper in probable reserves at its Inspiration area mines. At its inactive Christmas open pit mine, the company estimated proven reserves to be 8 million tons of 0.63% copper and at the inactive Christmas underground mine, proven reserves were 13 million tons of 1.78% copper and probable reserves of 7 million tons of 1.94% copper; at its Ox Hide Mine, proven reserves of 29 million tons of 0.3% copper; and at the Sanchez deposit near Safford, proven reserves of 79 million tons of 0.36% copper.[9]

Copper production of 63,578 tons at the firm's Inspiration area mines and leaching operations was down from 64,702 tons in 1981. Because byproduct molybdenum recovery was not economic, production was severely curtailed.

At the smelter, 77,000 tons of Inspiration's copper concentrates was treated in 1982, compared with 139,000 tons in 1981; toll concentrates treated in 1982 dropped to 158,000 tons from 237,000 tons processed in 1981. Cities Service's Pinto Valley operation, which supplied 63% of Inspiration's toll concentrates in 1981-82, shut down its Pinto Valley Mine and mill at midyear; Inspiration was required to supplement its production with feed from its own stockpiles and to purchase concentrate from third parties. On August 2, the smelter was shut down for maintenance; however, on October 2, as the smelter was being restarted, a molten-metal runaway caused a fire and extensive damage to the electrical and instrumentation control systems, delaying startup of the plant until January 3, 1983.

The company reported a reduction in unit costs per pound of copper by increasing productivity in its dump leach, ferric cure, and solvent-extraction operations; by reducing personnel; and by decreasing consumption of materials and capital spending. Major capital expenditures in 1982 included $2.7 million for haulage trucks for the surface mines and $1.2 million for relocating mine facilities to allow for pit expansion.

Employment at the Inspiration and Christmas Mines dropped from 2,181 on December 31, 1981, to 1,446 on December 31, 1982; about 250 workers were laid off at the Christmas Mine on January 2, 1982.

Kennecott Minerals Co., a subsidiary of Kennecott Corp., in turn a subsidiary of Standard Oil Co., an Ohio corporation (Ohio), operated the Ray Mines Div. The installations included the Ray open pit copper mine; a 15,000-ton-per-day silicate-ore vat leach, a solvent-extraction plant, and an 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 1982 annual report, Ray Mines produced 53,326 net tons of copper in 1982, compared with 111,267 net tons in 1981.

On March 12, 1982, a reduction in force at Ray Mines affected 83 salaried employees, and on March 27, an additional 39 hourly workers were laid off bringing the total work force to 1,700, compared with the nearly 2,000 employed at the division during most of 1981. Kennecott Minerals' operation in Arizona was shut down indefinitely on May 2, 1982. Another 800 workers were laid off, and about 640 employees were retained to complete major repair and maintenance projects until mid-August when an additional layoff of approximately 440 workers left about 200 workers for care and maintenance of the operations. Ray Mines remained closed the rest of the year.

Contract work continued throughout the year, however, on a multimillion dollar program to increase safety and efficiency at the Kennecott Hayden smelter. The project included pipe installation, duct work, concrete and instrumentation work to control new equipment, and the installation of a new cyclone and scrubber system over a preexisting structure.

Magma Copper Co., a subsidiary of Newmont, had two major operations in Pinal County: the San Manuel Div. 43 miles northeast of Tucson, and the Superior Div. 60 miles east of Phoenix. The San Manuel Div. comprised an underground mine, a 64,000-ton-per-day concentrator, a smelter with a 200,000-ton annual capacity of anode copper, a 200,000-ton annual capacity refinery, and a 125,000-ton-per-year continuous rod-casting plant. Products of 1982 copper sales included 80% continuous cast rod with the balance as plate cathode and "Magbar." Magma Copper ranked second in copper production with nearly 16% of Arizona's total.

According to the 1982 Newmont annual report, San Manuel Mine ore production dropped to 18,204,000 tons of 0.66% copper in 1982, compared with 22,198,000 tons of 0.635% copper in 1981. Because of depressed metal prices and low copper demand, Magma Copper reduced mine production in March to 55,000 tons of ore per day; curtailed mine development; and operated the smelter, electrolytic refinery, and continuous rod-casting plant on a reduced basis. On March 21, 2,500 of San Manuel's 3,800 hourly workers were placed on a 32-hour workweek; on April 4, 330 salaried and hourly employees were laid off; later, on June 29, an additional 650 workers were cut back. Development work on the Kalamazoo project, the deeper and down-faulted portion of the San Manuel deposit, remained suspended throughout the year.

Magma Copper estimated proven reserves at the San Manuel Mine to be 341.7 million tons averaging 0.696% copper, and at the deeper Kalamazoo project, 347.9 million tons averaging 0.718% copper in 1982. Byproducts molybdenum, silver, and gold are also present in both deposits.

The Magma Copper 1982 annual report showed that production at the Superior Div.'s Magma Mine fell to 638,899 tons of copper ore averaging 4.32% copper in 1982, compared with 1,022,000 tons averaging 4.48% copper in 1981. Operations were suspended on August 15, and the underground mine was placed on indefinite standby because of the slump in copper demand. Approximately 1,250 employees were idled. Proven ore reserves at the Superior Div. were an estimated 4 million tons averaging 5.69% copper in 1982.

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. Production was from the oxide ore body of the Lakeshore deposit.

In 1982, Noranda reported treating 1,668,000 tons of ore and recovering 22,800 tons of copper in cathodes, compared with 1,767,000 tons of ore and 13,035 tons of copper in 1981, reflecting improved grade and recovery. Oxide ores were mined under-

ground, treated in a conventional vat-leach system on the surface, and processed through a SX-EW plant.

Oxide ore inventories were estimated at 15 million tons of 1.18% copper in 1982. 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. Production from the sulfide ore bodies will not begin until economically feasible.[10]

Plans were made to gradually convert from mining the oxide ores by a block cave method to an in situ leach operation. After a successful testing program, the in situ leach equipment was being installed in 1982; on completion of the injection holes early in 1983, sulfuric acid solutions will be piped to the low-grade oxide ores that remain after block caving. During 1982, oxide ore was mined on the 900 level, and old workings on the 1100 level and below were prepared for initial leaching. Two 900-horsepower pumps were installed to transfer solutions from collection sumps and dams to the surface for distribution to the existing SX-EW plant; five monitoring wells were also drilled.[11]

Although reduced underground production continued throughout 1982, depressed copper prices forced the suspension of all underground development work in April; 195 of Noranda's 592 employees were laid off indefinitely.

Phelps Dodge ranked third in copper production with more than 14.5% of the State's total. The company owned and operated the Morenci and 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, that recovered copper precipitates by leaching low-grade material at the permanently shut down Lavender Pit Mine at Bisbee, Cochise County; the underground Copper Queen Mine at Bisbee, Cochise County; and the Douglas Reduction Works at Douglas, Cochise County. Located in Douglas since 1916, the corporation's Western General Offices were moved to Phoenix in July.

The company suffered a net loss of $74.4 million in 1982, the first loss incurred since the depression years of 1932-33. With the shutdown of the Phelps Dodge Arizona operations during most of 1982, the company's total production in the State dropped to 126,800 tons of copper, compared with 233,800 tons in 1981 and 176,500 tons during strike-ridden 1980.

In its 1982 annual report, the firm posted combined copper ore reserves at its Morenci, Metcalf, New Cornelia, and Safford Mines in Arizona and the Tyrone Mine in New Mexico as 1.7 billion tons in 1982, with 10.2 million tons of copper commercially recoverable.

At Morenci, the company's operations, the second largest in the Nation, included the Morenci open pit copper mine, a 60,000-ton-per-day concentrator, and a 160,000-ton-per-year smelter; and the Metcalf open pit mine and 40,000-ton-per-day concentrator. At its rated capacity, the Morenci Branch could move 400,000 tons of ore and waste per day from the Morenci and Metcalf sites. On April 17, 1982, the Morenci Mine, concentrator, and smelter, and the Metcalf concentrator were temporarily closed because of the drop in copper demand. The Metcalf pit, shut down at yearend 1980, remained closed until October 5, 1982, when the open pit mine and concentrator were restarted. The Morenci smelter was started up on October 12, followed by the Morenci Mine and concentrator on October 19. More than 3,000 workers were employed at the Phelps Dodge Morenci Branch in 1981; when the company shut down all of its Arizona operations in April, approximately 2,550 workers were laid off. In late September, Phelps Dodge, opting to resume production at its Morenci Branch rather than purchase copper on the open market, recalled 1,450 workers.

Although output was down during the year, the company continued to replace smaller flotation cells in the Morenci concentrator with new 1,000-cubic-foot cells. However, completion of the project, part of a program to reduce production costs, was deferred until 1983 because of capital restraints. During the year, the company also studied such long-range haulage options as a trolley assist for trucks to conserve diesel fuel, in-pit crushing with conveyor haulage to the concentrator, and the use of computer modeling of ore bodies as an aid to mine planning.[12]

At Ajo, Phelps Dodge operations included 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 production was shut down, and operations at the New Cornelia Branch remained

closed the rest of the year. Of the 1,100 workers normally employed, 800 were laid off. In 1982, the concentrator modifications begun in 1981 were completed; and engineering studies were continued on methods for increasing the capacity of the Ajo concentrator to reduce production costs.

During 1982, the 127,000-ton-per-year Douglas smelter was operated intermittently on a reduced schedule commensurate with demand. The first of the smelter's reverberatory furnaces was shut down on January 3, the second on February 28, and the third and last on May 20, 1982. In mid-July, one furnace was restarted but shut down again on November 8 because of lack of concentrates. Employment fluctuations included 550 workers laid off in April, 225 recalled in July, and 100 rehired in August; the labor force was then reduced again in November to about 115 salaried and security personnel. Normally, about 600 workers were employed at the Douglas operation. The principal source of feed for the Douglas smelter was the Cyprus Pima Mine that operated on a curtailed basis from the beginning of 1982 until it was shut down in September.

Phelps Dodge stated that the costs of installing an acid plant and related facilities at the Douglas smelter to bring it into compliance with sulfur dioxide emission limitations could not be justified economically. Therefore, the smelter was operated under a nonferrous smelter order, a variance form under the Clean Air Act that allowed the company to maintain ambient air standards by curtailing the smelter production rate. Before the variance expired at the end of 1982, Phelps Dodge applied to the State for a second variance that would allow the Douglas smelter to be operated until the end of 1987. Otherwise, unless the existing laws were altered or a dramatic change in economic circumstances were achieved, the company would be forced to close the Douglas smelter.

Near Safford, underground development at the company's deep copper ore body was continued until April when the property was placed on standby. Since 1969, development work at Safford has cost $85.7 million (exclusive of $22.7 million of related capitalized interest), including the $3.9 million invested in 1982.

Phelps Dodge proceeded with several programs in accordance with the consent decree negotiated with the EPA in 1981. The decree was designed to bring its Morenci smelter into compliance with the applicable emission standards for sulfur dioxide emissions and particulate matter by January 1, 1985, and to bring the Ajo smelter into compliance by December 31, 1985. During 1982, the initial phase of the Morenci project was substantially completed including a $17 million oxygen plant, the first of two, to feed a modified reverberatory furnace at the smelter. The new oxygen sprinkle furnace processed the first concentrates in October 1982. By yearend, $60.8 million had been expended on the Morenci project. Studies for achieving compliance with the existing and proposed air-quality regulations were underway at Ajo.

Byproduct sulfuric acid production at the Phelps Dodge Ajo, Douglas, and Morenci smelters in Arizona, and Hidalgo smelter in New Mexico declined to 579,200 tons in 1982, compared with 901,000 tons in 1981.

Ranchers Exploration and Development owned and operated the Bluebird Mine a few miles west of Miami, Gila County. Low-grade oxide ore was open pit mined and placed in heaps for leaching with sulfuric acid; the resulting copper-bearing solutions were processed through a SW-EX plant. Because of the depressed copper market and low copper prices, the mine was in the final stages of closure during 1982. Open pit mining ceased in July 1981, and from that time production continued by leaching and reworking the existing heaps. Studies during the fiscal year ending June 30, 1982, concluded that in situ leaching would not be economical at the current copper price. As of September 17, 1982, approximately 33 workers were employed at the mine; however, in October the operation was placed on standby and only a skeleton crew remained the rest of the year.

With production beginning in 1963, the Bluebird Mine was the first large-scale copper oxide leaching operation and the first to produce copper cathodes commercially by solvent extraction-electrowinning methods. More than 200 million pounds of copper was extracted from 48 million tons of ore. The company estimated the deposit still contained approximately 50 million tons of material averaging about 10 pounds of copper per ton. According to the 1982 company annual report, the mine produced 11,353,354 pounds of copper cathode in the fiscal year ending June 30, 1982. Another 2.4 million pounds of copper was to be

recovered before the mine went on standby.

The Continental Materials Corp. of Chicago, Ill., and Union Minière S.A. of Brussels, Belgium, general partnership completed the third and final phase of their Oracle Ridge copper mine reassessment program. The mine is 20 miles south of Oracle, Pima County, on the northeastern slope of Marble Peak in the Santa Catalina Mountains. During 1982, the managing partner, Union Mines Inc. of Denver, Colo., a subsidiary of Union Minière, conducted a feasibility study. According to the Continental 1982 annual report, ore reserves were substantially equivalent to the original estimate; in 1977, the company estimated reserves at 11 million tons of ore at 2.25% copper with small amounts of silver and gold. Exploration work on the project by the end of the year, totaling over $25 million, included 30,000 feet of tunneling, 120,000 feet of surface drilling, and 50,000 feet of underground drilling. Approximately 20 people were employed on the program. A 2,000-ton-per-day concentrator was purchased but never installed at the mine. Because of the capital required to construct a 1,000- or 2,000-ton-per-day facility and the current metals market, the company was seeking additional investors; in the meantime, project activities were suspended.

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
1978	891,405	$1,306,866	1,357,586	$1,990,323	65.7
1979	946,002	1,940,211	1,443,556	2,960,676	65.5
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	769,974	1,261,415	1,139,563	1,866,895	67.6

Table 5.—Arizona: 15 leading copper-producing mines in 1982, in order of output

Rank in 1982	Rank in 1981	Mine	County	Operator	Source of copper in 1982
1	4	Twin Buttes	Pima	Anamax Mining Co	Copper ore.
2	1	Morenci	Greenlee	Phelps Dodge Corp	Copper ore and precipitates.
3	2	San Manuel	Pinal	Magma Copper Co	Copper ore and tailings (slag).
4	7	Bagdad	Yavapai	Cyprus Bagdad Copper Co	Copper ore.
5	8	Inspiration	Gila	Inspiration Consolidated Copper Co.	Do.
6	6	Sierrita	Pima	Duval Corp	Do.
7	5	Pinto Valley	Gila	Cities Service Co	Do.
8	3	Ray	Pinal	Kennecott Minerals Co	Copper ore and precipitates.
9	9	Eisenhower	Pima	Eisenhower Mining Co	Copper ore.
10	13	Mission	do	ASARCO Incorporated	Do.
11	10	Magma (Superior).	Pinal	Magma Copper Co	Do.
12		Lakeshore	do	Noranda Lakeshore Mines Inc.	Do.
13	11	Pima	Pima	Cyprus Pima Mining Co	Do.
14	15	Sacaton	Pinal	ASARCO Incorporated	Do.
15		San Xavier	Pima	do	Do.

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)	
	1981	1982	1981	1982	1981	1982	1981	1982
OPEN PIT								
Twin Buttes	11,362	10,439	35,942	21,601	1,162	137	93,455	107,113
Morenci	26,073	14,069	15,735	5,346	26,873	5,782	175,931	103,061
Bagdad	13,421	17,468	23,416	22,671	588	2,663	64,869	78,583
Inspiration	6,088	6,473	9,349	7,523	6,740	19,589	50,427	58,226
Sierrita	32,986	16,142	25,205	7,922	7,219	1,331	79,531	47,417
Pinto Valley	17,278	8,799	--	--	29,417	15,289	80,457	47,378
Ray	13,441	4,343	--	--	25,294	9,993	104,887	47,688
Eisenhower	7,305	6,174	14,452	15,698	--	--	40,777	37,024
Mission	4,335	4,831	8,713	8,707	--	--	30,487	30,683
Pima	10,356	3,097	31,659	6,578	--	--	38,607	19,686
Sacaton	3,722	3,778	4,844	2,636	--	--	19,064	18,953
San Xavier	1,579	2,283	9,750	7,126	--	--	7,823	11,616
New Cornelia	8,809	1,873	4,295	1,134	--	--	34,135	9,588
UNDERGROUND								
San Manuel	20,138	16,514	64	--	--	--	115,739	102,774
Magma (Superior)	927	580	160	91	--	--	40,082	24,174
Lakeshore	1,285	1,471	--	--	1,603	1,513	11,825	20,689

[1]Gross metal content.

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

County	Lode mines producing[1]	Material sold or treated (metric tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
1980, total	33	155,244,137	79,631	$48,778,766	6,267,588	$129,363,016
1981, total	49	197,069,041	100,339	46,119,820	8,055,231	84,727,902
1982:						
Cochise	4	W	W	W	W	W
Gila	7	15,294,099	W	W	164,067	1,304,333
Greenlee	2	W	W	W	W	W
Mohave	1	W	W	W	--	--
Pima	9	48,760,990	W	W	3,846,076	30,576,304
Pinal	8	27,125,121	W	W	1,121,695	8,917,475
Yavapai	1	W	W	W	W	W
Yuma	1	W	--	--	W	W
Total	33	[2]123,561,881	[2]61,050	[2]22,949,307	[2]6,300,671	[2]50,090,338

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1980, total	770,118	$1,738,907,764	162	$151,849	W	W	W
1981, total	1,040,813	1,953,141,534	993	799,837	138	$135,270	$2,084,924,363
1982:							
Cochise	W	W	W	W	--	--	W
Gila	113,170	185,401,969	W	W	--	--	[2]187,609,350
Greenlee	W	W	--	--	--	--	[2]173,114,072
Mohave	W	W	--	--	--	--	W
Pima	266,515	436,619,228	143	80,534	--	--	W
Pinal	206,963	339,058,791	W	W	--	--	[2]361,429,729
Yavapai	W	W	--	--	--	--	[2]129,801,262
Yuma	--	--	W	W	--	--	[2]57,200
Total	[2]769,974	[2]1,261,415,195	[2]359	[2]202,414	--	--	[2]1,334,657,252

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

Table 8.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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	W	W	--
Gold-silver	2	W	W	W	W	--	--
Silver	7	86,310	W	105,563	W	W	--
Total	11	[2]130,856	[2]3,352	[2]159,104	[2]137	W	--
Copper	21	123,167,391	W	6,058,403	[3]706,378	187	--
Lead	1	W	--	W	--	W	--
Total	22	W	W	W	706,378	W	--
Other lode material:							
Gold tailings	--	10,886	516	742	--	--	--
Gold-silver tailings	--	W	W	W	W	W	--
Silver tailings	--	W	W	W	--	--	--
Copper precipitates	5	86,420	--	--	60,589	--	--
Copper tailings	1	W	--	--	W	--	--
Total	6	W	W	W	W	W	--
Grand total	33	[2]123,561,881	[2]61,050	[2]6,300,671	[2]769,974	[2]359	--

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 1982, 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]1,116	[1]742	--	--	--
Acid leaching (vat, tank, heap)	--	--	[2]117,812	--	--
Smelting of concentrates	56,629	6,057,964	[3]591,226	245	--
Direct smelting of:					
Ore	2,760	162,212	292	25	--
Precipitates	--	--	[2]60,589	--	--
Tailings	[4]545	[4]79,753	55	89	--
Total	3,305	241,965	60,936	114	--
Grand total	61,050	6,300,671	769,974	359	--

[1]Includes metal recovered by cyanidation process from tailings.
[2]Includes copper recovered by electrowinning process.
[3]Includes metal recovered from tailings.
[4]Does not include metal recovered from tailings by cyanidation process.

Gold.—Reflecting the decline in copper production and the slide of metal prices, Arizona's gold output dropped 39% in quantity and 50% in value. The average unit price of gold, $459.64 per troy ounce in 1981, fell to $375.91 in 1982. In 1982, 12 copper operations recovered 96% of the gold produced in the State. Gold was recovered from the following operations, in descending order of output: San Manuel, Morenci, Magma, New Cornelia, Sacaton, Pinto Valley, Copper Queen, Bagdad, Tyro, Congress, Pima, Sierrita, Ash Peak, Tiger, Ray, Golden Rule, Inspiration, and Hel-Roc. The number of small operations (under 100,000 tons per year of material treated) reporting production declined from 22 in 1981 to 9 in 1982. Pinal County yielded the most gold, follow-

ed by Greenlee, Pima, Cochise, Gila, Yavapai, and Mohave Counties.

Lead.—Two-thirds of the lead produced in Arizona came from seven copper operations in 1982. With the drop in copper production, lead output declined 64%, and that decline, coupled with the plunge in lead prices, dropped the value of lead production 75% compared with that of 1981. The average lead price fell to $0.2554 per pound in 1982 from $0.3653 in 1981. The McFarland & Hullinger Tiger Mine was the leading lead producer, followed by Duval's Sierrita Mine; Contract Mining Co.'s Dome Venture; Asarco's Mission, Sacaton, and San Xavier units; Eisenhower Mining's Eisenhower Mine; Little Hill Mines Inc.'s Gold Hill Mine; Goldfort Mining Corp.'s Golden Rule Mine; Asarco's Silver Bell Mine; Cities Service's Pinto Valley Mine; Hel-Roc Mining Co.'s Hel-Roc Mine; Inspiration Mines Inc.'s Reymert Mine; and Saga Mining Co.'s Gold Dust Mine. The number of small mines producing lead dropped from 13 in 1981 to 7 in 1982. Recovering lead at five operations, Asarco was the principal lead-producing company in the State.

Molybdenum.—Arizona again ranked second in the production of molybdenum after Colorado. Arizona shipped almost 28% of the Nation's molybdenum in 1982. All molybdenum was recovered as a byproduct or coproduct of copper output. Molybdenum shipments, however, declined 38% in amount because of the slowdown in copper production and 60% in value because of the fall in molybdenum price. The average producer's price per pound of molybdenum in technical-grade molybdic oxide dropped from about $6.85 in 1981 to about $4.45 in 1982.

Copper operations shipping molybdenum ore and concentrates were, in descending order of value, Sierrita, San Manuel, Cyprus Bagdad, Twin Buttes, Pinto Valley, Eisenhower, New Cornelia, Cyprus Pima, Morenci, Mission, Inspiration, Ray, and Mineral Park. About 63% of the State's molybdenum shipments originated in Pima County. Although the quantity of molybdenum shipped for export from 8 Arizona mines increased slightly, domestic shipments from 10 operations in the State were cut almost 50%.

Rhenium.—The rhenium compound, ammonium perrhenate, was recovered as a byproduct of roasting molybdenum concentrate at the Duval Sierrita Mine. Although the rhenium-processing unit began operation in 1981, actual production did not begin until January 1982. Rhenium was used principally as a platinum-rhenium catalyst for low-lead and lead-free high-octane gasoline.

Silver.—Silver, recovered principally as a byproduct of copper production in Arizona, declined 22% from the record high achieved in 1981. The value of silver output dropped 41% because copper operations were curtailed and shut down and because the price of silver slid from $10.52 per ounce in 1981 to $7.95 per ounce in 1982. Listed in descending order of output, the following mines recovered 98% of silver produced in the State: Twin Buttes, Eisenhower, Mission, Bagdad, Sierrita, San Manuel, Magma, Morenci, Pima, San Xavier, Sacaton, Pinto Valley, Ray, New Cornelia, Ash Peak, Copper Queen, Reymert, Silver Bell, Tiger, and Inspiration. Fifteen small operations reported silver production, four as precious metal mines, and the rest as precious and base-metal operations. Pima County led in production of silver, followed by Pinal, Yavapai, Greenlee, Gila, Cochise, and Yuma Counties.

Vanadium.—Arizona uranium-vanadium production was at a standstill in 1982. Energy Fuels Nuclear Inc., the producer in 1981, stockpiled uranium-vanadium ore from its Hack Canyon property in the Arizona Strip area north of the Grand Canyon, Mohave County. In 1981, the company shipped ores to its White Mesa mill near Blanding, Utah. During 1982, Energy Fuels sank a second shaft at its Pigeon Springs site in Coconino County and proposed developing Kanab North, about 16 miles northeast of its Hack Canyon property. By 1982, the company had staked 28,000 claims averaging 20 acres and obtained prospecting permits on 250,000 acres of State lands in the northwestern part of the State.

Zinc.—Not a single operation in Arizona posted zinc production in 1982.

NONMETALS

Asbestos.—All asbestos production in the State ended in 1982; chrysotile asbestos had been mined in Arizona since 1914. The demand for asbestos fell as adverse publicity mounted over concern that the material might be a cause of three lung diseases: asbestosis, lung cancer, and mesothelioma. In January 1982, Jaquays Mining Corp., the State's only surviving operation, ceased producing the low-iron fiber. Operating since 1952, the Jaquays properties included the

Victory and El Dorado Mines at Chrysotile in the Salt River Canyon area, Gila County, 35 miles northeast of Globe; and the Regal and Canadian (Asbestos King) Mines in the same area about 6 miles north of the El Dorado; and a mill near Globe. The fiber was used in special filtering applications and for electrical insulation.

At the Metate Asbestos Corp. processing plant adjacent to the Jaquays mill, operations were terminated in 1974; the Mountain View Mobile Home Estates subdivision was constructed on the abandoned asbestos-tailings site. Since 1979, controversy over the fear of asbestos-related diseases led to several unsuccessful attempts to cover the tailings, and the State applied for assistance from the Federal EPA Superfund program for the cleanup of hazardous wastes. During 1982, EPA studied the legality of using the funds for a problem caused by a naturally occurring mining waste.

Cement.—Portland cement production declined 8%, and shipments of gray finished portland cement dropped 18% in quantity and 15% in value during recession-dominated 1982. Prepared masonry cement shipments declined 19% in quantity and 22% in value. Producers of the product were Arizona Portland Cement Co., a division of California Portland Cement Co., at Rillito, Pima County; and Phoenix Cement Co., a division of Gifford-Hill & Co. Inc., near Clarkdale, Yavapai County. Raw materials consumed included limestone, clay, gypsum, fly ash, pyrite mill scale, and other substances. Natural gas and bituminous coal were used for dry-process kilns at both plants, and electrical energy was purchased for the facilities.

Because of declining sales, Arizona Portland Cement cut back its staff to 180 production workers by November, a 24% reduction from normal employment levels.[13] However, the company conducted evaluations for modernizing or expanding its Rillito plant. During the year, Phoenix Cement rebuilt its two-stage heaters and raw materials preblending facilities at its Clarkdale plant.[14]

Clays.—In 1982, clay production declined as bentonite output dropped 17% in quantity; common clay production, however, increased slightly. Again, no ball clay or fire clay was mined. 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; Filtrol Corp., acquired by Kaiser Aluminum & Chemical Corp., from its Cheto pit, Apache County; United Catalysts Inc. from its Cheto 1 pit, Apache County; Superior Companies' Arizona Gypsum Corp. from its Verde Mine, Yavapai County; and Magma Copper from its Magma Mine, Pinal County.

Filtrol, United Catalysts, and Arizona Gypsum mined nonswelling bentonite; and Phoenix Brick Yard, Phoenix Cement, and Magma Copper mined common clay. Common clay and shale continued to be used in manufacturing face and common brick and portland cement. Nonswelling bentonite was used for filtering, clarifying, and decolorizing animal, mineral, and vegetable oils, and for animal feed. The average unit value of clay and shale was $6.98 in 1982, compared with $7.46 in 1981.

Gem Stones.—Arizona ranked first in the Nation in output of gem stones, principally turquoise recovered at various copper operations. Because of shutdowns at those properties during the year, turquoise mining and production declined. Under contract, Hardy Turquoise Co. mined gem stones at the Duval property near Kingman and at the Cities Service property near Miami. W.O. Brown had a small operation at the Phelps Dodge Morenci Mine. Exports of stabilized turquoise from Mexico's Cananea Mine reportedly contributed to the drop in Arizona's production.

In February, Quartzite, Ariz., hosted many thousands at its annual gem and mineral festival, as did the Tucson Gem and Mineral Society at its annual show in Tucson the same month.

Gypsum.—Crude gypsum production decreased in amount and value in 1982 because of the depressed construction industry; however, calcined gypsum output 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, Maricopa County. Pinal Mammoth Gypsum Co. quarried gypsum for agricultural use at the 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.

Lime.—Curtailments and shutdowns of the State's copper operations and a depressed construction industry led to a 39% decline in quantity and a 43% drop in value

of lime produced in 1982. Genstar Cement & Lime Co., Yavapai County, was the leading producer of quicklime, followed by Can-Am Corp. near Douglas, Cochise County; Magma Copper at San Manuel, Pinal County; Amstar Corp. at Chandler, Maricopa County; and Kennecott Minerals, Ray Mines Div., Gila County. The shutdown of the lime plant at the Phelps Dodge Morenci Mine, Greenlee County, contributed to the downturn in Arizona's output of quicklime; however, production increased at the San Manuel and Amstar operations. Amstar used quicklime for processing beet sugar, but the plant was mothballed in mid-1982.

Perlite.—Crude perlite production increased in 1982. Although the quantity of material sold dipped slightly, its value increased over that of 1981. Harborlite Inc. sized perlite at its plant 2 miles west of Superior, Pinal County, and shipped the product out of State to expanding plants. Filters International Inc. sold its mine and sizing plant southwest of Superior to Silflo Inc. of the Silflo Holding Co., Norman, Okla. The perlite—marketed in Illinois, Indiana, and Texas—was used as a filtering aid in beverage, chemical, pharmaceutical, and sugar industries; as an agricultural fertilizer carrier; and in the building and construction industries. Commercial perlite deposits near Superior are associated with a rhyolitic phase of Tertiary volcanics that attain a maximum thickness of 1,970 feet in the Picketpost Mountain area. Although Arizona produces only a small amount of perlite, the State continued to rank second in the Nation after New Mexico.

Pumice and Pumicite (Volcanic Ash).—The only producer of pumice in the State was the Gila Valley Block Co. near Safford. Most of the material was processed for landscaping and building and decorative block; insulation and concrete aggregate uses, however, declined.

Pyrites.—Magma Copper, Superior Div., sales of pyrites from its Magma Mine increased slightly during the year.

Salt.—Southwest Salt Co., Arizona's only salt producer, solution mined the Luke Salt deposit west of Glendale, Maricopa County, and recovered the product in solar evaporation ponds. Output and dollar value of that production increased; the salt was marketed for domestic water softeners, agricultural, and industrial uses.

Sand and Gravel.—Total sand and gravel production declined in quantity and value in 1982. Construction and industrial sand was obtained from 77 producers at 117 operations in the following counties, in descending order of quantity of shipments: Maricopa, Pima, Yuma, Pinal, Yavapai, Coconino, Greenlee, Navajo, Mohave, Santa Cruz, Cochise, Gila, Graham, and Apache. Maricopa, Pima, and Yuma Counties accounted for 81% of the construction sand and gravel sold or used in the State during 1982.

As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981 collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Construction.—In 1982, the leading construction sand and gravel producers, in descending order of production, included the Tanner Co., with operations in Maricopa, Yuma, Pima, Pinal, and Coconino Counties; Arizona Sand and Rock Co., a division of California Portland Cement, Maricopa County; Union Rock and Materials Corp., Maricopa and Pima Counties; Nesbitt Construction Co. Inc., Maricopa and Greenlee Counties; Salt River Sand & Rock, Allied Concrete and Materials Co., and Sun Valley Crushing Co. Inc., all with operations in Maricopa County; Columbia Sand and Gravel Co. and Columbia Building Materials Inc., Pima County; and Phoenix Sand and Rock, Maricopa County. These 10 companies sold 64% of the construction sand produced in Arizona. During 1982, 36 operations produced less than 25,000 tons each of the total construction sand and gravel, 54 operations produced between 25,000 and 300,000 tons, 14 operations produced between 200,000 and 600,000 tons, and 9 operations produced between 600,000 and 1 million tons. Industrial sand operations each produced less than 50,000 tons in 1982.

Industrial.—Producers of industrial sand and gravel, in descending order of tonnage, included Paradise Mines Inc. (formerly Little Hills Mines), Pinal County; Arizona Silica Sand Co., Apache County; A. J. Gilbert Construction Co., Cochise County; and Don Kelland Materials, Yuma County. The product was used principally for flux in the copper industry, hydraulic fracturing in the petroleum industry, blasting, and filtration.

Seventy-five percent of the State's sand and gravel was shipped by truck; most of the remainder was used onsite; and a small amount was shipped by other means.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	5,294	$17,370	$3.28
Gravel	NA	NA	NA	12,336	37,568	3.05
Sand and gravel (unprocessed)	--	--	--	1,494	3,438	2.30
Total[1] or average	e20,990	e$63,340	e$3.02	19,124	58,375	3.05
Industrial:						
Sand	W	W	13.75	W	W	15.24
Gravel	W	W	W	W	W	9.00
Total or average	179	2,455	r13.70	107	1,617	15.15
Grand total[1] or average	e21,169	e65,795	e3.11	19,230	59,992	3.12

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.

Table 11.—Arizona: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	6,021	$20,708	$3.44
Plaster and gunite sands	572	1,815	3.17
Concrete products	796	2,960	3.72
Asphaltic concrete	3,319	10,981	3.31
Road base and coverings	5,778	15,251	2.64
Fill	2,511	6,198	2.47
Snow and ice control	75	209	2.78
Railroad ballast	3	9	3.45
Other	50	246	4.88
Total[1] or average	19,124	58,375	3.05

[1]Data may not add to totals shown because of independent rounding.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and completed the following year.

Preliminary estimates indicated that crushed stone sold and used in Arizona declined in quantity and value in 1982; however, dimension stone sales continued to increase over that of 1981.

Sulfuric Acid.—Arizona ranked first in byproduct sulfuric acid production. Of the total domestic byproduct output, 37% was recovered from the State's copper smelters. The slowdown in copper production was reflected in the 42% decline in Arizona sulfuric acid output; in 1982, the 780,569 tons produced was valued at $15,888,000.

Vermiculite (Exfoliated).—W. R. Grace & Co. continued to bring beneficiated vermiculite into Maricopa County for exfoliation. Exfoliated vermiculite production declined in quantity and value during 1982. Leading uses of the product included fireproofing, concrete aggregate, block insulation, soil conditioning, loose-fill insulation, and horticultural applications.

Zeolites.—Union Carbide Corp. shipped chabazite, the natural zeolite, from a deposit near Bowie. Production, however, was at its lowest level since 1975 because of a reduced demand for specialty absorbents.[15]

[1]State Liaison Officer, Bureau of Mines, Denver, Colo.
[2]Arizona's Economy. March 1983, p. 5.
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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 Inc.	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	4150 West Turney Box 23163 Phoenix, AZ 85063	Open pit mine and crushing plant.	Do.
Clays:			
Filtrol Corp., a subsidiary of Kaiser Aluminum & Chemical 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.
Cyprus Pima Mining Co.[3 4 5]	Box 7187 Tucson, AZ 85725	Open pit mine and mill	Pima.
Anamax Mining Co., Twin Buttes Mine.[3 4 5]	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[3 4 6]	Box 111 Sahuarita, AZ 85629	Open pit mine and mill	Pima.
Sacaton Unit[4 5 6]	Box V Casa Grande, AZ 85222	do	Pinal.
San Xavier Unit[4 6]	Box 111 Sahuarita, AZ 85629	Open pit mine	Pima.
Silver Bell Unit[3 4 6]	Silver Bell, AZ 85270	Open pit mine, mill, leach dumps, precipitation plant.	Do.

See footnotes at end of table.

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Copper —Continued			
Cities Service Co., Miami Operations, Pinto Valley Mine.[3 4 5 6]	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[3]	Box 3009 Kingman, AZ 86401	Open pit mine, mill, leach dumps, precipitation plant.	Mohave.
Sierrita Mine[3 4 5 6]	Box 125 Sahuarita, AZ 85629	Open pit mines, mills, leach dumps, precipitation plant.	Pima.
Eisenhower Mining Co., Eisenhower (Palo Verde) Mine.[3 4 6]	Box 39 Sahuarita, AZ 85629	Open pit mine	Pima.
Inspiration Consolidated Copper Co.[3 4 5]	Box 4444 Claypool, AZ 85532	Open pit mines, mill, vat-leaching plant, solvent extraction-electrowinning plant, in-place leaching, heap leaching, precipitation plant, rod plant, custom smelter, electrolytic refinery.	Gila.
Ox Hide Mine	Box 4444 Claypool, AZ 85532	Open pit mine and heap leach.	Do.
Kennecott Minerals Co., a subsidiary of Kennecott Corp., Ray Mines Div.[3 4 5]	Hayden, AZ 85235	Open pit mine, 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.
Superior Div.[4 5]	Box 37 Superior, AZ 85273	Underground mine and mill	Do.
Noranda Lakeshore Mines Inc., a subsidiary of Noranda Mines Ltd.	Box C6 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.
Ranchers Exploration and Development Corp., Bluebird Mine.	Box 880 Miami, AZ 85539	Open pit mine, heap leach, solvent extraction-electrowinning plant.	Gila.
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	Pinal.
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 Cement & Lime Co., a division of Genstar Corp.	Box 197 Peach Springs, AZ 86434	Quarries and plant	Yavapai.
Kennecott Corp., Ray Mines Div	Hayden, AZ 85235	Kiln	Gila.
Phelps Dodge Corp., Morenci Branch.	Morenci, AZ 85540	Rotary kiln and fluidized-bed-kiln plant.	Greenlee.

See footnotes at end of table.

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Perlite:			
Harborlite Inc	Box 960 Superior, AZ 85273	Open pit mine and plant	Pinal.
Silflo 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 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	Open pits and plant	Coconino, Maricopa, Pima, Pinal, Yuma.
Union Rock and Materials Corp	2800 South Central Ave. Box 8007 Phoenix, AZ 85066	Open pits and plants	Maricopa.
Stone:			
Andrada Marble Co	4901 East Drexel Rd. Tucson, AZ 85706	Quarry	Pima.
Dolomite:			
Robert E. McKee Inc	Box 107 Peach Springs, AZ 86434	Quarry and crushing plant	Mohave.
Vanadium:			
Energy Fuels Nuclear Inc.[9]	South Highway 89A Fredonia, AZ 86022	Underground mine	Do.
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.
[9] Also uranium.

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 Jane P. Ohl[1]

Arkansas' nonfuel mineral production in 1982, comprising 2 metallic and 12 nonmetallic minerals, was valued at $256.4 million, a 5.7% decrease from that of 1981. In 1972 constant dollars, the value of nonfuel minerals in Arkansas declined nearly 16% in the 1972-82 decade.

The State continued as a major producer of several nonfuel minerals, ranking first in bauxite, bromine, and special silica stone for natural abrasive applications (grindstones, oilstones, and whetstones) and third in barite. Arkansas was one of only two States that shipped gallium, and one of only four that produced tripoli and vanadium.

Ten of the mineral commodities produced during 1982 decreased in quantity from 1981 levels, reflecting the general national downturn in demand for metallic and some construction materials. Of those 10 showing the largest decreases in quantity produced were bauxite, construction sand and gravel (23%), dimension stone (29%), and vanadium (67%).

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Abrasives[2]	short tons	W	W	1,085	$469
Bauxite	thousand metric tons	1,242	$22,185	W	W
Clays	thousand short tons	880	9,333	629	6,658
Gem stones		NA	200	NA	200
Lime	thousand short tons	149	8,102	W	W
Sand and gravel:					
Construction	do.	e9,146	e22,400	7,076	19,056
Industrial	do.	642	8,236	881	11,370
Stone:					
Crushed	do.	13,834	47,260	p13,100	p48,500
Dimension	do.	7	411	p5	p290
Talc	do.	W	W	13	92
Combined value of barite, bromine, cement, gypsum, tripoli, vanadium, and values indicated by symbol W		XX	153,721	XX	169,754
Total		XX	r271,848	XX	256,389

eEstimated. pPreliminary. 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 grinding pebbles, grindstones, oilstones, tube-mill liners, and whetstones.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Ashley	$134	(3)	
Baxter	W	W	Stone (crushed).
Benton	W	$1,512	Do.
Boone	W	557	Do.
Bradley	167	(3)	
Calhoun	2,799	(3)	
Carroll	W	W	Stone (crushed).
Chicot	W	(3)	
Clark	W	W	Stone (crushed), clays.
Clay	145	(3)	
Cleburne	W	295	Stone (crushed).
Cleveland	325	(3)	
Columbia	W	W	Bromine.
Conway	282	W	Stone (crushed).
Craighead	1,130	65	Clays.
Crawford	W	W	Stone (crushed), sand and gravel (industrial).
Crittenden	W	W	Clays.
Cross	286	(3)	
Dallas	24	(3)	
Drew	12	(3)	
Faulkner	W	W	Stone (crushed).
Franklin	W	(3)	
Fulton	989	289	Stone (crushed).
Garland	W	W	Vanadium, abrasives, stone (crushed), tripoli, stone (dimension).
Grant	351	(3)	
Greene	170	(3)	
Hempstead	W	W	Sand and gravel (industrial), clays.
Hot Spring	3,201	W	Barite, clays, stone (crushed), abrasives.
Howard	25,707	27,624	Cement, gypsum, stone (crushed).
Independence	W	W	Stone (crushed), lime, stone (dimension).
Izard	W	W	Sand and gravel (industrial), stone (crushed).
Jefferson	W	(3)	
Johnson	W	W	Clays.
Lafayette	210	(3)	
Lawrence	W	4,949	Stone (crushed).
Lincoln	279	(3)	
Little River	41,744	W	Cement, stone (crushed).
Logan	W	444	Stone (dimension), stone (crushed).
Lonoke	W	W	Clays.
Madison	W	(3)	
Marion	1,075	48	Stone (crushed).
Miller	W	W	Clays.
Mississippi	10	(3)	
Montgomery	W	W	Stone (crushed).
Nevada	29	(3)	
Ouachita	W	W	Clays.
Perry	1,505	827	Stone (crushed).
Pike	W	W	Stone (crushed), gypsum.
Poinsett	737	(3)	
Polk	862	(3)	
Pope	1,080	237	Stone (crushed).
Pulaski	34,611	W	Stone (crushed), clays.
Randolph	148	(3)	
St. Francis	1,218	(3)	
Saline	23,747	26,271	Bauxite, lime, stone (crushed), talc.
Scott	7	(3)	
Sebastian	W	W	Clays, stone (crushed).
Sevier	W	W	Stone (crushed).
Stone	W	(3)	
Union	W	W	Bromine.
Van Buren	52	216	Stone (crushed).
Washington	W	729	Do.
White	W	1,420	Do.
Woodruff	W	(3)	
Yell	174	(3)	
Undistributed[4]	149,429	183,965	
Sand and gravel (construction)	XX	e22,400	
Total	[5]292,643	271,848	

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: Arkansas, Desha, Jackson, Lee, Monroe, Newton, Phillips, Praire, Searcy, and Sharp Counties.

[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 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 Arkansas business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,029.0	1,018.0	-1.1
Unemployment	do	94.0	99.0	+5.3
Employment (nonagricultural):				
Mining[1]	do	5.9	6.0	+1.7
Manufacturing	do	209.7	195.8	-6.6
Contract construction	do	34.3	29.6	-13.7
Transportation and public utilities	do	43.3	42.5	-1.8
Wholesale and retail trade	do	159.6	158.4	-.8
Finance, insurance, real estate	do	31.8	32.2	+1.3
Services	do	117.4	118.2	+.7
Government	do	138.1	136.6	-1.1
Total nonagricultural employment[1]	do	740.1	719.3	-2.8
Personal income:				
Total	millions	$18,460	$19,093	+3.4
Per capita		$8,041	$8,332	+3.6
Construction activity:				
Number of private and public residential units authorized		5,034	6,333	+25.8
Value of nonresidential construction	millions	$119.1	$181.6	+52.5
Value of State road contract awards	do	$82.1	$88.3	+7.6
Shipments of portland and masonry cement to and within the State	thousand short tons	707	584	-17.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$271.8	$256.4	-5.7
Value per capita, resident population		$123	$112	-8.9
Value per square mile		$5,302	$4,828	-8.9

[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.

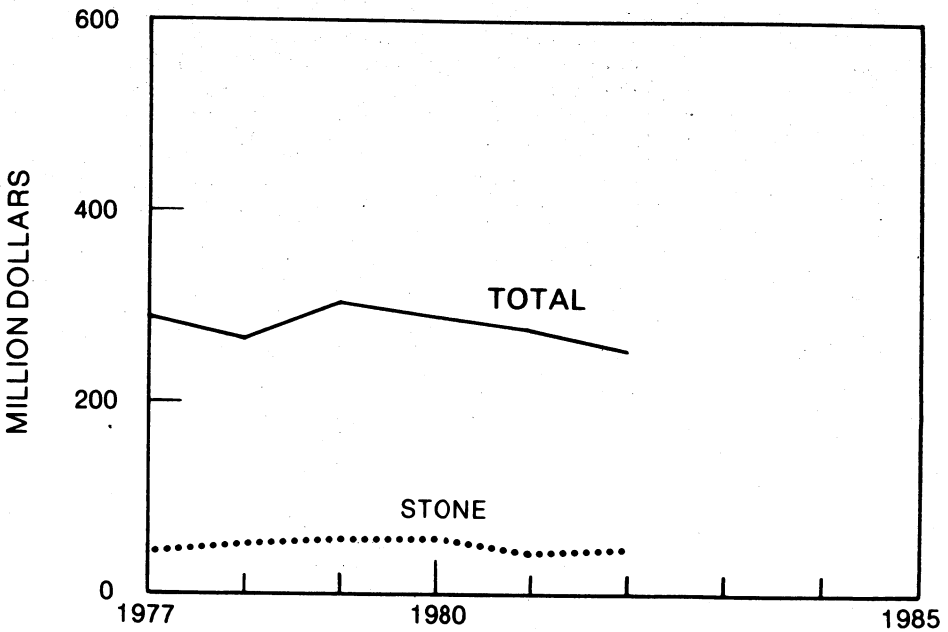

Figure 1.—Value of stone and total value of nonfuel mineral production in Arkansas.

Producers reported increases in quantity of barite, bromine, masonry cement, gypsum, industrial sand, elemental sulfur, talc, and exfoliated vermiculite.

The nonmetallic sector generated more than $9 out of every $10 of the State's total nonfuel mineral value. Leading the nonmetallic commodities in value was bromine, followed by portland cement, crushed stone, and sand and gravel. In the metallic sector, bauxite led in value, followed by vanadium.

Trends and Developments.—Aluminum Co. of America (Alcoa) was one of only two U.S. companies in two States to ship gallium, a metal used primarily in manufacturing electronic devices. The company recovered gallium as a byproduct from the fluids of the Bayer process for the conversion of bauxite to alumina. Fiber-optic transmission cables require gallium-based devices to convert electrical signals to light signals and vice versa. Greater reliance on fiber optics for communications, together with new computer, photovoltaic, and military applications, is expected to enhance the demand for gallium.

Compared with those of 1981, shipments of sand and gravel on the McClellan-Kerr Arkansas River Navigation System during 1982 decreased by 10%; however, shipments of bauxite and chemicals increased in 1982.

A landowner disputed the value of 230 acres in Marion County in north-central Arkansas. The landowner, whose acreage was taken from him and placed in the Buffalo River National Park, contended that he was trying to develop the mineral value of the land when the Government, offering $51,000 for it, took the land into the park. Test holes the Federal Government drilled next to the owner's test holes found only traces of zinc. A Colorado-based engineering firm testified that the owner's cost for mining the purported $31 million to $450 million worth of zinc ore would be at least $5.6 million more than he would receive for the zinc at current prices.[2]

The first Arkansas Mining and Minerals Industry Week meeting and mine tour was held September 23-24 in Russellville. A second is planned for September 1983 to publicize the mining industry's importance in the State's economy.

Employment.—Employees on mining payrolls in the State numbered 6,000 in January 1982, decreasing to 5,700 by yearend.[3]

Residential construction contracts, rising each quarter in 1982, were $15.3 million (2.4%) higher than the 1981 total value; however, nonresidential construction contracts decreased $22.5 million (7.4%) from 1981 total value.[4] Residential and nonresidential construction used many of the industrial minerals produced in the State: cement, clay, gypsum, and sand and gravel.

Legislation and Government Programs.—Arkansas was among 12 States identified on a U.S. Geological Survey map[5] as an area where solution mining is possible. In solution mining, water is injected into geological formations that contain such soluble minerals as salt or potash. The voids left underground when the minerals are removed may eventually collapse and cause the surface to subside.

On January 1, 1982, because of funding limitations imposed by the U.S. Congress, a temporary restraint of the Mine Safety and Health Administration's (MSHA) enforcement of safety rules in surface mining of stone and sand and gravel operations went into effect. This temporary restraint was lifted on July 15, 1982, and MSHA's inspectors resumed enforcing the safety rules, but under new guidelines that reduced the number of violations to those that were significant and substantial.

In early May, the Arkansas Pollution Control and Ecology Commission adopted an order stating that the term "mining," as used in its administration of the Arkansas Reclamation Law, Act 336 of 1977, "does NOT include exploratory drill holes, exploratory test pits, or exploratory trenches." The ruling effectively eliminated Commission control over companies exploring for diamonds near Murfreesboro.[6]

The Rural Abandoned Mine Program (RAMP) was established under the Surface Mine Reclamation Act of 1977 to reclaim mined land left as a community safety and health hazard. The first reclamation project in Arkansas under RAMP, begun in Franklin County in August 1982, was to be completed in the spring of 1983. On the 29-acre Hill project in Franklin County, permanent vegetation was to be established on land the Chipper Construction Co. of Oklahoma graded in 1982. Bids on other projects in Franklin County are to be let in 1983.

The Surface Transportation Assistance Act (Public Law 97-424), passed by Congress on January 6, 1982, initiated a 5-cent-per-gallon user fee and other fees highway users were to pay, effective April 1, 1983. States are expected to provide matching funds for interstate highway work, and some projects

are to start in the first half of 1983. Public Law 97-424 extended the Federal Highway Trust Fund to September 30, 1988. The levels of funding established in the act are the highest ever for highways and mass transportation, and the highest in constant dollars since the early seventies. The passage of this act was expected to increase crushed stone demand significantly.

On September 23, 1982, the Southwestern Power Administration (SPA), a Federal regional power agency, announced that beginning in 1984 it will reduce Arkansas' share of SPA-generated power from 28% to 11%. The reduction will directly affect U.S. aluminum production by ending the supply of relatively inexpensive hydroelectric power to the Reynolds Metals Co. smelters at Malvern and Arkadelphia. Reynolds was being supplied hydroelectric power at at 0.6 cent per kilowatt-hour; other industrial customers paid 1.75 cents per kilowatt-hour. Reynolds indicated that the increased cost of power may seriously affect its operations. The company had laid off more than 1,500 workers in Arkansas during the year.[7]

As of September 30, 1982, more than 900,000 acres in the State of Arkansas were under continuing nonfuel mineral leases, licenses, and permits on acquired, military, and other Federal lands. Other nonfuel mineral leases, licenses, and permits, amounting to 1,207 acres of acquired lands, were divided as follows: 885 acres, barite; 162 acres, quartz; and 160 acres, wavellite. The volume of reported production for nonfuel minerals from the acquired lands in fiscal 1982 amounted to 12,027 short tons of quartz crystals.[8] Figures are not available for either barite or wavellite.

In mid-December, the Union County Quorum Court agreed to appropriate funds for reappraising mineral properties in the county, a move that could result in newly discovered mineral properties and as much as $200,000 in new county taxes and additional revenues. The reappraisal process, to begin in March 1983, would be simplified by the county's proposed purchase of new computers. Any new revenues generated will be received in March 1984, at the earliest.[9]

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—During 1982, five companies mined novaculite for oilstone and whetstone products, valued at nearly $0.5 million, from mines in Garland and Hot Spring Counties: Arkansas Whetstones; Dans Whetstones Co. Inc.; Norton Co., Norton Pike Div.; Hiram A. Smith Whetstone Co. Inc.; and Wallis Whetstone. The finished stone was valued at nearly 10 times that of the mined rock. Several other firms that finished small quantities of abrasive materials did not mine the rock: American Trails Whetstone Co. (Montgomery County), and Arkansas Abrasives Inc., Halls Arkansas Oilstone Inc., Frontier Whetstones, Natural Hones Inc., Pioneer Whetstone, Poorboy Whetstones, and Washita Mountain Whetstone (all in Garland County).

Barite.—Arkansas ranked third in the Nation in barite production, although demand in the drilling mud market, which consumed more than 90% of the total national barite supply, dropped significantly during the last half of 1982.

Milchem Inc. conducted shakedown tests at its Fancy Hill flotation plant, completed at midyear 1982, and stockpiled some ore. By yearend, however, most employees were laid off, and the operation was shut down indefinitely.

NL Industries Inc., Baroid Div., permanently closed its barite mine and grinding plant at Magnet Cove, Hot Spring County, putting 97 people out of work on July 16; 26 people remained at the company's metallurgical laboratory and chemical plant. The Magnet Cove barite reserves were declared to be virtually exhausted; this depletion, coupled with the downturn in U.S. oil well and gas well drilling, made continued operation of the plant economically infeasible. In early August, NL Industries also shut down its flotation plant at Magnet Cove. NL Industries' McKnight Mine in Montgomery County produced about 12% of the State's barite.

Bromine.—Arkansas, the largest domestic bromine producer, accounted for about one-half of the world's output during the year; domestic production of elemental bromine during 1982 increased approximately 6% over that of 1981. The value of the Arkansas production increased about 14% over that of 1981. Four companies operated in southern Arkansas: Dow Chemical U.S.A. and Ethyl Corp. at Magnolia, in Columbia County, and Arkansas Chemicals Inc. and Great Lakes Chemical Corp. near

El Dorado, Union County. The increase in Arkansas production was attributed to a rising demand for bromine in flame retardants and well drilling fluids.

Dow announced plans to resume constructing a calcium bromide solution plant at Magnolia; construction had been halted when oil and gas demand declined. Rated at 120 million pounds of solution annually, the facility was to begin production in early 1985. Dow's decision to increase capacity was based on the improving market prospects, especially in onshore well-drilling applications.

Ethyl announced plans at the end of November to build two plants at Magnolia, where bromine recovered from the company's brine wells and bromine recovery unit would be used. A sodium and calcium bromide plant was to be operational by the first quarter of 1983; the company also announced a proposed plant construction at the same locality to make tetrabromobisphenol-A (TBBPA) and methyl bromide. Capacity for elemental bromine at the new sodium bromide plant was rated at 160 million pounds per year, and capacity of the calcium-bromide unit was to be increased by 40%. The new facilities will be capable of producing 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. The two plants were expected to increase employment by 10%.

Great Lakes began constructing a Halon 1301 and 1211 plant in El Dorado. Halon 1301 is a fire extinguishing agent in automatic systems, and Halon 1211 is used in portable fire extinguishers. The plant, scheduled for completion in 1983, will produce several thousand tons of Halon per year and will provide 20 additional jobs.[10]

Cement.—Portland cement shipments from the State's two producers decreased nearly 9% from those of 1981, a year that also showed a reduction in shipments; the average value, however, rose 5% over that of 1981. Masonry cement shipments increased more than 34% and value increased nearly 45% over 1981 figures. Portland cement, which accounted for more than nine-tenths of the total cement produced in Arkansas, consisted primarily of gray, Types I and II (general use, moderate heat cements). Only small amounts of gray, Type III (high-early-strength cement), were produced. All kilns used the wet process, and the pollution control equipment was the electric precipitator type. Natural gas was the predominant fuel, but both companies used a small amount of bituminous coal.

Ready-mix companies used nearly two-thirds of the portland cement; other users were general contractors, concrete product manufacturers, building material dealers, highway contractors, and government agencies. More than 96% of the finished portland cement shipped to consumers was handled by truck in bulk form; the remainder was shipped by rail or barge.

Clays.—Eight companies produced clay and shale in 10 counties. Crittenden County, adjacent to the large metropolitan user area of Memphis, Tenn., was the largest common clay and shale producer, followed by Hot Spring, Johnson, Hempstead, Miller, Craighead, Clark, Ouachita, and Sebastian Counties. Pulaski County was the sole producer of unprocessed and calcined high-temperature kaolin. Although more than 86% of clay production was common clay and shale from 13 of the State's 16 mines, Arkansas ranked third in the Nation as a kaolin producer from 3 mines; nevertheless, the total value of the kaolin declined 29% from that of 1981. Average unit value for all clays was $10.59 per ton; kaolin clays from Pulaski County averaged $66.42 per ton.

Gem Stones.—Park authorities at the Crater of Diamonds Park in Pike County reported that about 84,600 people visited the park and 70,000 visited the surface mine in 1982 and found 1,382 diamonds, weighing 263 carats, a slight increase over the 1,327 diamonds weighing 244 carats found in 1981. The number of park visitors in 1982 fell by more than 12,000. The largest diamond was a 3.48-carat brown stone of undetermined value. The next four largest diamonds—one brown, one yellow, and two white—ranged from 2.43 to 3.40 carats. New concentrating and screening techniques enabled diggers to recover more of the smaller (1- to 24-point) stones, contributing substantially to the total number of diamonds recovered; in 1980, the recovered stones averaged 33 points compared with 19 points in 1982.

Graphite (Synthetic).—Production of manufactured graphite in Arkansas in 1982 increased nearly 1,000% over that of 1981.

Gypsum.—Crude gypsum output and value increased 9% and nearly 30%, respectively, over those of 1981. Adjacent Howard and Pike Counties in southwestern Arkansas were the State's sole producers of crude gypsum. Calcined gypsum production in-

creased slightly, but its value decreased nearly 17% from that of 1981.

Lime.—Lime production and value both decreased, compared with 1981 figures. Rangaire Corp.'s subsidiary, Arkansas Lime Co., produced from its Limedale plant in Independence County. By yearend, Arkansas Lime had nearly completed its $1.75 million improvement program at the Limedale quarry and plant near Batesville. Improvements included a new electronic scale, a new quality control laboratory and equipment, and an additional roller mill. The firm also updated its narrow gauge railroad, bridges, and stockpile tunnel and conveyor. Arkansas Lime employed 120 persons.

Arkansas Lime also operated, on contract, an underground limestone mine at Myersville, owned by Reynolds, and a quarry at Love Hollow, owned by Alcoa; both operations were in Izard County. Anticipating the closure of Reynolds' Hurricane Creek plant in August 1983, Arkansas Lime shut down and sealed the Reynolds operation February 28, with the loss of 21 jobs. Rock was shipped from the Izard County operations to produce crushed limestone and quicklime for processing alumina. Alcoa's Love Hollow was operated at 50% of normal schedule, evidence of the slowdown at its alumina facilities at Bauxite, Saline County.

Perlite (Expanded).—Strong-Lite Products Corp., in Jefferson County, expanded and sold perlite, but output decreased 20% and value decreased 5% from 1981 figures.

Quartz.—Various grades of natural quartz were produced by Coleman Crystal Inc., at Jessieville, and by Ocus Stanley and Burrows Mining Co., both at Mount Ida. Estimated total production of natural quartz increased 14% from the 1981 estimate.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Of 111 operations during 1982, only 6 each produced more than 300,000 short tons of construction sand and gravel, and 63 each produced less than 25,000 tons.

St. Francis Materials Co., a division of B. M. Hogan Co., was the State's largest producer of construction sand and gravel from operations in Calhoun County in southern Arkansas, from Craighead, St. Francis, Poinsett, and Cross Counties in the northeast, and from Marion County in the north-central part of the State. Gifford-Hill & Co. Inc., the second ranking producer, operated in Ouachita and Miller Counties. The Arkansas State Highway Department worked 43 of the State's 111 combined private and government-owned operations.

In decreasing order of quantity, construction sand and gravel was used principally for concrete aggregate, road base and coverings, asphaltic concrete aggregates, fill, concrete products (blocks, bricks, pipe, etc.), and plaster and gunite sands.

More than 80% of construction sand and gravel was shipped by truck; the remainder was transported by railroad and other unspecified means. Construction sand and gravel averaged $2.69 per ton.

Industrial.—Nine operations produced industrial sand and gravel during 1982; none produced more than 500,000 short tons; and five produced less than 25,000 tons each.

Gifford-Hill, in Miller County, was the largest producer, followed by Silica Products Co. Inc., in Izard County. Other firms operated in Calhoun, Craighead, Crawford, Hempstead, Hot Spring, Poinsett, and St. Francis Counties.

More than 50% of the industrial sand and gravel output was used in blasting abrasives; an additional 26% was used in foundry molding and core.

Most industrial sand and gravel was shipped by truck. Industrial gravel averaged $38.32 per ton, and industrial sand averaged $12.89 per ton.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	2,904	$7,713	$2.66
Gravel	NA	NA	NA	2,688	9,078	3.38
Sand and gravel (unprocessed)	NA	NA	NA	1,484	2,265	1.53
Total or average	e9,146	e$22,400	e$2.45	7,076	19,056	2.69
Industrial:						
Sand	W	W	12.80	W	W	12.89
Gravel	W	W	W	W	W	38.32
Total or average	642	8,236	12.82	881	11,370	12.90
Grand total or average	e9,788	e30,636	e3.13	7,957	30,426	3.82

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

Table 5.—Arkansas: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,834	$12,295	$3.21
Plaster and gunite sands	208	508	2.44
Concrete products	308	747	2.42
Asphaltic concrete	682	2,070	3.04
Road base and coverings	1,656	2,729	1.65
Fill	311	500	1.61
Other	78	207	2.66
Total or average	[1]7,076	19,056	2.69

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

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Crushed.—During 1982, Arkansas' crushed stone producers quarried 13.1 million short tons of rock, valued at $48.5 million, a 5% decrease in quantity but a 3% increase in value, compared with 1981 figures. Arkansas Cement Corp. produced limestone from its Foreman quarry in Little River County. McGeorge Contracting Co. Inc. and Minnesota Mining & Manufacturing Co. produced syenite from Granite Mountain No. 1 and No. 2 quarries and Little Rock quarry, respectively, in Pulaski County.

Dimension.—Dimension stone production declined very little in quantity and value compared with that of 1981.

Sulfur (Recovered).—Recovery of elemental sulfur increased 16.7% from that of 1981. Ethyl, in Columbia County, recovered sulfur during bromine extraction at its plant near Magnolia; Phillips Petroleum Co., in Lafayette County, recovered sulfur as a byproduct of petroleum refining at its McKamie plant.

Talc.—In 1982, The Milwhite Co. Inc. significantly increased soapstone production from its Congo Pit near Benton, Saline County, over that of 1981. The company's Bryant mill processed and sold the crude ore for use in paper products and roofing.

Tripoli.—Malvern Minerals Co. Inc., in Garland County, was the State's sole tripoli producer.

Vermiculite (Exfoliated).—Crude vermiculite imported from out of State was

exfoliated by Strong-Lite at its Pine Bluff plant in Jefferson County and by W. R. Grace & Co. at its North Little Rock plant in Pulaski County. According to a company spokesman, Strong-Lite, a member of the Strong Management Group Inc., imported its vermiculite ore from the Palabora deposit in the northeast Transvaal, Republic of South Africa.[11]

In decreasing order of consumption, exfoliated vermiculite was used for texturing paint and in aggregates, insulation, agriculture, and fireproofing.

METALS

Bauxite.—Alcoa closed the year with 338 of its 1,200 hourly and salaried employees on layoff because of general economic conditions and a downturn in orders for alumina chemicals. However, because Alcoa had sufficient domestic bauxite reserves to supply its alumina plant for years to come, it remained operating while neighboring Reynolds, which had to use imported bauxite to upgrade domestic ores, considered closing its Arkansas operations.

In November 1982, Reynolds announced that it would probably close its Hurricane Creek plant in August 1983. Earlier in 1982, the company already had shut down its mining operation, for many years the largest bauxite mine in the United States. Between 1978 and 1980, ore production at Reynolds' bauxite mine decreased more than 28%, and between 1979 and March 1982, Reynolds' Arkansas work force was reduced from 3,505 to 2,166.[12]

The Hurricane Creek plant was built by the Federal Defense Plant Corp. and began operation in 1942. Reynolds leased the plant in 1946 and purchased the facility in 1949. Its closing is expected to have a drastic economic effect on the community. By year-end, Reynolds was operating its Jones Mills reduction plant at 50,000 short tons per year, or at 40% capacity, and its Hot Spring continuous rolling mill at 75% capacity. The Malvern cable plant had been closed indefinitely in September 1982, and the remaining 120 employees were laid off; when at full production, about 350 were on the Malvern plant payroll.

At Fort Smith, Norton was completing a plant that would consume 80 to 100 million pounds of sintered bauxite, which can be used as a proppant to fracture and prop open rock formations in deep (15,000-foot) gas and oil wells. Proppants can increase daily flows in gas wells by more than 700%.[13]

Table 6.—Arkansas: Mine production of bauxite and shipments from mines and processing plants to consumers in the United States

(Thousand metric tons and thousand dollars)

Year	Mine production			Shipments from mines and processing plants to consumers		
	Crude	Dry equivalent	Value[1]	As shipped	Dry equivalent	Value[1]
1978	1,778	1,446	21,103	1,734	1,483	24,230
1979	1,685	1,430	20,555	1,783	1,512	25,726
1980	1,533	1,299	19,252	1,577	1,371	24,405
1981	1,505	1,242	22,185	1,429	1,221	26,358
1982	W	W	W	1,214	1,038	25,142

W Withheld to avoid disclosing company proprietary data.
[1]Computed from selling prices and values assigned by producers and from estimates of the U.S. Bureau of Mines.

Vanadium.—Arkansas ranked last of the four States still producing vanadium in 1982. On June 15, Union Carbide Corp. closed its vanadium mine and mill in Hot Springs, Garland County, indefinitely because of reduced vanadium demand. The facility was capable of recovering 5,000 to 7,500 tons of a modified vanadium oxide per year from the vanadiferous clays in the area. Total vanadium production from Arkansas declined about 67% from that of 1981, but value per pound of V_2O_5 rose 45 cents.

[1]State Liaison Officer, Bureau of Mines, Denver, Colo.
[2]Shiras, G. Millions Divide Zinc Arguments. Boone County Headlight, Dec. 16, 1982.
[3]Bureau of Labor Statistics. Employment and Earnings. Table B-8, March 1982, pp. 66-77, and March 1983, p. 86.
[4]Arkansas Business and Economic Review. V. 16, No. 1, Summer 1983, pp. 46-47.
[5]Dunrud, C. R., and B. B. Nevins. Solution Mining and Subsidence in Evaporite Rocks in the United States. U.S. Geol. Surv. Misc. Inv. Ser. Map I-1298, 1981.
[6]Griffee, C. Panel Strips Its Staff of Regulatory Power. Arkansas Gazette, May 29, 1982, p. 4B.
[7]Arkansas Gazette. Reynolds Fears Serious Impact in Power Loss. Sept. 25, 1982.
[8]Bureau of Land Management. Public Land Statistics, 1982. U.S. Government Printing Office, Washington, D.C., 1983, pp. 118-119, 121.

[9]Ewing, C. Increased Revenue Possible; County Approves Mineral Reappraisal. El Dorado News-Times, Dec. 15, 1982.
[10]Chemical Week. In Bromine Chemicals, Stepped-Up Competition. Nov. 24, 1982, p. 11.
[11]Navarro-Monzo, J. Strong Management Group Inc., Pine Bluff, written cummunication, Apr. 7, 1983.
[12]Argall, G. O., and P. Rapalus. United States Open Pit and Underground Mine Tonnages. World Min., v. 35, No. 9, September 1982, pp. 66-71.
[13]American Metal Market. Bauxite Use in Oil Fields Seen Leveling. Feb. 12, 1982.

Table 7.—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 Industries Inc., Baroid Div.:	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.[2]	Box 130 Foreman, AR 71836	Plant	Little River.
Ideal Cement Co., a subsidiary of Ideal Basic Industries Inc.[3]	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	Pits and plant	Crittenden and Lonoke.
Eureka Brick & Tile Co	Box 379 Clarksville, AR 72830	Mine	Johnson.
Gypsum:			
C. W. Harrison Sr., DBA Highland Gypsum	Box 336 Lindsay, OK 73052	do	Pike.
Weyerhaeuser Co., Dierks Div	Route 4, Box 78 Nashville, AR 71852	Mine and plant	Howard.
Lime:			
Arkansas Lime Co., a subsidiary of Rangaire Corp.[4]	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:			
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 Forest City, AR 72335	Pits and plants	Calhoun, Craighead, Cross, Marion, Poinsett, St. Francis.
Industrial:			
Gifford-Hill & Co. Inc.[5]	Box 6615 Shreveport, LA 71106	Pits	Miller.
Silica Products Co. Inc	Box 248 Guion, AR 72540	Pit	Izard.
Stone:			
Granite:			
Freshour Construction Co. Inc.[6]	Box 77 Sweet Home, AR 72164	Quarry	Pulaski.
McGeorge Contracting Co. Inc	Box 7008 Pine Bluff, AR 71611	Quarries	Do.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Granite —Continued			
Minnesota Mining & Manufacturing Co.	3M Center, 223-4N-05 St. Paul, MN 55144	Quarry	Pulaski.
Limestone:			
McClinton-Anchor Co., a subsidiary of Ashland Oil Inc.	Box 756 Fayetteville, AR 72701	do	Benton and Washington.
Midwest Lime Co	Box 2608 Batesville, AR 72501	do	Independence.
Sandstone:			
Arkhola Sand & Gravel Co., a subsidiary of Ashland Oil Inc.	Box 1627 Fort Smith, AR 72901	Quarries	Crawford and Sebastian.
Ben M. Hogan Co. Inc.[7]	Box 2860 Little Rock, AR 72203	do	Fulton, Garland, Pike, 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	Box C 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 in Saline County.
[2]Also produced limestone in Little River County.
[3]Also produced limestone in Howard County.
[4]Also produced limestone in Independence and Izard Counties.
[5]Also produced construction sand and gravel in Ouachita County.
[6]Also produced limestone in Fulton County.
[7]Also produced limestone in Lawrence 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 Division of Mines and Geology, Department of Conservation, for collecting information on all nonfuel minerals.

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

California's nonfuel mineral production value declined more than 18% in 1982, to a total of $1.6 billion. The drop was attributed to a slump in construction activity, as nearly all industrial mineral output was less in 1982 than was recorded in 1981.

The continuing and deepening recession was the most important factor in the California mining industry during 1982. During this period, mineral prices hit 30-month lows, with mining companies closing mines, laying off employees, and depleting invento-

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

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
Boron minerals thousand short tons	1,481	$435,387	1,234	$384,597
Cement (portland) do	7,896	518,966	6,464	401,883
Clays do	2,309	19,118	1,762	15,642
Diatomite do	W	W	340	68,139
Gem stones	NA	300	NA	250
Gold (recoverable content of ores, etc.) troy ounces	6,271	2,882	10,547	3,965
Gypsum thousand short tons	1,456	13,948	1,088	10,614
Lime do	472	26,834	364	23,000
Mercury 76-pound flasks	85	35	—	—
Perlite thousand short tons	36	1,044	W	W
Pumice do	98	1,501	59	1,285
Sand and gravel:				
Construction do	e107,200	e352,100	81,147	270,995
Industrial do	2,150	28,269	2,317	28,703
Silver (recoverable content of ores, etc.) thousand troy ounces	53	560	34	271
Stone:				
Crushed thousand short tons	34,560	118,698	p28,500	p105,400
Dimension do	29	1,909	p29	p1,895
Talc and pyrophyllite do	2111	25,855	85	1,699
Combined value of asbestos, calcium chloride, carbon dioxide, cement (masonry, 1982), copper, feldspar, iron ore, lead, magnesium compounds, molybdenum, peat, 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	293,855
Total	XX	r1,973,716	XX	1,612,193

eEstimated. pPreliminary. 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 pyrophyllite; value included with "Combined value" figure.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Alameda	W	W	Salt, stone (crushed), clays.
Alpine	$591	$242	Gold, silver, lead, zinc, copper.
Amador	13,654	W	Sand and gravel (industrial), stone (crushed), clays.
Butte	4,823	(3)	
Calaveras	56,179	50,739	Cement (portland), asbestos, stone (crushed), gold, clays, copper.
Colusa	W	(3)	
Contra Costa	W	14,872	Stone (crushed), sand and gravel (industrial), lime, clays.
Del Norte	W	58	Stone (crushed).
El Dorado	W	W	Stone (crushed), talc.
Fresno	15,466	623	Gold, stone (dimension), clays, stone (crushed), silver.
Glenn	W	W	Lime.
Humboldt	3,406	207	Stone (crushed).
Imperial	W	W	Gypsum, lime.
Inyo	35,174	52,871	Tungsten, boron minerals, talc, stone (crushed), molybdenum, perlite, copper, silver, gold, pumice, clays, lead, zinc.
Kern	433,458	129,495	Cement (portland), stone (crushed), gypsum, clays, carbon dioxide, silver, stone (dimension), gold.
Kings	W	W	Gypsum.
Lake	W	1,033	Stone (crushed), mercury.
Lassen	2,384	303	Stone (crushed).
Los Angeles	64,781	4,936	Stone (crushed), lime, clays, stone (dimension), tungsten.
Madera	9,440	9,514	Tungsten, stone (dimension), stone (crushed), pumice.
Marin	W	W	Stone (crushed), clays.
Mariposa	W	73	Stone (crushed), stone (dimension).
Mendocino	1,546	(3)	
Merced	1,825	(3)	
Modoc	W	W	Peat, stone (crushed), pumice.
Mono	1,019	1,427	Pumice, stone (crushed), tungsten, clays, pyrophyllite, gold, silver.
Monterey	61,058	19,407	Lime, magnesium compounds, stone (crushed), sand and gravel (industrial).
Napa	W	W	Salt, stone (crushed), stone (dimension).
Nevada	W	W	Stone (crushed), clays.
Orange	22,166	6,154	Sand and gravel (industrial), feldspar, stone (crushed), clays.
Placer	W	W	Clays, stone (dimension), stone (crushed), gold.
Plumas	W	W	Stone (dimension), stone (crushed), copper, silver.
Riverside	W	118,703	Iron ore, cement (portland), stone (crushed), clays, wollastonite, stone (dimension), gypsum.
Sacramento	19,069	W	Clays, gold.
San Benito	W	16,394	Stone (crushed), asbestos, clays.
San Bernardino	488,269	851,888	Boron minerals, cement (portland), sodium carbonate, rare-earth metal, sodium sulfate, potassium salts, stone (crushed), lime, calcium chloride, clays, salt, gold, sand and gravel (industrial), feldspar, gypsum, talc, iron ore, stone (dimension), silver, tungsten, lead, copper, zinc.
San Diego	51,867	14,263	Sand and gravel (industrial), stone (crushed), gypsum, salt, magnesium compounds, stone (dimension), clays, tungsten.
San Joaquin	12,764	1,155	Lime, gold, peat, silver.
San Luis Obispo	W	W	Stone (crushed), gypsum, stone (dimension).
San Mateo	W	W	Magnesium compounds, salt, stone (crushed).
Santa Barbara	W	73,622	Diatomite, lime, stone (crushed), stone (dimension).
Santa Clara	W	W	Cement (portland), stone (crushed).
Santa Cruz	W	31,025	Cement (portland), stone (crushed), sand and gravel (industrial), clays.
Shasta	W	W	Cement (portland), clays, stone (crushed).
Sierra	W	W	Gold.
Siskiyou	1,353	W	Stone (crushed), pumice.
Solano	1,646	W	Stone (crushed).
Sonoma	11,493	1,872	Do.
Stanislaus	W	266	Gold, clays, silver.
Sutter	W	W	Stone (crushed), clays.
Tehama	1,192	208	Stone (crushed).
Trinity	W	530	Stone (crushed), gold, silver.
Tulare	W	W	Stone (crushed), tungsten.
Tuolumne	W	W	Lime, stone (crushed).
Ventura	W	7,501	Clays, sand and gravel (industrial), stone (crushed), gypsum.

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Yolo	W	W	Lime, sand and gravel (industrial).
Yuba	W	W	Stone (crushed), clays.
Undistributed[4]	$557,226	$212,239	
Sand and gravel (construction)	XX	[e]352,100	
Total[5]	1,871,856	1,973,716	

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.
[1]San Francisco County was not listed because no nonfuel mineral production was reported.
[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 mercury that cannot be assigned to specific counties and values indicated by symbol W.
[5]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of California business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	11,811.0	12,189.0	+3.2
Unemployment	do	874.0	1,211.0	+38.6
Employment (nonagricultural):				
Mining[1]	do	49.2	50.1	+1.8
Manufacturing	do	2,022.7	1,928.4	-4.7
Contract construction	do	427.7	366.1	-14.4
Transportation and public utilities	do	554.8	543.1	-2.1
Wholesale and retail trade	do	2,301.6	2,275.4	-1.1
Finance, insurance, real estate	do	642.9	645.1	+.3
Services	do	2,241.0	2,284.0	+1.9
Government	do	1,756.5	1,733.2	-1.3
Total nonagricultural employment[1]	do	[2]9,996.3	9,825.4	-1.7
Personal income:				
Total	millions	$289,584	$310,097	+7.1
Per capita		$11,968	$12,543	+4.8
Construction activity:				
Number of private and public residential units authorized		104,927	85,423	-18.6
Value of nonresidential construction	millions	$7,834.3	$7,122.8	-9.1
Value of State road contract awards	do	$300.0	$390.0	+30.0
Shipments of portland and masonry cement to and within the State	thousand short tons	[3]7,268	6,034	-17.0
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,973.7	$1,612.2	-18.3
Value per capita, resident population		$83	$65	-21.7
Value per square mile		$12,446	$10,159	-18.4

[p]Preliminary.
[1]Includes oil and gas extraction.
[2]Data do not add to total shown because of independent rounding.
[3]Portland only.

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

ries. The decrease in the reported 1982 mineral output value followed more than a decade of steadily rising values of each year's output.

Despite the drop in production, California remained the Nation's leading producer of asbestos, boron minerals, diatomite, rare-earth metal concentrate, and tungsten ore and concentrate, and ranked second among the States in total value of nonfuel mineral production. Portland cement was the leader in dollar value in the State, closely followed by boron minerals and sand and gravel. The leading mineral-producing counties were San Bernardino and Kern.

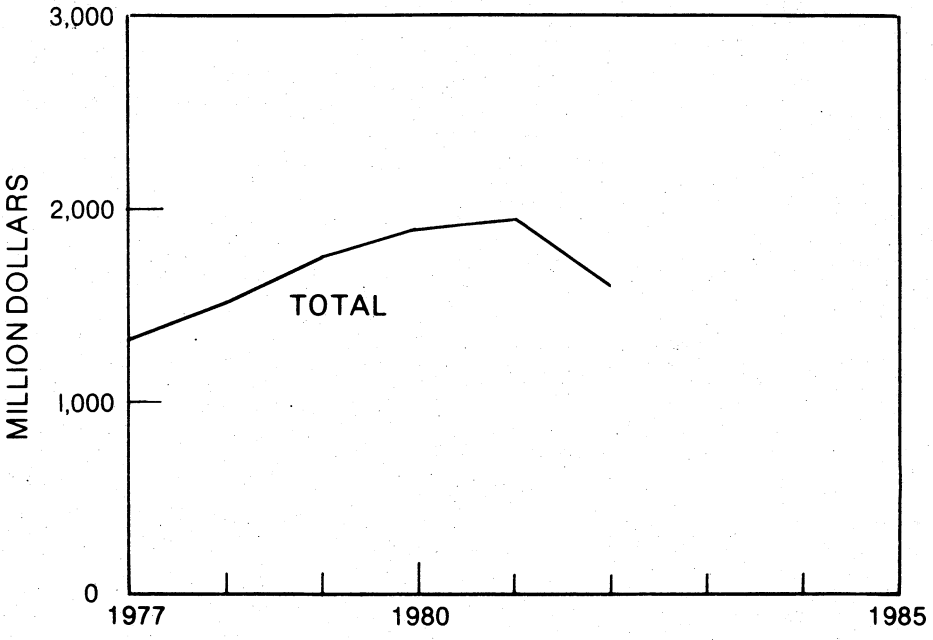

Figure 1.—Total value of nonfuel mineral production in California.

Trends and Developments.—Kerr-McGee Chemical Corp. began closing its 60-year-old Trona plant in San Bernardino County in April and laid off nearly 500 employees. High energy costs were blamed for the closure. Production continued at reduced rates for anhydrous borax and boric acid at the company's neighboring Argus and Westend plants. Sulfate production remained at the same level as that of 1981. U.S. Borax and Chemical Corp., a subsidiary of the United Kingdom-based Rio Tinto Zinc Corp. Ltd., also laid off 107 employees in April in Kern County, citing declining boron minerals sales, but began recalls a month later as demand improved.

The Calaveras Cement Co., a division of Genstar Cement & Lime Co., laid off 65 workers in December from its Mountain Gate plant in Calaveras County because of slow market conditions; the plant normally employs 117. General Portland Inc. shut down the kiln at its Los Robles cement plant near Lebec (Kern County) in June.

Davidson Brick Co. contracted with the Lingel Corp. of Paris, Tenn., to build a new plant in Pervis, near Riverside, Calif. The plant, targeted for completion in the spring of 1983, was to produce about 300 tons per day of large, hollow block.

Molycorp Inc. began production of high-purity, rare-earth oxides from its new $15 million separation plant at Mountain Pass in San Bernardino County. The new circuits will enable the production of samarium and gadolinium oxides.

Early in the year, Kaiser Steel Corp. announced a $400 million purchase agreement for its facilities by an investor group. After the offer was withdrawn in March, Kaiser Steel began to entertain options on the feasibility of selling the company to its employees. Reductions in the work force at the Kaiser Steel Fontana plant were put into effect throughout the year, as Kaiser Steel temporarily stopped steelmaking and announced plans to lay off more than 875 workers. In May, the Kaiser Steel work force was reduced to 3,800 people when 400 steelworkers were laid off. Additional layoffs were announced in June and October, as shutdowns of the coke plant, steelmaking shop, caster, soaking pits, slabbing mill, and foundry commenced.

United States Steel Corp. modified the production line at its Pittsburg, Calif., facility to permit the production of tin-free steel used on the ends of cans.

Bethlehem Steel Corp. announced in September the closing of its Los Angeles mill by yearend because of poor profit performance. The Bethlehem plant, which had been in operation since 1930, was running at less than 40% of capacity in recent months.

An increase in price stimulated interest in continuing development work through-

out the year of numerous gold and silver prospects in California. Development by Noranda Mines Ltd. began at the Gray Eagle Mine north of Happy Camp, in Siskiyou County, on a recently discovered disseminated gold ore body. Mother Lode Gold Mines Consolidated announced that a drilling program increased the reserves of its Mountain King-Royal group of mines near Copperopolis in Calaveras County to 639,000 ounces of gold.

The Keynot Mine, located 7 miles northeast of Lone Pine in a remote part of the Inyo Mountains, was developed using helicopter transportation. A complete mill and all earthmoving machinery were flown in.

Exploration Activities.—Rising prices at yearend fueled the continuing interest in gold exploration and development throughout the State. California's southeastern corner experienced an exploration boom. Gold Fields Mining Corp. explored the Mesquite Project northeast of Glamis, in Imperial County. The old Picacho Mine south of Picacho, in Imperial County, was reopened as an open pit, cyanide heap leach gold operation by Chemgold Inc. A 390,000-acre area in the Chemehuevi Valley south of Needles, in San Bernardino County, was explored by three Canadian companies.

Homestake Mining Co. completed exploration drilling on its McLaughlin gold project that spans parts of Napa, Lake, and Yolo Counties. Standard Metals Corp. drilled and sampled the Monumental Mine in Del Norte County near the Oregon border. Placer Services Corp. continued drilling on an unmined portion of a Tertiary auriferous channel on San Juan Ridge in Nevada County.

Additional exploration was reported at the Primrose Mine in Sierra County, the Cajon property in San Bernardino County, the Rich Gulch Prospect in Plumas County, the Jumbo gold property in Amador County, the Indian Gulch property in Mariposa County, and the Ruby Mine in Sierra County, where development work was completed and mining begun.

Newmont Mining Co. explored for low-grade mineralization in the vicinity of the Cargo Muchacho deposit in southeastern California.

California Silver Ltd. continued with an extensive exploration and development program at the Zaca gold-silver property in Alpine County. Sunshine Mining Co. explored for silver in Plumas and Sierra Counties and in the Washington district.

Legislation and Government Programs.—Policy for surface mining and reclamation practice was reviewed and filed in compliance with requirements of the Administrative Procedures Act, Assembly bill 1111. Changes were submitted to the State Office of Administrative Law in February 1982 for incorporation into the Administrative Code. The State Mining and Geology Board began implementation of the California Surface Mining and Reclamation Act (SMARA). Regionally significant sand and gravel deposits were designated in western Ventura County and Simi Valley. Designations were also started in Orange County, San Gabriel Valley, and San Diego County. A completed classification report on an important Monterey County limestone deposit was adopted and transmitted by the Board to Monterey County. A pilot report classifying mineral resources in the Mother Lode mineral belt was completed as part of the new Non-urban Classification Program.

A 5-year Mine Lands Reclamation Work Plan was approved in July by the SMARA board. Review began on the approximately 1,500 active mines in California, which are now regulated under SMARA.

Surveys were conducted under the Roadless Area Resource Evaluation Program (RARE II) of the U.S. Forest Service. A report was completed on the mineral investigation of the Orleans Mountains RARE II area in Humboldt and Siskiyou Counties.

The U.S. Department of the Interior's Bureau of Land Management distributed more than $35.6 million to California as its share of Federal mineral leasing receipts received during 1982.

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 $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Asbestos.—California remained the leading U.S. producer of asbestos from mines in Calaveras and San Benito Counties. Calaveras Asbestos Corp.'s operation in Calaveras County and Union Carbide Corp.'s Santa Rita Mine in San Benito County continued to be the main producers.

Manville Products Corp. closed its asbestos-cement pipe plant at Carson, citing drop off in demand due to substitution of plastic

pipe for company products.

Boron Minerals.—U.S. Borax operated a processing plant in Kern County that continued to supply the major portion of the Nation's domestic boron production. Kerr-McGee operated its Trona and Westend plants for part of the year in San Bernardino County. American Borate Corp. mined colemanite and ulexite from Inyo County.

U.S. Borax signed an $18 million contract with Westinghouse Electric Corp. for a combustion turbine powerplant to supply power for U.S. Borax's planned cogeneration facility in Boron. The cogeneration plant was scheduled to be in operation early in 1984 and expected to produce more than 46 megawatts of electricity annually.

Calcium Chloride.—Natural calcium chloride was reported from three producers 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. Reported portland cement output from 12 plants indicated a decline of about 18% in production from that of 1981.

Manifast Holdings S.A. purchased 9.5% of Kaiser Cement Corp. for a reported $12.5 million. Kaiser Cement completed a $150 million modernization and expansion of its Lucerne Valley cement plant in December. California Portland Cement Co. completed construction in April on its $15.8 million finish grinding project at the Colton plant, with the installation of two new grinding mills.

Genstar Cement announced the first phase of a $50 million modernization and expansion program at its San Andreas plant near Redding. New finish grinding mills and a new kiln are expected to help boost production to more than 700,000 short tons per year.

A 5-1/2-week strike against the concrete industry by cement truck drivers in April and May affected companies that produce over 80% of the concrete used in southern California.

Table 4.—California: Portland cement salient statistics

(Short tons unless otherwise specified)

	Northern California		Southern California		California total	
	1981	1982	1981	1982	1981	1982
Number of active plants	4	4	8	8	12	12
Production	2,297,212	2,098,925	5,581,393	4,407,999	7,878,605	6,506,924
Shipments from mills:						
Quantity	2,413,013	2,038,845	5,483,060	4,425,111	7,896,073	6,463,956
Value	$152,933,399	$117,990,376	$366,032,893	$283,892,542	$518,966,292	$401,882,918
Stocks at mills, Dec. 31	234,863	286,051	304,272	291,693	539,135	577,744

Clays.—Production of more than 1.8 million short tons of clay and shale was reported from 76 mines. Common clay and shale comprised the bulk of the clays produced, with smaller amounts of kaolin, fire clay, ball clay, and bentonite.

Lone Star Industries Inc. and Lightweight Processing Co. were the State's leading producers of common clay from quarries in Santa Cruz and Ventura Counties. Additional important producers included Genstar Cement, Shasta County, and Excel Minerals Co., Kern County. The leading bentonite producer in California was Lowes Inc. of Kern County. Standard Industrial Minerals Co. was the leading producer of kaolin, and Southern Clay Co. of California Inc. was the leading producer of nonswelling bentonite.

The majority of all clays produced was used in the manufacture of construction materials, except for bentonite, which was used in oil well drilling. Bentonite production increased slightly in California despite a precipitous drop in world drilling activities for oil and gas at midyear attributed to a continued depression in the oil industry.

NL Industries Inc. mined and processed hectorite, an unusual lithium-bearing clay, southeast of Newberry Springs, near Hector in San Bernardino County. The deposit continued to be the world's only source for the material used in the production of water-based paints, printing ink, grease, ceramics, cosmetics, pharmaceuticals, and malt beverage stabilizers.

Diatomite.—California led the Nation in diatomite production in 1982, producing 55% of the total. Santa Barbara County accounted for most of the production. A

smaller amount was recorded from Lassen County. Manville Products continued to be the State's major producer from deposits near Lompoc in Santa Barbara County.

Freshwater diatomite deposits at Lake Britton, Shasta County, were mined and sold to the Genstar Cement plant near Redding.

Feldspar.—Total State output was derived from three operations in 1982. Flotation concentrates were recovered at the Crystal Silica Co.'s Oceanside plant in San Diego County. Feldspar-silica mixtures were reported from the Owens-Illinois Inc. Mission Viejo operation in Orange County and Calspar Corp.'s Santa Fe Springs plant in Los Angeles County.

Graphite (Synthetic).—California ranked eighth in the Nation in the production of synthetic graphite, reporting 2% of the total national output. Great Lakes Carbon Corp. produced most of the synthetic graphite in the State from Kern County.

Gypsum.—Despite a 6% increase in byproduct gypsum output, a 25% decrease in crude gypsum production and a 12% decrease in calcined gypsum production dropped California's ranking among the States to second among calcined gypsum producers and fourth among crude gypsum producers.

Seven producers reported calcined gypsum production from Alameda, Contra Costa, Imperial, and Los Angeles Counties. Major producers included United States Gypsum Co., National Gypsum Co., and Domtar Gypsum America Inc.

Crude gypsum output was reported from 10 producers in Imperial, Kern, King, Riverside, San Bernardino, San Diego, San Luis Obispo, and Ventura Counties. The bulk of the production was from United States Gypsum in Imperial County and H. M. Holloway Inc. in Kern County.

Lime.—California regained its position as the 12th largest lime producer among the States despite 1982 declines of 23% in output and 14% in value from that reported in 1981. Quicklime shipments, sold or used, from 10 counties were reported by 8 companies throughout the State. The Kaiser Aluminum & Chemical Corp.'s Natividad plant in Monterey County was the largest producer. Other important producers included Kerr-McGee, Genstar Cement, Holly Sugar Corp., and Amstar Corp.

Magnesium.—Magnesia refractories were produced from dolomite and seawater by Kaiser Aluminum 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.

Peat.—Peat production in 1982 declined from that reported in 1981. Radel Inc. in Modoc County and Delta Humas Co. in San Joaquin County were the principal producers. Consumption was primarily by nurseries.

Perlite (Expanded).—American Perlite Co.'s Fish Springs Mine in Inyo County was the sole California source of crude perlite during 1982. Expanded perlite was processed at a total of seven plants in Los Angeles, San Bernardino, and San Diego Counties.

Potassium Salts.—California ranked third among the States in production of potassium salts. All of the production reported was muriate of potash (60% K_2O) or potassium sulfate from Kerr-McGee plants in San Bernardino County.

Kerr-McGee announced in March that it was closing its Trona plant in Searles Valley for a combination of reasons, including plant obsolescence, high energy costs, and a declining market for muriate of potash. Approximately 473 workers were laid off in April.

Pumice.—Siskiyou County was the leading producer among the five counties reporting pumice output in 1982. Inyo, Madera, Modoc, and Mono Counties also reported production during the year.

Cal Pumice Inc. operated two pits south of Haiwee Reservoir Dam in Inyo County. The pumice was hauled to the Los Angeles area for use as aggregate in concrete blocks and as a soil amendment.

Salt.—The value of California's salt production increased nearly 7% over that of 1981, although only a 2% increase in production was reported. Cargill reported the largest output, from plants in Alameda, Napa, San Bernardino, and San Mateo Counties. Additional output was reported by Oliver Bros. Salt Co. in Alameda County, Western Salt Co. in San Diego County, and, in San Bernardino County, by National Chloride and Pacific Salt and Chemical Co.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. Construction sand and gravel production in 1982 was 24% lower than that reported in 1981. Production was reported from 260 operations throughout the State. Lone Star's

Pacific Region, Conrock Co. Inc., and Koppers Co. Inc.'s Kaiser Sand & Gravel Co. were the largest producers. Major uses were for road building and construction aggregate. More than 1 million tons of sand and gravel production was reported from each of 14 construction sand and gravel operators.

The decline in the construction industry throughout California was reflected in the 24% drop in quantity and 21% drop in value of sand and gravel produced in 1982 compared with that of 1981.

Industrial.—Production was 8% higher in 1981 and was reported from 12 operations in 9 counties. Owens-Illinois, Martin Marietta Corp., and Ottawa Silica Co. were the leading producers of industrial sand and gravel. The four largest operations each produced more than 200,000 tons. Industrial sand was used principally in fiberglass, glass containers, flat glass manufacture, and blasting.

Table 5.—California: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	36,551	$125,672	$3.44
Plaster and gunite sands	2,074	8,347	4.02
Concrete products	3,822	12,421	3.25
Asphaltic concrete	14,869	53,312	3.59
Road base and coverings[1]	17,328	54,725	3.16
Fill	4,781	10,630	2.22
Snow and ice control	192	575	2.99
Railroad ballast	153	517	3.39
Other	1,377	4,796	3.48
Total or average	81,147	270,995	3.34

[1]Includes road and other stabilization (cement and lime).

Table 6.—California: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	31,808	$105,579	$3.32
Gravel	NA	NA	NA	45,010	155,375	3.45
Sand and gravel (unprocessed)	NA	NA	NA	4,328	10,041	2.32
Total or average	e107,200	e$352,100	e$3.28	[1]81,147	270,995	3.34
Industrial sand	2,150	28,269	13.15	2,317	28,703	12.39
Grand total or average	e109,350	e380,369	e3.48	83,464	299,698	3.59

eEstimated. 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 1982. All sodium sulfate output came from plants in San Bernardino County operated by Kerr-McGee.

Kerr-McGee also produced soda ash at its Westend and Argus plants in San Bernardino County.

Lake Minerals Corp., a subsidiary of Cominco American Inc., produced crude sodium carbonate from the surface of Owens Lake in Inyo County. The total production from this operation was used at U.S. Borax's boric acid plant at Boron, Kern County.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year. In view of the above, the principal producers shown for stone in table 10 are based on 1981 data.

Based on the preliminary estimates, output of crushed stone declined 18%, and value, 11%, from that reported in 1981. The

quantity and value of dimension stone reported for 1982 remained nearly the same as the 1981 figures.

Kaiser Aluminum produced crushed dolomite for concrete aggregate, landscaping rock, and roofing granules at the Natividad plant in Monterey County. Crushed dolomite was also produced from the Inyo Mountains east of Lone Pine, in Inyo County.

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. Total 1982 production of nearly 494,000 metric tons was an increase of about 4% over that of 1981. California ranked third in the Nation for recovered sulfur shipped in 1982. Chevron U.S.A. Inc.'s refinery at El Segundo, Los Angeles County, was the largest producer.

Talc and Pyrophyllite.—California ranked fifth among the States in production of talc and pyrophyllite in 1982. Output declined 25%, and value, 71%, from that reported in 1981. Production of talc was principally from Inyo and San Bernardino Counties, as well as from El Dorado, Los Angeles, Calaveras, and Sacramento Counties. Crude talc production was reported from 13 mines. Pfizer Inc., Cyprus Industrial Minerals Co., and Western Source Inc. were the principal producers.

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).—Production of exfoliated vermiculite decreased 15% from that of 1981, although value remained nearly constant. W. R. Grace & Co. produced all of California's vermiculite from plants in Newark (Alameda County) and Santa Ana (Orange County). California dropped to third among the States in production of exfoliated vermiculite in 1982. Almost two-thirds of the vermiculite output was used in fireproofing.

Wollastonite.—Pfizer was the State's sole producer of wollastonite from Riverside County. Output decreased 54% from that reported in 1981.

Zeolites.—A naturally occurring zeolite quarry near Barstow, San Bernardino County, was purchased by the Phelps Dodge Corp. from Occidental Minerals Corp. Clinoptilolite from the quarry was shipped to the United Kingdom for use in nuclear waste cleanups at powerplants.

Anaconda Minerals Co. suspended all of its zeolite operations in California, including the operation of a zeolite mine on the California-Nevada border, at Ash Meadows.

METALS

Chromium.—There was no reported chromite production in California in 1982. Interest continued in chromium properties in the northern portion of the State. Noranda Exploration Inc. was reportedly examining properties near the California-Oregon border. California Nickel Corp. investigated procedures for extracting chromite from nickel-laterite ores at its Gasquet Mountain project in Del Norte County.

Copper.—California's copper production declined 57%, as the shutdown of the Pine Creek Mine in Inyo County resulted in less byproduct copper from the principal producer, Union Carbide. Byproduct copper from gold and silver production was reported from seven mines. Despite its closure in early August, the Pine Creek Mine remained as California's principal producer. The additional six mines in Alpine, Calaveras, Inyo, Plumas, and San Bernardino Counties accounted for less than 5% of the total production.

Gold.—Although the number of lode operations active in 1982 dropped to 11 from the 15 reported in 1981, total lode and placer gold production increased 68%, and value, 38%, despite a decline in the average yearly price of gold. Placer production increased nearly 250%, with a total of six placer locations reported in Del Norte, Plumas, Sierra, Siskiyou, and Yuba Counties. California ranked 11th among the gold-producing States.

Homestake Mining filed its first application in September to begin construction on its surface mining facility near Knoxville. The company announced plans to process ore from an estimated 30-million-ton ore body at a 3,000-short-ton-per-day mill in Napa County. The ore body reportedly contains at least 3.2 million ounces of gold with an average grade of 0.16 ounce per ton.

Placer Services, a subsidiary of St. Joe Minerals Corp., filed an application to extract gold from a 500-acre site on San Juan Ridge in Nevada County.

Table 7.—California: 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
1980, total	7	2	7,856	4,078	$2,498,020	49,257	$1,016,666
1981, total	15	2	27,451	6,271	2,882,403	53,286	560,482
1982:							
Del Norte	--	1	--	W	W	--	--
El Dorado	1	--	W	W	W	--	--
Fresno	--	--	--	W	W	W	W
Inyo	4	--	1,582	368	138,335	W	W
Kern	1	--	W	W	W	W	W
Mono	1	--	W	W	W	W	W
Plumas	--	1	--	30	11,277	--	--
Riverside	1	--	W	W	W	--	--
San Bernardino	2	--	30,663	1,595	599,577	2,046	16,266
San Joaquin	--	--	W	W	W	W	W
Shasta	--	--	W	--	--	--	--
Sierra	--	2	--	W	W	--	--
Siskiyou	--	1	--	31	11,653	--	--
Stanislaus	--	--	--	W	W	W	W
Trinity	1	--	W	W	W	W	W
Yuba	--	1	--	W	W	W	W
Total	11	6	[3]35,791	[3]10,547	[3]3,964,725	[3]34,048	[3]270,683

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1980, total	W	W	W	W	--	--	$3,844,945
1981, total	W	W	W	W	W	W	3,993,128
1982:							
Del Norte	--	--	--	--	--	--	W
El Dorado	--	--	--	--	--	--	W
Fresno	--	--	--	--	--	--	W
Inyo	W	W	W	W	--	--	[3]472,317
Kern	--	--	W	W	--	--	W
Mono	--	--	--	--	--	--	W
Plumas	--	--	--	--	--	--	11,277
Riverside	--	--	--	--	--	--	W
San Bernardino	W	W	W	W	--	--	[3]616,294
San Joaquin	--	--	--	--	--	--	W
Shasta	W	W	--	--	--	--	W
Sierra	--	--	--	--	--	--	W
Siskiyou	--	--	--	--	--	--	11,653
Stanislaus	--	--	--	--	--	--	W
Trinity	--	--	--	--	--	--	W
Yuba	--	--	--	--	--	--	W
Total	W	W	W	W	--	--	[3]4,437,137

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.

Table 8.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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	60	--	--	--	--
Cyanidation	1,017	1,000	--	--	--
Smelting of concentrates[1]	1,238	26,010	W	W	--
Direct smelting of:					
Ore	434	6,849	W	W	--
Precipitates	--	--	W	--	--
Total lode material	2,749	33,859	W	W	--
Placer	7,798	189	--	--	--
Grand total	10,547	34,048	W	W	--

W Withheld to avoid disclosing company proprietary data.
[1]Includes byproduct recovery from tungsten ore.

Table 9.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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]	9	34,694	2,733	7,869	W	W	--
Gold-silver	1	W	16	W	--	W	--
Silver	1	W	--	W	--	--	--
Total	11	W	2,749	W	W	W	--
Other lode material:							
Copper precipitates	--	W	--	--	W	--	--
Tungsten ore	--	--	--	W	W	--	--
Total lode	11	[4]35,791	2,749	[4]33,859	W	W	--
Placer	6	--	7,798	189	--	--	--
Grand total	17	[4]35,791	10,547	[4]34,048	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 iron ore declined 42% from that of 1981, principally because the closure of Kaiser Steel's Eagle Mountain Mine and concentrating plants reduced operations at Kaiser Steel's Fontana plant. California Portland and Standard Slag Co. shipped minor amounts of crude ore from the Baxter and Beck Mines in San Bernardino County.

Lead.—Only a small amount of lead production was reported in the State during 1982, as California's already small output dropped by more than 72%. The lead was recovered as a byproduct from four gold and silver producers in Inyo, Kern, and San Bernardino Counties.

Mercury.—With the cessation of production from the Knoxville Mine in Lake County, no mercury mine production was reported in California for the first time since 1849.

The Idria Land & Development Co. Inc. began processing 7 million short tons of mercury tailings for what was described as micron gold; the tailings were from the New Idria Quicksilver Mining Co. in San Benito County.

Molybdenum.—All of California's molybdenum production was derived as a byproduct from Union Carbide's tungsten ore mining at the Pine Creek Mine in Inyo County. That production essentially ceased when the mine was closed in early August.

Rare-Earth Metal Concentrate.—Rare-earth oxides (REO) from the Molycorp Mountain Pass bastnaesite deposit in San Bernardino County continued to be the major source of the Nation's rare-earth metal concentrate production. Molycorp, a subsidiary of Union Oil Co. of California, reported production of 17,500 metric tons of REO contained in bastnaesite concentrates in its 1982 annual report. Molycorp completed installation of separation circuits at its new $15 million separation plant and began production during the year of samarium and gadolinium oxides from REO concentrate.

Silver.—Output of silver was 36% lower, and value, 52% less, than that reported in 1981. Union Carbide's Pine Creek Mine in Inyo County was still the principal source of silver, but closure of that mine in the second half of the year resulted in a reduction of silver output. Placer silver was recovered from six dragline dredging operations in Fresno, San Joaquin, and Stanislaus Counties and one bucketline operation in Yuba County. Byproduct silver from lode gold mining was also reported from eight lode mines. The Beauregard Mine in Mono County and the Telegraph Mine in San Bernardino County were significant producers of silver from lode gold and silver mining.

Anaconda Minerals began milling operations in March to recover silver from old Darwin mill tailings in Inyo County, only to shut down in November because of the low silver price.

Tungsten Ore and Concentrate.—Despite a more than 56% reduction in tungsten ore and concentrate shipments and a decline of

68% in value, California remained the number one tungsten producer among the States, as other tungsten-producing areas were similarly affected by the nationwide drop in tungsten demand.

Union Carbide's Pine Creek Mine near Bishop, in Inyo County, was closed from early August through yearend. Normally the Nation's largest producer, the mine operated at a reduced capacity from April until its closure. The adjoining paratungstate mill was closed from mid-April through late December. The closures were attributed to lower prices and the lack of a market from the depressed carbide industry.

Teledyne Tungsten's Strawberry Mine and mill near North Fork, in Madera County, produced tungsten ore and concentrate except when it was closed for the winter.

Small mine operators in Inyo, Kern, Los Angeles, Mono, San Bernardino, and San Diego Counties shipped scheelite concentrates to tungsten processors.

The U.S. Bureau of Mines developed a new resin, QRF 8-hydroxy-guinoline-resorcinol-formaldehyde, to economically extract tungsten from the brines of Searles Lake, the largest single known tungsten resource in the United States. In pilot-plant tests on over 50,000 tons of brine, 91% of the contained tungsten was consistently recovered.

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[2]State geologist and Director, California Division of Mines and Geology, Sacramento, Calif.
[3]Associate geologist, California Division of Mines and Geology, Sacramento, Calif.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Calaveras Asbestos Corp	Box 127 Copperopolis, CA 95228	Open pit mine	Calaveras.
Union Carbide Corp., Metals Div	Box K King City, CA 93930	do	San Benito.
Boron minerals:			
Kerr-McGee Chemical Corp.[1]	1406 McGee Tower Oklahoma City, OK 73102	Evaporators	San Bernardino.
U.S. Borax and Chemical Corp	Box 75128 Sanford Station Los Angeles, CA 90010	Open pit mine	Kern.
Calcium chloride:			
Leslie Salt Co.,[2] a subsidiary of Cargill Inc.	Box 5621 Minneapolis, MN 55440	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	300 Lakeside Dr. Oakland, CA 94612	do	Do.
Clays:			
Allied Chemical Div., North American Refractories Co.	3502 Breakwater Ct. Haywood, CA 94545	Pits	Amador.
Excel Minerals Co.[4]	Cymric Rd. McKittrick, CA 93251	Pit	Kern.
Lightweight Processing Co	715 North Central Ave. Suite 321 Glendale, CA 91203	Pits	Ventura.
Port Costa Materials Inc	Box 5 Port Costa, CA 94569	Pit	Contra Costa.
Diatomite:			
Manville Products Corp	2500 Miguelito Rd. Lompoc, CA 93436	Open pit mine	Santa Barbara.
Feldspar:			
Owens-Illinois Inc.[5]	Box 248 31302 Ortega Hwy. San Juan Capistrano, CA 92675	Pit	Orange.
Gold:			
Cascade Energy & Metals Corp.[6]	6101 South 9th East Salt Lake City, UT 84121	Mine	San Bernardino.
Vanderbilt Gold Corp., Cactus Hill Ventures.[7]	Nipton, CA 92364	do	Do.
Gypsum:			
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	Quarries and plants.	Contra Costa and Los Angeles.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	Quarry and plants.	Imperial and Los Angeles.
Iron ore:			
Kaiser Steel Corp	Box 158 Eagle Mountain, CA 92241	Surface mine	Riverside.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lime:			
Kaiser Aluminum & Chemical Corp.[8]	Box 1938 Salinas, CA 93901	Mine and plant	Monterey.
Perlite:			
American Perlite Co	11831 Vose St. North Hollywood, CA 91605	Open pit mine	Inyo.
Pumice:			
Tionesta Aggregates Co	13290 Hodge Dr. Reno, NV 89511	do	Siskiyou.
Sand and gravel:			
Basalt Rock Co. Inc	Box 2540 Napa, CA 94558	Pits	Various.
Conrock Co. Inc	Box 2950, Terminal Annex Los Angeles, CA 90051	do	Do.
Gulf + Western Industries Inc., Livingston-Graham Div.	16080 East Arrow Hwy. Irwindale, CA 91706	do	Do.
Koppers Co. Inc., Kaiser Sand & Gravel Co.	Box 580 Pleasanton, CA 94566	do	Do.
Lone Star Industries Inc., Pacific Region.[9]	2800 Campus Dr. San Mateo, CA 94403	do	Do.
Owl Rock Products Co	Box 330 Arcadia, CA 91006	do	Do.
A. Teichert & Sons Inc., Teichert Aggregates.	3500 American River Dr. Sacramento, CA 95813	do	Do.
Transit Mix Concrete	Box 54423 4760 Valley Blvd. Los Angeles, CA 91702	do	Do.
Silver:			
Don Beauregard[10]	Box 702 Bishop, CA 93514	Mine	Mono.
Stone:			
Gifford-Hill & Co. Inc., Riverside Cement Div.[5]	Box L Oro Grande, CA 92368	Quarries	Various.
Granite Rock Co	Box 151 Watsonville, CA 95076	Quarry	San Benito.
Koppers Co. Inc., South Coast Asphalt Products Co.	Box 218 Carlsbad, CA 92008	Quarries	San Diego.
Southwestern Portland Cement Co.[9]	Box 937 Victorville, CA 92392	do	San Bernardino.
Talc and pyrophyllite:			
Pfizer Inc.[11]	17092 D St. Victorville, CA 92392	Open pit mines	Inyo.
Western Source Inc	Box 280 San Andreas, CA 95249	Open pit mine and mill.	Calaveras.
Tungsten ore and concentrate:			
Teledyne Tungsten	4709 North El Capitan Ave. Suite 109 Fresno, CA 93711	Underground mine.	Madera.
Union Carbide Corp., Metals Div.[12]	Route 2 Bishop, CA 93514	Underground mine and plant.	Inyo.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plants	Alameda and Orange.

[1]Also lime, potassium salts, soda ash, and sodium sulfate.
[2]Also salt.
[3]Also clays, gypsum, and iron ore.
[4]Also diatomite.
[5]Also industrial sand and gravel.
[6]Also silver.
[7]Also copper, lead, and silver.
[8]Also magnesium.
[9]Also cement and clays.
[10]Also gold.
[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 mineral production in Colorado in 1982 was $437.5 million, nearly 55% less than the 1981 value. This was the second consecutive year that nonfuel minerals production decreased in value after 10 years of steady increases. The entire difference between the 1982 level of output and that of 1981 was in lower output and value of molybdenum, Colorado's premier mineral. Despite its market and production woes, molybdenum continued as the State's leading nonfuel mineral product, accounting for more than one-third the value of the State's nonfuel mineral output. This figure, however, was less than the two-thirds of the total normally attributed to molybdenum. Silver and lead also declined significantly, more because of lower prices

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	276	$1,734	201	$1,124
Copper (recoverable content of ores, etc.)	metric tons	W	W	575	941
Gem stones		NA	80	NA	80
Gold (recoverable content of ores, etc.)	troy ounces	51,069	23,473	64,584	24,278
Gypsum	thousand short tons	203	2,346	184	1,571
Lead (recoverable content of ores, etc.)	metric tons	11,431	9,207	W	W
Molybdenum	thousand pounds	73,615	636,037	[2]39,006	[2]159,925
Peat	thousand short tons	33	299	47	275
Sand and gravel:					
Construction	do.	[e]23,500	[e]73,300	19,591	60,780
Industrial	do.	W	W	222	3,266
Silver (recoverable content of ores, etc.)	thousand troy ounces	3,009	31,650	1,934	15,378
Stone:					
Crushed	thousand short tons	6,969	24,083	[p]6,900	[p]27,800
Dimension	do.	1	64	[p]1	[p]64
Combined value of beryllium concentrate (1982), carbon dioxide, cement, iron ore, lime, perlite, pyrites, salt, tin, tungsten ore and concentrate, vanadium, zinc, and values indicated by symbol W		XX	164,493	XX	142,049
Total		XX	[r]966,766	XX	437,531

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

than lower output in the case of lead, but in both output and value in silver. Cement and sand and gravel production fell moderately in 1982 as the slump in construction continued. Gold production increased notably, although lower prices restricted the increase in total value.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Adams	$10,198	(3)	
Alamosa	W	W	Peat.
Arapahoe	4,009	$302	Sand and gravel (industrial), stone (dimension).
Archuleta	27	(3)	
Boulder	36,671	W	Cement, stone (crushed), gold, silver, clays, stone (dimension), lead, zinc, peat, copper.
Chaffee	W	1,345	Stone (crushed), peat, lime.
Clear Creek	449,244	287,093	Molybdenum, gold, silver, lead, zinc, copper.
Conejos	W	(3)	
Costilla	W	W	Stone (crushed).
Crowley	W	(3)	
Custer	W	W	Perlite.
Delta	921	(3)	
Denver	73	(3)	
Dolores	313	405	Stone (crushed).
Douglas	W	W	Stone (crushed), clays, stone (dimension).
Eagle	7,195	3,423	Silver, gold, zinc, copper, stone (crushed), lead.
Elbert	W	W	Clays.
El Paso	W	4,052	Stone (crushed), sand and gravel (industrial), clays.
Fremont	W	W	Cement, stone (crushed), gypsum, clays.
Garfield	W	(3)	
Gilpin	65	79	Gold, silver, copper, lead, zinc.
Grand	W	(3)	
Gunnison	W	(3)	
Huerfano	W	(3)	
Jefferson	17,984	7,924	Stone (crushed), clays.
Kit Carson	W	(3)	
Lake	527,867	399,686	Molybdenum, tungsten, zinc, silver, lead, gold, pyrites, copper, tin.
La Plata	577	(3)	
Larimer	29,357	W	Cement, stone (crushed), gypsum, lime, stone (dimension).
Las Animas	W	(3)	
Lincoln	W	(3)	
Logan	W	W	Lime.
Mesa	W	(3)	
Mineral	W	15,414	Silver, lead, zinc, copper, gold.
Moffat	1,375	(3)	
Montezuma	W	W	Carbon dioxide.
Montrose	W	W	Salt.
Morgan	W	W	Lime.
Otero	357	(3)	
Ouray	W	1,499	Silver, zinc, lead, gold, copper.
Park	W	1,244	Silver, peat, gold, lead, zinc, copper.
Phillips	61	(3)	
Pitkin	W	W	Iron ore.
Prowers	W	(3)	
Pueblo	9,041	W	Lime, clays.
Rio Blanco	W	(3)	
Rio Grande	W	(3)	
Routt	328	275	Stone (crushed).
San Juan	W	24,882	Gold, zinc, silver, lead, copper.
San Miguel	W	(3)	
Sedgwick	W	W	Lime.
Summit	2,047	103	Gold, silver, lead, copper.
Teller	W	1,673	Gold, peat, silver, lead.
Washington	26	(3)	
Weld	W	W	Lime.
Undistributed[4]	166,783	144,050	
Sand and gravel (construction)	XX	e73,300	
Total[5]	1,264,515	966,766	

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, Hinsdale, Jackson, Kiowa, Saguache, and Yuma.

[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 values indicated by symbol W.

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

Table 3.—Indicators of Colorado business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,535.0	1,577.0	+2.7
Unemployment	do	84.0	122.0	+45.2
Employment (nonagricultural):				
Mining[1]	do	43.4	43.4	--
Manufacturing	do	186.2	182.8	-1.8
Contract construction	do	77.5	79.3	+2.3
Transportation and public utilities	do	82.4	85.4	+3.6
Wholesale and retail trade	do	314.4	320.9	+2.1
Finance, insurance, real estate	do	80.3	83.3	+3.7
Services	do	269.3	278.1	+3.3
Government	do	241.7	238.3	-1.4
Total nonagricultural employment[1]	do	1,295.2	[2]1,311.7	+1.3
Personal income:				
Total	millions	$33,257	$35,853	+7.8
Per capita		$11,216	$11,776	+5.0
Construction activity:				
Number of private and public residential units authorized		29,733	31,466	+5.8
Value of nonresidential construction	millions	$1,267.5	$966.0	-23.8
Value of State road contract awards	do	$88.2	$141.0	+59.9
Shipments of portland and masonry cement to and within the State	thousand short tons	1,559	1,488	-4.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$966.8	$437.5	-54.7
Value per capita, resident population		$334	$144	-56.9
Value per square mile		$9,264	$4,197	-54.7

[p]Preliminary.
[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.

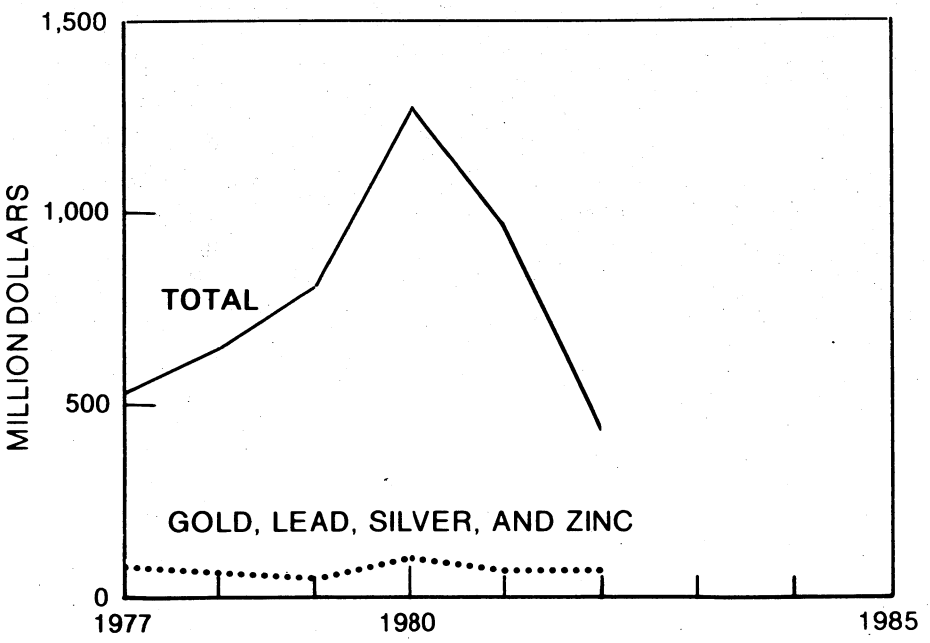

Figure 1.—Value of mine production of gold, lead, silver, and zinc and total value of nonfuel mineral production in Colorado.

Colorado's national ranking in value of nonfuel mineral production dropped from being in the upper 15% in 1981 to the upper 30% in 1982. The State ranked first in the Nation in carbon dioxide, molybdenum, and vanadium production; second in tin and tungsten (byproducts of molybdenum); third in lead; fifth in gold; sixth in zinc; and seventh in silver. Twenty-three nonfuel minerals were produced in the State—11 metals and 12 nonmetals.

The mining sector employed about 41,200 people in Colorado in 1982; of that number, approximately 10,000 were in nonfuel mineral production. Although mining employment has been growing at 14% to 18% in Colorado over the past 8 years, the fastest rate of increase among employment sectors in Colorado, the 1982 employment level in mining decreased about 4.8%.

The change in relative importance of mineral production in Colorado was reflected in a per capita value of mineral output in the State of $210, compared to a national average of $85. In 1981, these values were $334 and $111, respectively.

Trends and Developments.—The mining slump begun in 1981 continued throughout 1982. The decline in industrial demand and, hence, prices for those metals produced in Colorado remained depressed. Nearly every major mine in Colorado was closed or severely restricted in operation at sometime during the year. After 60 years of steady operation and growth, AMAX Inc. shut down its molybdenum operations in the State. Its Climax and Henderson Mines, the State's two largest mines, were closed most of the second half of the year. More than 4,400 people were affected.

Although not part of the nonfuel mineral picture, Exxon Co. U.S.A.'s May 2 termination of its participation in the Colony shale oil project in western Colorado was a significant mining event. Exxon had invested more than $500 million in acquisition and development costs for its 60% of Colony. The company estimated that completing the project would cost an additional $5 billion to $6 billion, more than double its original estimates. Representing a potential of perhaps 10,000 jobs in western Colorado, the project had employed 2,100 people.

CF&I Steel Corp. laid off 2,500 of its 6,000 employees as it severely cut back operations at its Pueblo plant. Approximately 1,000 workers in the uranium-vanadium industry lost jobs in western Colorado. Other major mineral companies that closed Colorado offices or laid off portions of their work force during 1982 included Anaconda Minerals Co., Conoco Inc., Occidental Minerals Corp., and Rocky Mountain Energy Co.

The gold and silver industry, which seemed on the verge of a boom when prices skyrocketed in late 1980, deflated when higher prices failed to hold. A partial price revival in late 1982 again encouraged some miners. After 10 years of steady growth, mining employment decreased substantially.

Exploration.—Despite the current mining slump, mineral exploration continued strong. Earth Sciences Inc. pursued a preference right lease application for 1,667 acres of Federal land in Hinsdale County where the company believes the largest known alunite deposit in the world is located. The deposit is potentially a major potash and alumina source.

Multi-Mineral Corp. pulled back from developing the nahcolite and dawsonite resource interbedded with oil shale in the Piceance Basin of northwestern Colorado. Nahcolite, a form of sodium bicarbonate, has been used successfully as a scrubbing agent to reduce powerplant emissions. Dawsonite is a source of alumina.

Exploration for gold, silver, and other metals continued at a high level throughout the year. Six companies explored for gold among the old mining properties in the Cripple Creek-Victor district of Teller County. Gold Fields Mining Ltd. explored for silver at Red Cliff in Eagle County. Brunten Mining Co. drilled at the Wellington Mine near Breckenridge in Summit County. Draco Mines Inc. appraised a mine near La Garita, while Molycorp Inc. test drilled near Bonanza; both these activities are in Saguache County where the county clerk reported record numbers of individuals and companies registering patented and unpatented mining claims. Exploration activity was also high in the Central City-Idaho Springs-Georgetown area in Gilpin and Clear Creek Counties.

Cominco American Inc. and Superior Minerals Co. continued exploring for diamonds in the Colorado-Wyoming State line area. Homestake Mining Co., Minerals Engineering Co., and Todilto Exploration and Development Corp. explored old properties for silver near Creede in Mineral County. The Anaconda Copper Co. continued to explore for molybdenum at Rico, Dolores County, and for gold at Summitville, Rio Grande County. Noranda Exploration Inc.

ended its molybdenum exploration activity in the Jamestown district of Boulder County, deciding not to proceed with a mine. Mineral companies, large and small, were actively exploring throughout the Colorado Mineral Belt, which strikes across the mountain summit of the State from the Front Range north of Boulder to the San Juan Mountains in the southwest corner of the State, as well as elsewhere in Colorado.

Legislation and Government Programs.—The second regular session of Colorado's 53d General Assembly, a short, or "call," session to consider only fiscal matters and topics the Governor specified, convened January 6, 1982, and adjourned May 24, 1982.

Severance taxes were one of the most controversial items among the 150 or so topics the Assembly considered. Among the bills passed that related to nonfuel minerals were—

S.B. 95, effective April 23, 1982, granted immunity against civil damages to any person engaged in mine rescue or recovery work who, in good faith, rendered emergency care or recovery services at or in a mine.

S.B. 115, effective April 6, 1982, required mineral producers subject to the severance tax to file an annual report listing actual addresses of its employees.

H.B. 1110, effective April 9, 1982, increased the maximum yearly distribution of Federal leasing money to a single county to $800,000 and readjusted the formula under which distribution would be made to counties and the State public school fund.

H.B. 1147, effective March 17, 1982, imposed a severance tax on carbon dioxide at the same 5% rate as on oil and gas and let producers deduct 87.5% of their property tax payments from the severance tax, as can oil and gas producers.

All other severance tax bills seriously considered, including H.B. 1160 and H.B. 1191, were defeated in the Legislature. An environmentalist-backed initiative, dubbed IMPACT (Initiative on Mineral Policy Assisting Colorado Taxpayers), to put a proposed constitutional amendment on the November 1982 ballot failed to file the required 39,000 signatures with the Secretary of State by the July 27, 1982, deadline. The amendment would have required an overall 5% severance tax on Colorado mineral production. Bills to expand the mine-safety-inspection function of the State Division of Mines also failed.

Because of an unexpected quirk in the formula for distributing severance tax monies to mining-impacted communities, metropolitan Denver communities received nearly 70% of the money. Under the formula the Legislature established, 7.5% of severance taxes the State collected was distributed to communities where mine workers lived; 50% went into a State trust fund, and 42.5% was to be used for water, sewer, and other grants to energy-development-impacted communities. Because of the many energy and mining-firm employees working at Denver headquarters locations, most of the 7.5% money went to Denver, rather than to smaller, more directly affected communities as the legislature had intended.

In other legislative matters, the Colorado Supreme Court unanimously upheld a district court ruling forbidding county governments to deny requests to mine on Federal land within their jurisdictions. In September, the Justices ruled in Earl J. Brubaker, Rexford L. Mitchell, and Valco Inc. versus the El Paso County Commissioners that Federal law (such as the Mining Law of 1872) preempts State and local governmental power to deny mining operations involved with claims on Federal lands already authorized by Federal law. The ruling, however, did not prevent State and local government from imposing "reasonable conditions" upon such mining proposals. In a Garfield County case, a mineral operator sued the county over conditions placed on its license to mine.

In a ruling that could eventually have heavy impact on western lands where the surface estate and mineral estate are separated, the U.S. Supreme Court declared Indiana's Dormant Mineral Act of 1971 valid. The Indiana law provides that a company or person's right to any interest in minerals under a piece of land is forfeited to the surface owner if those rights have not been exercised for 20 years. No notification to the mineral owner is required. Illinois, Michigan, and Wisconsin have similar laws.

Colorado received $124.2 million in direct payments from mineral production, including severance taxes, royalties, and rentals from the State Land Board's management of minerals on State lands and Colorado's 50% share of mineral revenues from Federal lands. This figure amounted to 8.7% of the State's general fund. In addition, local governments received $60.2 million in ad valorem taxes levied on production, equipment, and leases related to mineral extrac-

tion. State severance taxes contributed $48.7 million of the total, of which $3.1 million was paid on molybdenum. About $42.8 million of the total was from Federal mineral revenues.

The Colorado Geological Survey activities during the year included preparation of an overview of strategic and critical minerals in the State, initiating work on revision of the Metals Activity Map and Directory in Colorado, and gathering information for a new Nonmetals Activity Map and Directory in Colorado.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Cadmium and Indium.—At its Globe smelter in Denver, ASARCO Incorporated recovered cadmium and indium from flue dust, dross, and byproduct materials from out-of-State smelters. 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. Cadmium, however, occurred in some base-metal ore in the San Juan area of Colorado.

Copper.—Copper, produced in Colorado only as a byproduct from base-metal ores, was the least important of the gold-silver-copper-lead-zinc complex in value, comprising only about 2% of the five-metal total. Copper was produced in 12 mines in 10 counties in Colorado. In no mine was it the most valuable product, and it was the second most valuable in only one mine; it was not an important factor in the economic health of any of these mines. Nationally, the State ranked 10th of 11 copper-producing States; Colorado's share was a small fraction of 1% of the total.

Copper production in the State in 1982 was nearly one-quarter less than that of 1981 in quantity, and nearly one-third less in value as the average price declined from about $0.81 per pound in 1981 to $0.74 per pound in 1982. Closing of the Camp Bird, Eagle, and Sherman Mines and lower copper production at the Leadville Unit and Sunnyside Mines were reasons for the decline in output. The largest copper producer in the State, Standard Metals Corp.'s Sunnyside Mine, near Silverton, produced more than two-thirds of the total. Most of the balance of production was from Homestake Mining Co.'s Bulldog Mountain Mine at Creede and Asarco's Leadville Unit (Black Cloud Mine) at Leadville.

Gold.—Gold production was reported from 17 lode mines and 4 placer mines in 9 counties in 1982. Gold was the most important product of 16 of these mines. The quantity of gold produced in 1982 increased substantially over the 1981 level primarily because of increased production in San Juan County (Sunnyside Mine) and Teller County (Iron Clad, Glove Hill, Rubie Leach, and School Section operations). The total value of production was imperceptibly higher as the average price of gold fell from about $460 in 1981 to about $376 in 1982. Standard Metals' Sunnyside Mine near Silverton, San Juan County, yielded well over one-half the gold produced in the State, considerably more than the combined total from all other gold mines in the State. The second largest gold-producing mine was Asarco's Leadville Unit (Black Cloud Mine) near Leadville, although at a considerably lower level of gold output than that of Sunnyside. Third was the new Ironclad operation of Silver State Mining Corp. near Victor in Teller County; fourth was the Globe Hill deposit of Newport Minerals Inc., a subsidiary of Gold Resources Inc., also near Victor in Teller County. Each produced at a considerably lower level than the next largest producer. These four mines produced more than 95% of the State's gold output. Other gold producers, in order of output, included Gold Ore Ltd.'s Rubie Leach pad near Cripple Creek in Teller County; Newport Minerals' School Section operation, also in Teller County; the London Mine operated in Park County by Cobb Resources Corp.; Concord Minerals Corp.'s Bald Eagle Mine in Clear Creek County; Moritz Mining Co.'s Smith Mine in Gilpin County; and the Cross Mine operated by Hendricks Mining Co. Inc. in Boulder County.

Despite the decline in 1982 gold prices (as well as the price declines of copper, lead, silver, and zinc) from the 1981 level, Standard Metals reported in its 1982 annual report that the Sunnyside Mine was profitable in the last three-quarters of 1982, operating with a profit of $2.8 million for the year on revenues of about $18 million compared with $300,000 in 1981 and $5.6 million in 1980. Significant operating economies put into effect during the year includ-

ed suspension of work on subeconomic areas, a temporary suspension of all exploration, a temporary 50% reduction in work force, and introduction of a new mining technique. The new mining technique, vertical crater retreat (VCR) stoping, resulted in a 50% reduction in direct stoping costs, or $5 to $7 per ton, compared to the cost of traditional shrink stoping. A second method, adopted late in the year, was sublevel stoping, a compromise between VCR stoping and conventional shrink stoping, used where VCR was not feasible or practical. It was anticipated that sublevel stoping would essentially replace shrink stoping at Sunnyside. Because of the new mining techniques, 225,000 tons of ore was milled, a 12.5% increase over that of 1981. The Sunnyside, or Mayflower, mill was operated at capacity in 1982, based on a 5-day workweek, compared with 80% in 1981 and 50% in 1980.

On March 1, 175 of 300 miners at Sunnyside, the Nation's third largest gold mine, were laid off; the mine work force had been cut by 40 jobs in February. The Sunnyside was the largest employer in San Juan County. In late September, employment returned to 250, operations were expanded from 5 to 7 days per week, and monthly ore production increased from 20,000 to 28,000 tons.

Also in the San Juan area, the Bakers Park Mining and Milling Co. mill at Silverton, the only precious metal-base metal mill offering custom milling in southwestern Colorado, closed in June.

In the Cripple Creek district, four companies were still operating at yearend—Cripple Creek and Victor Gold Mining Co. (joint venture of Golden Cycle Corp. and Texasgulf Inc.), Gold Ore Ltd., Newport Minerals, and Silver State.

Cripple Creek and Victor Mining had rebuilt part of the old Carlton mill to 300 tons per day capacity and begun operations in February. In July, the company, which was also rehabilitating the Cresson and Ajax Mines, cut the mill back to 150 tons per day 5 days per week and reduced its work force from 97 to 52 because of the declining gold price.

Gold Ore bought all the mining assets of Cripple Creek Gold Production Inc. for about $2 million. These assets included the Mary Nevin Mine, a 100-ton-per-day mill, and about 225,000 tons of ore in several area dumps. Gold Ore's production was through its Rubie pad, a 300,000-ton, heap-leach facility.

Newport Minerals processed old run-of-mine tailings at its Globe Hill conventional heap-leach facility. The company had about 300,000 tons of ore in its open pit, which was closed in early January, and about 1 million tons of processable material in old dumps.

In March, Silver State began production at a 1,000-ton-per-day open pit mine at Victor, using a covered vat-leach facility and an agglomeration process developed by the U.S. Bureau of Mines. Silver State's estimated reserves at the site of the old Ironclad Mine to be 4 million tons, grading 0.06 ounce of gold per ton in the upper 400 feet of depth. The deposit is mined with bulldozers and front-end loaders. At a recovery rate of 80%, the operation produced gold at about $160 per ounce. It estimated its mining cost at $0.20 per ton of ore, compared with as much as $30 per ton of ore in nearby underground operations.

Considerable exploration and development continued in the important old Clear Creek-Central City area. The Franklin Consolidated Mining Co. Inc. began producing 40 to 60 tons per day of millable material from the Franklin Mine.

Cobb Resources Corp. shipped the first gold and silver concentrates from its rehabilitated London Mine near Fairplay.

Union Mines, a subsidiary of Union Minière S.A. of Belgium, closed its Mammoth Mine near Platoro, Conejos County, in May, laying off 24 employees.

The Saguache County Commissioners approved Draco's plans for a 400,000-ton-per-year mine at the company's Crystal Hills Project near La Garita in January; however, Federal stipulations on site reclamation after mining delayed the project through yearend.

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
1980, total	23	1	549,148	39,447	$24,163,656	2,987,058	$61,652,877
1981, total	28	1	1,095,082	51,069	23,473,357	3,008,994	31,649,710
1982:							
Boulder	2	--	W	W	W	W	W
Clear Creek	1	--	W	W	W	W	W
Gilpin	4	1	1,592	271	101,871	1,245	9,897
La Plata	1	--	W	--	--	W	W
Lake	2	--	W	W	W	W	W
Mineral	1	--	W	--	--	W	W
Moffat	--	1	--	W	W	--	--
Montrose	1	--	W	--	--	W	W
Ouray	1	--	W	W	W	W	W
Park	3	1	9,724	W	W	44,652	354,984
San Juan	2	--	W	W	W	W	W
San Miguel	--	1	--	100	37,591	25	199
Summit	1	--	W	W	W	W	W
Teller	5	--	369,820	8,593	3,230,195	W	W
Total	24	4	[3]883,700	[3]64,584	[3]24,277,771	[3]1,934,312	[3]15,377,781

	Copper		Lead		Zinc		Total[3] value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1980, total	461	$1,040,531	10,272	$9,615,189	13,823	$11,406,279	$107,878,532
1981, total	W	W	11,431	9,206,517	W	W	81,827,760
1982:							
Boulder	W	W	W	W	--	--	W
Clear Creek	W	W	W	W	W	W	W
Gilpin	1	2,279	10	5,645	--	--	119,692
La Plata	W	W	W	W	--	--	W
Lake	W	W	W	W	W	W	W
Mineral	W	W	W	W	W	W	W
Moffat	--	--	--	--	--	--	W
Montrose	W	W	--	--	--	--	W
Ouray	W	W	W	W	--	--	W
Park	W	W	36	20,269	--	--	W
San Juan	W	W	W	W	W	W	W
San Miguel	--	--	--	--	--	--	37,790
Summit	--	--	W	W	--	--	W
Teller	--	--	W	W	--	--	3,245,327
Total	[3]575	[3]941,438	W	W	W	W	61,035,717

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

Table 5.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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	25,356	--	--	--	--
Cyanidation	8,537	1,800	--	--	--
Smelting of concentrates	30,443	1,931,512	574	W	W
Direct smelting of ore	4	975	1	W	--
Total	64,340	1,934,287	575	W	W
Placer	244	25	--	--	--
Grand total	64,584	1,934,312	575	W	W

W Withheld to avoid disclosing company proprietary data.

Table 6.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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]	10	591,970	W	W	W	W	W
Gold-silver	5	10,871	W	8,565	W	W	W
Silver	5	W	W	W	W	W	W
Lead	3	W	--	W	W	W	--
Lead-zinc	1	W	W	W	W	W	W
Total lode	24	[3]883,700	[3]64,340	[3]1,934,287	[3]575	W	W
Placer	4	--	244	25	--	--	--
Grand total	28	883,700	64,584	1,934,312	575	W	W

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

Iron Ore.—Pitkin Iron Corp.'s Cooper Mine near Ashcroft and Aspen, Pitkin County, was Colorado's sole source of iron ore. Operated under contract by the Morrison-Knudsen Co. Inc., it produced a magnetite ore of about 65% iron. CF&I's Pueblo steel mill has been the major customer for the mine's ore. Shutdown of much of CF&I's Pueblo plant greatly reduced demand for Pitkin's ore; reported 1982 shipments of ore were only a fraction of shipments reported in 1981. Colorado ranked 11th of the 12 States reporting iron ore production in 1982; Colorado's share of the Nation's output was a small fraction of 1%.

CF&I continued to lay off workers through the year, reducing its labor force from about 6,000 to 3,500 people. The last of the company's four blast furnaces and its two basic oxygen furnaces were shut down in June; only two electric furnaces continued to operate. Company coal mines were closed, coke production curtailed, and rolling and finishing mill operations reduced. In October, workers agreed to a 1-year reduction in wages and benefits valued at about $5 per hour. Sales were reported to be 65% below those of the preceding year. In August, the company filed an $18.3 million suit charging Mitsui & Co. Ltd. of Japan with violating Federal antitrust and antidumping laws.

Lead.—Lead, retrieved as a byproduct of base and precious metals in Colorado, was produced in 13 mines in 11 counties. Although not the most valuable product from any of these mines, it was second in value in five of them, hence important to the economics of several mines. Lead production in Colorado in 1982 was down significantly from the 1981 level in both quantity and value. Lead prices, which averaged $0.36 in 1981, averaged only $0.26 in 1982.

Asarco's Leadville Unit Mine produced more than one-half the State's output; Standard Metals' Sunnyside Mine at Silverton was second in output and Homestake's Bulldog Mountain Mine at Creede, a distant third. Although Colorado ranked third among the eight lead-producing States, its contribution to the national total was very small.

Idarado Mining Co. reported no plans to reopen the Idarado Mine in San Miguel and Ouray Counties, formerly one of Colorado's largest producers of lead; however, the company did expand the sprinkler system on the old mine's tailings ponds east of the town of Telluride to control blowing of tailings dust.

Molybdenum.—Despite a significant decline in market demand and closure of the two major molybdenum mines in the State, molybdenum continued to be the most important nonfuel mineral produced in Colorado. Normally providing about two-thirds the total value of nonfuel mineral production in the State, molybdenum's share dropped to just over one-third of the total in 1982 as value of production declined 43% from the 1981 value. Nonetheless, this output was about 70% of the Nation's molybdenum production for the year and just over 20% of the world's total. All primary molybdenum was produced at two mines, Climax Mine, on the Continental Divide near Leadville in Lake County, and the Henderson Mine, a little over 30 air miles from Climax

near Empire in Clear Creek County. Climax and Henderson, the second and third largest underground mines in the country in terms of production, were owned and operated by Climax Molybdenum Co., a division of AMAX.

In a little more than 2 years, AMAX's mine work force in Colorado fell from over 5,000 to less than 650; mine output fell from 27 million tons in 1981 to less than 10 million tons in 1982, and AMAX had a full year's inventory of molybdenum on hand compared to a normal inventory of about a 3-month supply. The aggregate book value of AMAX's molybdenum inventories at yearend 1982 was approximately $194 million, compared with $186 million at yearend 1981.

The record production levels of 1980 and much of 1981 ended as demand declined rapidly in early 1982; inventories rose, prices fell, and production cutbacks began. AMAX had begun hiring on a replacement basis only at Climax and Henderson in September 1980, and by yearend, employment at the two mines stood at about 5,000 workers. During 1981, work crews were reorganized, some operations reduced from three to two shifts and to 5-day weeks, open pit crews reassigned, and holidays extended to reduce production. At yearend 1981, employment was about 4,400, but in January 1982, the Climax Mine work force was reduced by more than 600 people through layoffs, retirements, and voluntary termination. Production was reduced from 48,000 to 33,000 tons per day. At the Henderson Mine, the work force was reduced by more than 300 people through a voluntary termination program and employee retirements. Production was reduced from 33,000 to 26,000 tons per day, about 45% of capacity at both mines. The workweek was reduced from 7 to 5 days. The staff at the Western Headquarters of AMAX at Golden was reduced by about 100 people, or 30%.

In April, employment at Climax was further reduced by 385 people to about 1,500 employees; Henderson was cut back about 225 employees to about 1,200. Production was reduced from 33,000 to about 30,000 tons per day at Climax and from about 26,000 to 22,000 tons per day at Henderson. Climax was also put on a 5-day week. To reduce mounting inventories, the company suspended mining operations at both mines for 5 weeks, June 28 to August 2; 1,500 workers at Climax and 1,150 workers at Henderson were furloughed. Both mines were reopened August 2 with production scheduled at about 33% of capacity at Climax and 36% of capacity at Henderson.

All mining and milling operations were again suspended at Climax on September 18 and at Henderson on October 2. All but approximately 650 of the 2,200 remaining workers at the two mines were laid off until the reopening scheduled for November 8. In October, however, the shutdown of both mines was extended through the end of the year into 1983.

By yearend 1982, there was no primary molybdenum production in the United States. The 1982 consumption of molybdenum, 90% of which is in alloying steel, was about 41% below 1981 levels, the lowest in 14 years. Prices, which had peaked in 1980 at about $9.70 per pound producer's price for molybdic oxide and nearly $40 per pound trader's price, fell to a producer's price of about $4.40 per pound and a trader's price of about $2.50 per pound. The slump in demand for molybdenum derived from the decline in the U.S. steel industry, which was producing at about 35% capacity in December 1982, weak worldwide demand, high inventories, and from the increasing availability of byproduct molybdenum. All of these factors raised the possibility that a permanent change in the structure of demand for Colorado's molybdenum was occurring.

At the Climax Mine, which has operated as an underground mine since 1918 supplemented by an open pit operation since 1973, proven and probable reserves were estimated to be 144 million tons averaging 0.307% molybdenum disulfide in the open pit and 269 million tons averaging 0.316% molybdenum disulfide underground. Capital expenditures at Climax in 1982 were approximately $27 million, compared with $92 million in 1981.

The Henderson Mine began producing development ore in mid-1976 and was producing at design capacity of 30,000 tons per day by the end of 1980. Proven and probable ore reserves at the Henderson were estimated to be 246 million tons averaging 0.376% molybdenum disulfide. Capital expenditures at the Henderson were approximately $20 million in 1982, compared with $44 million in 1981. The 39 million pounds of molybdenum shipped from the two mines in 1982 compared with 74 million pounds shipped in 1981 and 102 million pounds shipped in 1980. Peak annual capacity at Climax was 52 million pounds, and at Hen-

derson, 50 million pounds.

Because of the Climax shutdown, the unemployment rate at Leadville jumped from 4.9% in December 1981 to about 35% after the closure in September 1982. AMAX extended worker benefits through January 1983. The Climax work force is unionized; the Henderson force is not.

Because of existing and projected excess molybdenum production capacity, AMAX continued deferring development of its Mount Emmons molybdenum prospect near Crested Butte in Gunnison County; the project had been put on hold for 2 years in August 1981. The company closed its Gunnison office in January 1982, retaining only the staff of the water-treatment plant at the old Keystone Mine on the Mount Emmons property. AMAX's investment in Mount Emmons was stated at approximately $155 million by December 31, 1982. AMAX estimated that the Mount Emmons prospect contained approximately 146 million tons of mineralized material averaging approximately 0.43% molybdenum disulfide, including approximately 74 million tons averaging about 0.55% molybdenum disulfide.

Closing Climax and Henderson will also affect local governments, which received considerable tax revenues from operation of the two mines. In 1982, Climax paid $7.4 million to Lake County, 86% of the county's property tax revenue; Henderson paid $5.7 million to Clear Creek County, about 79% of that county's property tax income. In all, AMAX paid about $17 million in property taxes in Colorado in 1982, $8.1 million for Climax, $8.5 million for Henderson. AMAX paid property taxes in 16 Colorado counties. Counties that were major recipients included Grand County, $2.8 million; Summit County, $670,000; Gunnison County, $160,000; and Jefferson County, $127,000. In addition, the company paid about $3.1 million in State severance taxes and $8 million in sales use and income taxes.

In other actions during the year, AMAX moved its Climax Molybdenum Div. headquarters from Greenwich, Conn., to Golden, Colo., affecting nearly 100 employees; continued work on a land exchange with the U.S. Forest Service for 2,800 acres adjacent to the Climax Mine, exchanging 9,300 acres of private land within National Forest boundaries; and negotiated with the State a new water agreement on Climax water discharges.

Silver.—Compared with silver yield in 1981, production declined severely in 1982; output fell by one-third. However, because the average silver price dropped from $10.52 in 1981 to $7.95 in 1982, the value of silver produced in 1982 was only one-half that of 1981. The major cause for the dramatic fall in 1982 was that several large 1981 silver producers, including the Eagle Mine and the Camp Bird Mine, did not produce in 1982; the Sherman Mine closed down for part of 1982; and production fell slightly at the Bulldog Mine. Silver, which was reported produced at 18 mines in 12 counties, was the most valuable product from just three of these mines. Silver was second to gold in total value of the five metals (copper, gold, lead, silver, and zinc), frequently produced as coproducts from Colorado's complex ores, contributing about one-fourth of the total.

The largest silver producer continued to be Homestake's Bulldog Mountain Mine at Creede, Mineral County; according to Homestake's annual report, the mine yielded about two-thirds of the State's total output. Second in order of output was Asarco's Leadville Unit; Standard Metals' Sunnyside Mine at Silverton ranked third. Only two other mines, Silver State's Moose Mine, Park County, and Hecla Mining Co.'s Sherman Mine, Lake County, produced as much as 1% of the total.

Because of lower silver prices, Homestake cut back production at the Bulldog Mine and, during the year, reduced the work force from 150 to about 100. The secondary carbon-in-pulp recovery operation was closed; the flotation mill was cut from a 7- to a 5-day week; and contract incentive pay was cut. Dealing with a declining ore grade for the past 5 or 6 years, Homestake was seeking and producing higher grade ores. According to the company's 1982 annual report and Form 10K Annual Report submitted to the Securities and Exchange Commission, silver output fell from 1.4 million ounces in 1981 to a little more than 1.3 million ounces in 1982, while revenues fell from nearly $13 million in 1981 to about $10 million in 1982. Nonetheless, by yearend, the silver market and profitability of the mine improved, and the mine ended the year with a profit. Although full operation was not resumed, the company granted the employees a 7% wage increase.

The Bulldog had a daily capacity of about 300 tons of ore with proven and probable reserves estimated at 751,000 tons containing 16.1 ounces of silver per ton. A diamond drilling program was underway to reach new reserves, and development work was

exploring for new reserves on the northern extension of the Puzzle and West Strand vein systems. Because of the nature of the vein, the practicality of developing large tonnages of proven and probable reserves in advance of mining was limited. A new cone crusher and screening system were installed in the mill to upgrade lower grade ore. The Bulldog is Mineral County's largest tax payer, and lower revenues at the mine were reflected in lower county revenues.

Because of the declining silver price, production was suspended at the Sherman Mine near Leadville on January 15. About 76 of 100 employees at the mine, operated by Hecla under agreement with the Leadville Corp., were laid off. Twenty-two miners who had remained for exploration and development work were also laid off on June 14, and the mine was temporarily closed. The Sherman had produced about 1 million ounces of silver annually in 1981 and 1980.

In other silver mining, Silver State closed its operation at Alma in April, idling 12 workers. Mill capacity had recently been doubled to handle 200 tons of ore daily. The president of Silver State said the facility would remain on standby until silver prices reached $10 to $12 per ounce. Efforts by Federal Resources Corp. of Salt Lake City, Utah, to reopen the Camp Bird Mine near Ouray, which had been closed in 1981, were unsuccessful. In December, Federal announced that it had agreed to sell the mine to Gila Mines Corp. of Phoenix, Ariz., for $4 million. Ranchers Exploration and Development Corp. continued an 18-month project to reopen the old Revenue-Virginius Mine near Ouray as a major producer of high-grade silver-lead ore. Following termination of its agreement with Chevron Resources Co. to explore and develop its property near Creede, Minerals Engineering Co. (MECO) moved part of its Denver staff to Creede to complete a feasibility study on reopening its mines in the area. In September, MECO announced an agreement giving Pioneer Nuclear Inc. certain exploration and development rights to the 2,000 acres of mining claims MECO controlled. Gold Fields explored for silver at Red Cliff in Eagle County.

Tin.—Besides the Nation's major tin-producing State, Alaska, Colorado was the only other source of tin in the United States in 1982. Tin was produced as a byproduct of molybdenum at AMAX's Climax Mine where the ore contained about 0.002% tin. Tin production in 1982 declined from the 1981 level as output at Climax was progressively reduced until, ultimately, the mine was closed on September 18.

Tungsten.—Colorado was second among the three States reporting a significant tungsten production in 1982. California was the major producer. Most Colorado production, from AMAX's Climax Mine near Leadville in Lake County, was a byproduct of molybdenum production. Although only about 0.15 pound of tungsten is recovered from each ton of ore processed, Climax, in recent years, has been the seventh most productive tungsten mine in the Western World. Minor amounts of tungsten production were also reported in Boulder and Fremont Counties.

The amount of iron manganese tungstate, or wolframite, produced at Climax declined during the year as operations at that mine were cut back and finally ended with the closing of the mine on September 18. AMAX's 1982 10K Report indicated 1.0 million pounds of tungsten trioxide (WO_3) containing 0.8 million pounds of tungsten was produced at Climax in 1982. This output compares with 2.59 million pounds of WO_3 containing 2.06 million pounds of tungsten produced in 1981. Tungsten produced at Climax was sold principally in the United States. Because of its unique properties of a high melting point and high density, it was used mostly as cemented carbides for cutting and wear-resistant materials and for mill products such as light-bulb filaments. Tungsten prices during 1982 were 35% lower than those in 1981.

Vanadium.—In 1982, Colorado was again first among the four States reporting vanadium production with an output nearly equaling that of the other three States combined. Production for the year was slightly greater than that of 1981. Demand for vanadium continued to be tied to the fortunes of the steel industry, which used vanadium as an alloying agent; production was also related to that of uranium since in Colorado ores, vanadium and uranium often occur together in the ratio of about five pounds of vanadium to each pound of uranium. The Union Carbide Corp. at its Uravan and Rifle facilities was the State's major purchaser and processor of vanadium ores. Homestake also processed some vanadium from ores mined at its Pitch Mine in Gunnison County. Colorado ores were also processed in Utah at Atlas Corp.'s Moab mill and at Energy Fuels Nuclear Inc.'s Bland-

ing mill. A major source of ore was the Uravan Mineral Belt in western Colorado located generally in Mesa, Montrose, and San Miguel Counties. The unemployment rate in those counties was among the State's highest as the uranium industry continued to close down; Union Carbide laid off 150 more of its 300 remaining western Colorado miners in November.

At Uravan, Union Carbide suspended operation of its uranium-vanadium mill in April, idling about 60 of the mill's 150 employees. Scheduled as a 5-month shutdown, the closure extended to September and again to November and through the end of the year. Although not initially affected by the Uravan mill closure, Union Carbide also closed its vanadium processing plant at Rifle in November as it exhausted its supply of vanadium-feed materials. Union Carbide continued to work with the Colorado Department of Health on renewing an operating license for the Uravan mill. In August, the Colorado Department of Health issued a radioactive materials license to Pioneer Nuclear for a proposed 1,000-ton-per-day, uranium-vanadium processing mill northeast of Slick Rock. The vanadium circuit of the Cotter Corp.'s Canon City uranium-vanadium plant remained closed through the year. Homestake's Pitch operation in Saguache County continued operating at a reduced level through the year and faced possible closure in early 1983.

Zinc.—The most important of the three base metals produced in Colorado in 1982, zinc was extracted as a byproduct or coproduct with copper, gold, lead, or silver from Colorado's complex ores and nearly equaled silver in value of output in 1982. Zinc output was reported from just four mines in Colorado in 1982—Concord Minerals' Bald Eagle in Clear Creek County, Homestake's Bulldog in Mineral County, Asarco's Leadville Unit (Black Cloud) in Lake County, and Standard Metals' Sunnyside in San Juan County. The Leadville Unit, by far the largest producer of zinc in the State in 1982, and the Sunnyside accounted for most of the output. According to Asarco's annual report, zinc was the most important product of the Leadville Unit Mine, contributing nearly one-half the mine's revenues; it was the second ranking product in value at the Sunnyside.

Zinc output increased very slightly in Colorado in 1982, but value decreased more than 12%. The average price of zinc moved from about $0.44 in 1982 to an approximate average of $0.38 in 1982. Relatively unimportant in the Nation's total zinc supply, Colorado ranked 6th among 10 States that reported production in 1982.

Reports persisted through the year of sale of The New Jersey Zinc Co.'s Eagle Mine, for many years the State's largest zinc producer, which was closed last year. Discussions between New Jersey Zinc and Ore Verde Enterprises included sale of the mine, the town of Gilman, and approximately 11,000 acres; final outcome of the negotiations was not announced by year-end.

NONMETALS

Carbon Dioxide.—Colorado was the Nation's largest producer of carbon dioxide in 1982. Two oil-company partnerships were developing the State's large carbon dioxide resource. Shell Oil Co. and Mobil Oil Corp. drilled additional wells in the McElmo Dome and Doe Canyon area in southwest Colorado near Cortez, where the carbon dioxide reserves were estimated at 8 to 9 trillion cubic feet. Thirty of an estimated goal of 200 wells had been drilled. In June, Cortez Pipeline Co., a partnership comprising subsidiaries of Shell, Mobil, and Continental Oil Co., awarded a $700 million contract to Willbros Energy Services Co. for constructing a 502-mile-long, 30-inch-diameter pipeline from Cortez to the Denver City area of west Texas, where the gas will be used to repressurize old oilfields. The pipeline will initially carry 330 million cubic feet daily, with a maximum daily capacity of 650 million cubic feet. Gas was expected to begin flowing sometime in 1984. Nearly $3 billion was to be invested over the life of the project.

In a second, separate carbon dioxide project at Sheep Mountain near Trinidad in southeastern Colorado, ARCO Oil and Gas Co. (a subsidiary of Atlantic Richfield Co.) and Exxon jointly funded a $350 million project. Thirty to thirty-five wells were being drilled, and a 400-mile pipeline connecting Sheep Mountain to the Bravo Dome in northeastern New Mexico and, thence, to west Texas was nearly completed. Maximum capacity of this line was to be 330 million cubic feet daily, to begin flowing in early 1983.

Cement.—Cement was produced at three plants in Colorado in 1982—Ideal Basic Industries Inc.'s two plants, the Boettcher plant in Larimer County and the Portland

plant in Fremont County; and Martin Marietta Corp.'s Lyons plant in Boulder County. All three plants produced portland cement; two also produced masonry cement, representing a very small fraction of the total. Types I and II, moderate-heat-resistant-type cement, comprised about 95% of total output. Ready-mix concrete companies purchased more than three-fourths of the finished portland cement. Concrete product manufacturers, building material dealers, and other contractors purchased most of the rest. More than 80% of cement output was shipped directly to consumers, about 95% in bulk and by truck. Ideal's Portland plant was the State's largest producer of cement.

Ideal reported a net loss of $24.9 million for 1982, its first annual loss in nearly 50 years. The company's Cement Div. reported a $5.6 million loss, compared to a $26.2 million operating profit last year. During the year, the company reduced its Denver headquarters staff from more than 400 people to about 300 people and pared down its national work force from about 4,000 to 3,600 people. On October 1, Ideal shut down its newly renovated Boettcher plant near Fort Collins, idling 117 workers. Sixty-one workers remained on duty to fill customer orders from the large existing inventory. The company described the shutdown as an "early winter curtailment." Annual capacity at the Boettcher plant was 460,000 tons. Overall, cement production was down by about 10% from that of 1981 because of a continuing construction recession.

Despite the existing depressed climate for cement, Mineral Reserves Inc. of Dallas, Tex., announced plans to build a 650,000-ton-per-year cement plant on six sections of State-owned land south of Pueblo. The Pueblo site was selected because of its large limestone supply and availability of labor, power, transportation, and water. The Pueblo County commissioners granted the company a special use permit, and a core drilling program to assess the resource was begun. Colorado was 15th in rank among the 40 States producing cement.

Clays.—Thirteen companies at twenty-nine mines in seven Colorado counties produced clay. All but two of the counties were Front Range counties associated with major metropolitan areas. About 97% of the output was common clay with a small amount of bentonite produced in Fremont County and fire clay in Pueblo County. Clay production in 1982 was about 27% less than in 1981. The major use was as common brick and face brick. Bentonite was used in foundry sand and waterproof seals; a small amount of common clay was used in manufacturing flower pots. Average price of all clays produced was about $5.58, with prices ranging from $1.00 to $18.10 for common clay, $11 to $14 for bentonite, and $3.96 to $20.97 for fire clay. Jefferson County, by far the largest source, was followed by Douglas and Fremont Counties. The three major producing counties accounted for more than 80% of total output.

With nine mines in four counties, Robinson Brick & Tile Co. was the largest individual clay producer. Second-ranked Lakewood Brick and Tile Co. operated three mines in two counties. These two companies produced most of the clay.

In June, Denver Brick Co. began constructing a $4.2 million brick production facility west of Castle Rock. When completed in early 1983, the computer-controlled, fuel-efficient facility was expected to produce more than 35 million bricks per year. The company had operated at its old site in Denver since 1889 where its facilities had included 50 unique beehive kilns. Colorado ranked 29th among the 44 States in which clay was produced.

Table 7.—Colorado: Clays sold or used by producers, by county

County	1981		1982	
	Quantity (short tons)	Value	Quantity (short tons)	Value
Boulder	W	W	W	W
Douglas	W	W	W	W
Elbert	W	W	W	W
El Paso	W	W	W	W
Fremont	58,403	$531,349	22,583	$160,763
Jefferson	99,867	533,201	94,279	477,521
Pueblo	37,444	195,193	15,989	68,929
Other	80,166	474,491	68,539	416,691
Total	275,880	1,734,234	201,390	1,123,904

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

Gem Stones.—Colorado was a very minor producer of gem stones with only about 1% of the United States total. Turquoise was produced on a small scale in Conejos County. Cominco American continued to test samples of kimberlite from the Colorado-Wyoming State line area for diamonds at its plant near Fort Collins. Superior Minerals Co. also was exploring for diamonds, 25 miles north of Fort Collins.

Gypsum.—Two companies in Fremont County and three in Larimer County produced crude gypsum. Most of the State's production came from Fremont County. Genstar Building Materials Co. of Florence, Fremont County, was the largest producer of crude gypsum and the only producer of calcined gypsum in the State. The quantity of gypsum produced fell about 9% from that of 1981. Colorado was a minor source, with less than 2% of the crude gypsum and less than 1% of calcined gypsum produced in the United States.

Lime.—Three companies operating in six counties reported lime production. The Great Western Sugar Co. produced about one-half the total for use in processing sugar beets into sugar at its plants at Loveland, Sterling, Fort Morgan, Ovid, and Greeley in Larimer, Logan, Morgan, Sedgwick, and Weld Counties, respectively. CF&I in Pueblo County and Calco Inc. in Chaffee County produced quicklime. CF&I used its lime production in manufacturing steel at its Pueblo plant. Reported lime output in Colorado in 1982 was less than one-half that of 1981, resulting mainly from reduced steel production by CF&I and its consequent smaller lime requirements.

Peat.—Six companies produced peat in five counties—Alamosa, Boulder, Chaffee, Park, and Teller. Two companies, Universal Peat Co., in Park County, and Bonaza Soil Products Inc., in Teller County, produced more than 90% of the total. Almost the entire peat output was delivered in bulk rather than packaged. Amount produced increased by more than 40% over the 1981 level. Colorado ranked 6th among 21 peat-producing States with over 6% of the national total.

Perlite.—Persolite Products Inc. reported crude perlite production from its Rosita Mine in Custer County. Output of the mine was shipped to Persolite's expanding plant in Florence, 36 miles away. A second perlite expanding plant, Grefco Inc., at Antonito, treated crude perlite from No Agua, N. Mex., several miles to the south. A type of volcanic ash, perlite is commonly used in cement blocks, floor and ceiling tiles, heat and sound insulation, wall plaster, and other building materials; thus the construction slowdown affected production. Output in Colorado in 1982 was about one-third less than in 1981.

The Grefco plant, the larger of the two, produced two types of perlite—regular perlite, which was expanded for horticultural uses and construction materials, and perlite filtering used to take impurities out of soft drinks and foods. About 25 of the plant's 100 employees were laid off during the year.

Pyrites.—AMAX produced pyrite as a byproduct of molybdenum at its Climax Mine near Leadville. Three to five pounds of pyrite were removed from each ton of ore processed at the Climax mill. Because of reduced operations and closure of the Climax Mine during the year, pyrite output was less than two-thirds the 1981 output. Colorado ranked second of three States producing pyrite, accounting for a very small fraction of total output.

Salt.—Union Carbide recovered salt in the form of brine from a well in Montrose County for use in the company's uranium-vanadium mill at Uravan. Because salt production was related to needs at the Uravan mill, which was closed 8 months in 1982, output was substantially less than in 1981. Colorado salt production was an infinitesimal portion of total national output.

Sand and Gravel.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981 collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Sand and gravel, the most common of the State's minerals, was reported mined in 42 of Colorado's 63 counties. One hundred and eight companies produced construction sand and gravel, and 5 companies produced industrial sand and gravel at 249 pits from 171 deposits. The quantity produced was about 17% less than the estimated 1981 output, reflecting a continuing slump in the construction industry. The major producing counties were those related to metropolitan areas. Six counties reported production exceeding 1 million tons of construction sand and gravel. The largest producer, Adams County (metro Denver), reported nearly 4

million tons of construction sand and gravel output. Two counties, Jefferson (metro Denver) and El Paso (Colorado Springs), produced over 2 million tons, and three counties, Weld (Greeley and metro Denver), Mesa (Grand Junction), and Larimer (Fort Collins), produced over 1 million tons. The top two counties accounted for nearly one-third of the State's sand and gravel output, and the top six producers for nearly two-thirds of the total. A high-bulk, low-value mineral such as sand and gravel cannot be economically shipped very far. More than 90% of Colorado's output was moved from production pit to consumption site by truck.

About two-thirds of the State's sand and gravel output was gravel, a little less than one-fourth was sand, and the remainder was an unprocessed mixture of the two. Only a small fraction of total sand and gravel production was industrial sand and gravel. The major uses of industrial sand were in manufacturing containers and for hydraulic fracturing of geologic formations in oil production. Nearly 50% of construction sand and gravel was used as road-base material; more than 25% as construction aggregate; 13% in asphalt and construction aggregate; and the balance as fill material, in construction products, plaster and gunite, railroad ballast, snow and ice control, and other uses. The average price of construction sand and gravel was about $3.10 per ton, with values ranging from $1.79 to $4.58 per ton. Industrial sand ranged in price from $7.50 to $22.93 per ton.

Mobile Premix Concrete Inc. was the largest individual producer of sand and gravel in the State. Other major producers, ranked in order of output, included Cooley Gravel Co., Schmidt-Tiago Construction Co., Zignan Sand and Gravel Inc., Asphalt Paving Co., Flatiron Sand and Gravel Co., Western Paving Co., and Brannan Sand and Gravel Co. Among the 108 producers, 10 companies each produced one-half million tons or more; 12 produced between one-quarter million tons and one-half million tons. One-half the total State output was by the nine largest companies. Twenty-three companies produced 75% of total output. One company produced one-half of the industrial sand.

Annual production yields at sand and gravel operations in the State were as follows: 1 exceeded 1 million tons; 7 were 500,000 to 1 million tons; 38 were 50,000 to 99,999 tons; 35 were 25,000 to 49,999 tons; and the largest number of operations, 47, or more than 27%, was less than 25,000 tons. Seventy percent of all operations was less than 100,000 tons per year.

Public controversy over proposed mining sites continued to be a fact of life for sand and gravel operators. Among sites drawing particular public notice were the South Draw Quarry proposal; Deer Creek Canyon and Clear Creek Canyon proposals in Jefferson County; a proposed site near Canon City in Fremont County; and several proposed sites in Garfield County. A suit filed against the Garfield County commissioners challenged their power to impose certain conditions on mining Federal land.

Table 8.—Colorado: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	5,236	$19,436	$3.71
Plaster and gunite sands	217	725	3.34
Concrete products	594	2,724	4.58
Asphaltic concrete	2,591	6,947	2.68
Road base and coverings[1]	9,164	26,635	2.91
Fill	1,116	2,001	1.79
Snow and ice control	209	620	2.96
Railroad ballast	137	803	5.84
Other	327	888	2.72
Total or average	19,591	[2]60,780	3.10

[1]Includes road and other stabilization (lime).
[2]Data do not add to total shown because of independent rounding.

Table 9.—Colorado: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	4,619	$15,310	$3.31
Gravel	NA	NA	NA	12,761	40,862	3.20
Sand and gravel (unprocessed)	--	--	--	2,212	4,608	2.08
Total or average	e23,500	e$73,300	e$3.12	[1]19,591	60,780	3.10
Industrial:						
Sand	W	W	22.31	W	W	14.84
Gravel	--	--	--	W	W	9.00
Grand total or average	W	W	e3.18	19,813	64,045	3.23

eEstimated. 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.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

The Colorado Lien Co. invoked the Boulder District Court and U.S. Supreme Court rulings restricting local and county authority over mining on Federal lands; in the suit, the company challenged conditions the Garfield County commissioners placed upon a limestone mining operation. The Supreme Court ruling prohibited the county government from denying Colorado Lien a permit to mine; thus, the point in question became what constituted "reasonable conditions" the county could apply. Citizen protest against proposed quarry operations continued, one of the most controversial relating to Colorado Rock Co.'s South Draw Quarry proposal in northern Jefferson County.

Sulfur (Recovered).—Continental Oil recovered elemental sulfur from acid gases at its petroleum refinery 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. About two-thirds of the product was used in fireproofing, and most of the remainder in block insulation, loose-fill insulation, and horticultural use.

[1]State Liaison Officer, Bureau of Mines, Denver, Colo.
[2]Geologist, Colorado Geological Survey, Denver, Colo.

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]	6801 Rockledge Dr. Bethesda, MD 20817	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.
U.S. Soil Conditioning Co	Box 926 Salida, CO 81201	do	Do.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
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:			
CF&I Steel Corp.[1]	Box 316 Pueblo, CO 81002	Mine	Pueblo.
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.
Perlite:			
Grefco Inc	Box 308 Antonito, CO 81120	Plant	Conejos.
Persolite Products Inc	Box 105 Florence, CO 81226	Mine and plant	Custer and Fremont.
Sand and gravel:			
Asphalt Paving Co	14802 West 44th Ave. Golden, CO 80401	Pit and plant	Jefferson.
Cooley Gravel Co.[1]	Box 5485TA Denver, CO 80217	Pits and plants	Adams and Arapahoe.
Flatiron Sand and Gravel Co	Box 229 Boulder, CO 80302	do	Boulder, Douglas, Eagle, Jefferson, Larimer, Weld.
Mobile Premix Concrete Inc.[1]	Box 5183TA 1590 West 12th Ave. Denver, CO 80217	do	Adams, Jefferson, Larimer, Moffat, Weld.
Schmidt-Tiago Construction Co.[1]	Box 487 Arvada, CO 80002	do	El Paso, Garfield, Moffat, Rio Blanco, Routt.
Zignan Sand and Gravel Inc	1875 West Dartmouth Englewood, CO 80110	do	Adams.
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.
Vanadium:			
Cotter Corp	Box 352 Golden, CO 80401	do	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 1982 was $56.1 million, the third consecutive year value declined and $13.1 million below the 1979 record of $69.2 million. Output of clay, feldspar, lime, sand and gravel, and crushed stone decreased.

Nationally, Connecticut continued to rank second in feldspar production and fifth in mica. In New England, the State ranked second in output of crushed stone and lime.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	73	$391	56	$329
Lime	do.	16	1,190	8	568
Sand and gravel:					
Construction	do.	e6,500	e15,400	4,920	16,388
Industrial	do.	W	W	80	1,746
Stone:					
Crushed	do.	r6,837	r36,745	p6,100	p32,700
Dimension	do.	19	910	p20	p1,046
Combined value of feldspar, gem stones, mica (scrap), and value indicated by symbol W		XX	3,985	XX	3,299
Total		XX	r58,621	XX	56,076

eEstimated. pPreliminary. 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

(Thousands)

County	1980	1981[1]	Minerals produced in 1981 in order of value
Fairfield	$1,854	(2)	
Hartford	W	W	Stone (crushed), clays, stone (dimension).
Litchfield	9,746	W	Stone (crushed), lime.
Middlesex	4,643	W	Feldspar, mica, clays.
New Haven	W	W	Stone (crushed), stone (dimension).
New London	2,964	W	Sand and gravel (industrial).
Tolland	1,198	W	Stone (dimension).
Windham	W	W	Stone (crushed), stone (dimension).
Undistributed[3]	45,357	$43,221	
Sand and gravel (construction)	XX	e15,400	
Total	[4]65,763	58,621	

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

[1]County distribution for construction sand and gravel is not available; total State value shown separately under "Sand and gravel (construction)."

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

[3]Includes gem stones 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

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,591.0	1,608.0	+1.1
Unemployment	do	98.0	111.0	+13.3
Employment (nonagricultural):				
Mining	do	(1)	(1)	--
Manufacturing	do	439.0	416.2	-5.2
Contract construction[2]	do	50.8	50.1	-1.4
Transportation and public utilities	do	61.3	61.8	+.8
Wholesale and retail trade	do	303.6	303.2	-.1
Finance, insurance, real estate	do	110.0	113.4	+3.1
Services	do	291.6	301.3	+3.3
Government	do	182.4	179.5	-1.6
Total nonagricultural employment	do	1,438.7	1,425.5	-.9
Personal income:				
Total	millions	$40,131	$43,158	+7.5
Per capita		$12,806	$13,687	+6.9
Construction activity:				
Number of private and public residential units authorized		9,421	10,376	+10.1
Value of nonresidential construction	millions	$730.8	$553.0	-24.3
Value of State road contract awards	do	$77.5	$67.1	-13.4
Shipments of portland and masonry cement to and within the State	thousand short tons	606	624	+3.0
Nonfuel mineral production value:				
Total crude mineral value	millions	$58.6	$56.1	-4.3
Value per capita, resident population		$20	$18	-10.0
Value per square mile		$12,516	$11,195	-10.6

pPreliminary.

[1]Included with "Contract construction."

[2]Includes mining.

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.—Although production and sales in the State's mining sector declined in 1982, Connecticut's unemployment rate was below both national and regional levels. The U.S. unemployment rate increased from 7.6% in 1981 to 9.7% in 1982; in Connecticut, the rate increased from 6.2% in 1981 to 7% in 1982. The 0.8% increase in unemployment was the lowest among the six New England States and 0.6% below the region's average rate of 1.4%.[2]

Manufacturing has traditionally been an important segment of the State's industrial base. Nearly 30% of the total nonagricultural employment in Connecticut in 1982 was employed in manufacturing; in comparison, New England and U.S. figures were 26% and 21%, respectively.

The downturn in the Nation's economy affected Connecticut's manufacturing sector as employment dropped by 6% in 1982 compared with 1981 levels. Table 4 reflects some of the developments in the State's manufacturing sector during the year. The mixed performance, indicated by plant openings, expansions, and closings was typical of most States in 1982.

Table 4.—Connecticut: Selected developments in manufacturing in 1982

Company	Location	Event
Bristol Brass Co	Bristol	Plant was closed after operating for 1 year under chapter 11 of the Federal Bankruptcy Code. Eastern Rolling Mills Inc. seeking to acquire at yearend.
Emhart Corp	Farmington	Closed the Farrell-Rochester machine tool plant. The firm spent $6 million in an unsuccessful attempt to regain profitability. About 335 workers lost their jobs.
Howmet Turbine Components Corp	Winsted	Opened a new $9.5 million facility to manufacture engine blades and vanes. Eventual employment was expected to be 250.
Phelps Dodge Corp	Norwich	Increased production to capacity of 175,000 tons per year at continuous casting copper rod mill.
Plume & Atwood Brass Mill	Thomaston	Restructuring product line to shift to electronic markets. Work force was reduced from 325 in 1981 to 90 in 1982.
Sikorsky Aircraft, a division of United Technologies Corp.	Stratford	Aircraft engineering and manufacturing facilities expanded by 330,000 square feet to 2 million square feet.
Trumpf America Inc	Farmington	Received a $3.5 million bond guarantee from Connecticut Development Authority for addition to sheet metal facility.

Legislation and Government Programs.—The 1982 Connecticut General Assembly, under sections of Public Act 82-91, authorized the State's Department of Environmental Protection (DEP) to levy permit or user fees. Sand and gravel dredging, dam and reservoir construction, and coastal zone building or filling were among the activities included under the new stipend. User fees shift the tax burden for processing applications from general tax funds to the individual or company receiving the permit or service. Fee schedules for the various permit activities were expected to be completed by the DEP before July 1983 when the legislation becomes effective.

Also in 1982, the Legislature passed a toxic waste disclosure act that required employers to provide education and training on workplace toxics during a new worker's first month on the job. The State's chemical industry and other segments of the manufacturing sector were concerned about the cost of implementing the new legislation, which becomes effective July 1, 1983. The act also included a "superfund" provision for cleanup of hazardous waste areas polluted with chemical wastes, sludges, and metal byproducts. A 4-cent-per-gallon waste charge was to be administered by the DEP for waste cleanup and safety inspections.

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 1982 General Assembly." The index lists measures by bill number and includes amendments to existing statutes.[3]

During the year, the Connecticut Geological and Natural History Survey continued bedrock and surficial mapping through a cooperative program with the U.S. Geological Survey and through a separately funded State program. Other Connecticut Survey activities included studies on base-metal mineralization and mapping of mined lands.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—Output of clay dropped for the third consecutive year. The State's two producers, K-F Brick Co. and The Michael Kane Brick Co., manufactured brick from common clay.

K-F Brick Co., Hartford County, applied to the DEP for permission to use a 75% coal-25% natural gas mixture for kiln fuel; previously, the firm used all natural gas. The conversion plans exemplify a growing trend in the brick industry aimed at lowering fuel costs in the manufacturing process. The DEP's decision on the conversion plans remained pending at yearend.

Feldspar.—Commercial mining of feldspar began in the State about 1825, and Connecticut was the leading U.S. producer until 1909. Connecticut again in 1982 ranked second nationally in feldspar production; North Carolina ranked first.

In 1982, The Feldspar Corp., the State's only producer, mined feldspar at two open pits in Middletown, Middlesex County. Output dropped compared with that of 1981, reflecting weakened demand from the glass industry.

The crude ore was beneficiated using a flotation system and marketed as a flux in glassmaking and ceramics. Shipments were by truck, primarily to the New England States, New Jersey, and New York.

Lime.—In 1982, lime output in Connecticut dropped to 8,000 tons, marking the third year of a continuing downward trend. In 1979, 33,000 tons of lime was manufactured; in 1980, 19,000 tons; and in 1981, 16,000 tons. The decline resulted from depressed sales to the construction industry.

Pfizer Inc., Connecticut's only lime manufacturer, produced dolomitic hydrated lime and quicklime at Canaan in the northwestern corner of the State. Limestone was mined at a nearby quarry and trucked to the company's plant. The lime was used primarily for mason's lime, sewage treatment, and glass manufacturing. Market areas included Connecticut, Massachusetts, New Jersey, New York, and Rhode Island. Pfizer also produced calcium metal at the Canaan plant. This is the only calcium metal facility in the United States.

Mica.—The Feldspar Corp. continued to recover mica as a byproduct of the company's feldspar mining operations in Middletown. The mica was shipped to Heflin, Ala., for fine grinding and marketed as a filler and as an additive in well-drilling muds.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Production declined for the fourth consecutive year reflecting reduced demand from the construction industry. Since 1978, the number of private and public residential units authorized in Connecticut dropped from 15,851 to 10,376 in 1982.[4] Similarly, sand and gravel output in the State decreased from 11 million tons in 1978 to 4.9 million tons in 1982. Sand and gravel was mined in all eight counties in the State; Hartford, New Haven, and Tolland were the leading producing counties in 1982. Since 1980, the number of active operations in the State decreased from 124 to 81.

Table 5.—Connecticut: Construction sand and gravel sold or used by major use category in 1982

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,678	$6,455	$3.85
Plaster and gunite sands	13	75	5.57
Concrete products	238	846	3.56
Asphaltic concrete	613	2,260	3.69
Road base and coverings[1]	1,189	3,215	2.70
Fill	631	1,480	2.35
Snow and ice control	310	977	3.15
Other	248	1,081	4.36
Total or average	4,920	[2]16,388	3.33

[1]Includes road and other stabilization (cement).
[2]Data do not add to total shown because of independent rounding.

Table 6.—Connecticut: Sand and gravel sold or used by producers, by use

Use	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	2,354	$7,787	$3.31
Gravel	NA	NA	NA	1,975	7,131	3.61
Sand and gravel (unprocessed)	--	--	--	591	1,470	2.48
Total or average	e6,500	e$15,400	e$2.37	4,920	16,388	3.33
Industrial sand	W	W	25.67	80	1,746	21.84
Grand total or average	W	W	e2.51	5,000	18,134	3.63

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

Industrial.—Three companies produced industrial sand in southern Connecticut in 1982. The State ranked second in output among the three New England States that produced industrial sand.

Stone.—To reduce reporting burdens and costs, the Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and preliminary estimates, only, for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Crushed.—Output of crushed stone dropped from 6.8 million tons to an estimated 6.1 million tons in 1982. Traditionally, about 70% of the crushed stone produced in Connecticut was for use in road construction and maintenance. From 1979 through 1981, leading counties in output were New Haven, Hartford, and Litchfield; the combined tonnage for these counties accounted for about 80% of the State's total production.

Dimension.—Output increased slightly in 1982 compared with that of 1981 to nearly 20,000 tons or about 230,000 cubic feet. During the year, the State's leading dimension granite producer extended a lease with the town of Branford, New Haven County, due to expire in 1992, for an additional 50 years. This extension was sought because the company plans to invest in finishing equipment and machinery. Terms of the agreement stipulated (1) an annual rental fee of $1,000, (2) royalty payments of $0.10 per cubic foot of finished stone for the first 25 years and $0.20 for the subsequent 25 years, (3) site inspection privileges for town officials, and (4) liability insurance of $1 million per incident.[5] The operation was one of only four active dimension granite quarries in the State.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.

[2]Federal Reserve Bank of Boston. New England Economic Indicators. March 1983, p. B6.

[3]Greater Hartford Chamber of Commerce. The Classified Index of Legislation Enacted by the 1981 General Assembly, State Legislation Committee. August 1982, 18 pp; for more information write to the Greater Hartford Chamber of Commerce, 250 Constitution Plaza, Hartford, CT 06103.

[4]Bureau of the Census (Dept. of Commerce). Construction Review. March-April 1983, p. 31.

[5]Branford Review. Nov. 18, 1982, 3 pp.

Table 7.—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.
Lime:			
Pfizer Inc.[3]	Daisy Hill Rd. Canaan, CT 06018	Pit and limekiln	Litchfield.
Sand and gravel:			
Construction:			
Dan Beard Inc.[2]	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.[4]	1776 South Main St. East Granby, CT 06026	do	Hartford.
Tilcon Inc.[4]	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.
York Hill Trap Rock Quarry Co	Westfield Rd. Meriden, CT 06450	do	New Haven.

[1] Also crude mica.
[2] Also industrial sand.
[3] Also limestone.
[4] 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 Kebblish[1] and Thomas E. Pickett[2]

The value of Delaware's nonfuel mineral production in 1982 was $3.2 million, a slight increase over that of 1981. The two mineral commodities produced in the State were construction sand and gravel and magnesium compounds extracted from seawater. Production and value of magnesium compounds are excluded from total State figures to avoid disclosing company proprietary data. Commodities such as iron and steel slag and sulfur were recovered as byproducts in steelmaking and oil refining, respectively. Gypsum and titanium were shipped into Delaware and processed into higher-value-added products. One company operated a steel mill in the northern part of the State. Delaware continued to rank 50th nationally in value of nonfuel mineral output.

Trends and Developments.—The 1981 nationwide recession continued through 1982 and had a significant impact on industries located in the State. Especially affected was the Phoenix Steel Corp. Claymont plant, which operated at a financial loss, requiring temporary closing, renegotiation of a labor contract, and infusion of funds from the majority stockholder Creusot Loire S.A., a French firm. At yearend, the precarious financial condition of the steel plant continued.

In contrast with a 7% decrease in total value of nonresidential construction nationwide from 1981 to 1982, statewide value for Delaware increased nearly 19%. This increase boosted sand and gravel production, but gypsum products produced in the State declined since these enter interstate commerce. Also demonstrating an increase was production of magnesium compounds used in pharmaceuticals and other health-related products, which are not usually affected by national recessionary trends.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel (construction) ------ thousand short tons	[e]1,205	[e]$2,959	1,300	$3,197
Total ----------	XX	[2]2,959	XX	[2]3,197

[e]Estimated. 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

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	288.0	299.0	+3.8
Unemployment	do	23.0	25.0	+8.7
Employment (nonagricultural):				
Mining	do	(1)	(1)	--
Manufacturing	do	71.0	67.9	-4.4
Contract construction	do	13.4	15.2	+13.4
Transportation and public utilities	do	12.1	11.6	-4.1
Wholesale and retail trade	do	56.6	56.6	--
Finance, insurance, real estate	do	12.9	13.4	+3.9
Services[2]	do	48.8	50.1	+2.7
Government	do	44.5	43.9	-1.3
Total nonagricultural employment[3]	do	259.2	258.6	-.2
Personal income:				
Total	millions	$6,643	$7,104	+6.9
Per capita		$11,102	$11,796	+6.3
Construction activity:				
Number of private and public residential units authorized		2,302	3,050	+32.5
Value of nonresidential construction	millions	$93.0	$110.4	+18.7
Value of State road contract awards	do	$40.0	$68.8	+72.0
Shipments of portland and masonry cement to and within the State	thousand short tons	130	161	+23.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$3.0	$3.2	+6.7
Value per capita, resident population		$5	$5	--
Value per square mile		$1,361	$1,554	+14.2

[p]Preliminary.
[1]Included with "Services."
[2]Includes mining.
[3]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.

Legislation and Government Programs.—The Governor signed into law Senate bill 610, authorizing disposal of nonhazardous industrial waste at landfills in Kent and New Castle Counties. Also signed into law was a bottle bill requiring a deposit on beverage containers, except those made of aluminum. Beginning in 1984, deposits also will be required on aluminum beverage containers.

A Governor's committee was formed to develop a statewide water plan pertaining to problems and available options. Of special interest is ownership of ground water, contamination, and State regulatory authority. In Delaware, ground water supplies more than one-half of the population with drinking water. At yearend, studies continued on these problems.

Amendments to Delaware's wetlands regulations require individuals engaged in dredging operations, construction, or filling of marshlands to obtain State permits. Those violating wetlands regulations may now be tried in local justice of the peace offices instead of the superior court.

During fiscal year 1982, the Federal Government provided $279 million to the Delaware Treasury for State programs such as highway construction, subsidized housing, urban development grants, and other State-related programs. The amount represented a $35 million reduction compared with the 1981 allotment.

Delaware also will share in the Federal Superfund for elimination of hazardous waste sites. Eight sites have been identified within the State by the U.S. Environmental Protection Agency for possible treatment purposes, all located in New Castle County. One site contains electric-furnace dust, which is currently being recycled.

Additional Federal funds were paid to local governments within the State. These payments, known as "payments in lieu of taxes," totaled $4,520 in 1982 and were paid to two units of local government for 6,636 acres of nontaxable Federal land within local government jurisdiction.

In 1982, the Delaware Geological Survey continued work on offshore oil and gas potential, geologic mapping, ground water availability and quality, geothermal evaluation, sanitary and hazardous landfills, and geologic hazards. The State Survey obtained additional mid-Atlantic well data for analysis during the year. The second phase of the analysis program is nearing completion, with maps being prepared to indicate potential oil and gas reserves. Ground water

investigations include possible contamination from a waste dump area near Glasgow, requiring drilling of six test holes. Other programs include a study of ground water in southern New Castle County, initiation of an educational program on ground water and geophysical logging, cooperative programs with a Federal agency involving 15 continuous record stream gauging stations and 20 ground water observation wells, and investigation of a sinkhole emergency.

The State Survey received a $26,558 Federal Emergency Management Agency contract for continuation of data repository scheduled for completion in late 1982. The Survey also became affiliated with the National Cartographic Information Center, providing data on the State's geology.

Survey publications in 1982 include the following: Bulletin No. 16, "Ground Water Resources of the Piney Point and Cheswold Aquifers"; Hydrologic Map Series No. 3, "Geohydrology of the Wilmington Area" and No. 4, "Geohydrology of the Milford Area"; Open File Reports No. 16, "Geologic and Hydrologic Aspects of Landfills," No. 17, "A Guide to Information on Benchmarks in Delaware," No. 18, "A Numerical Indicator of Water Conditions for Northern Delaware," and No. 19, "Regolith Thickness of the Delaware Piedmont"; and Report of Investigation No. 36, "History of Oil and Gas Exploration in the Mid-Atlantic Region and Delaware's Involvement in the Federal OCS Leasing Program."

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Gypsum (Calcined).—Crude gypsum imported from Nova Scotia, Canada, was calcined by Georgia-Pacific Corp. at Wilmington, New Castle County. Production and sales of calcined gypsum decreased in both quantity and value compared with 1981 levels. The primary product from gypsum was wallboard for housing construction.

Iron and Steel Slag.—International Mill Service Co., a subsidiary of IU International Corp., processed and sold steel slag produced at the Phoenix Steel facility in Claymont. From 1981 to 1982, quantity and value decreased 26% and 28%, respectively, owing to reduced production of steel products. Slag is produced from steelmaking operations when a flux, such as limestone, combines with the waste portion of the ore. The steel slag sold was used mainly for road base.

Magnesium Compounds.—The Barcroft Co., the sole producer of magnesium compounds in the State, extracted magnesium from ocean water at its plant in Lewes, Sussex County. Both production and value increased slightly from 1981 levels. The recovered product, magnesia, was used in pharmaceuticals, including milk of magnesia. A proposed geothermal well that was to be drilled on company property adjacent to the Delaware Bay was temporarily canceled for financial reasons. State and Federal monies were to be appropriated for the project. The water from the geothermal well was to be used as a heat source for processing of magnesium at the Barcroft facility.

American Minerals Inc. began processing magnesium oxide imported from Greece and China at a new plant near the Wilmington Marine Terminal. Other minerals processed include manganese dioxide, iron chromite, and chrome sands.

Sand and Gravel (Construction).—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981 collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. Construction sand and gravel was one of two principal mineral commodities produced in Delaware, the other being magnesium compounds. In 1982, production totaled 1.3 million tons valued at $3.2 million, with a unit value of $2.46 per ton. Approximately 77% of the total product was processed sand and gravel; the remainder, unprocessed. Production occurred in all three of Delaware's counties, with New Castle County in the northern part of the State leading in output.

Eight sand and gravel companies operated eight deposits throughout the State—two in New Castle County, five in Kent County, and one in Sussex County. Two operations produced less than 25,000 tons each, two produced between 25,000 and 50,000 tons each, one produced between 50,000 and 100,000 tons, two produced between 200,000 and 300,000 tons each, and one produced between 600,000 and 700,000 tons.

Approximately 83% of the sand and gravel was transported to market by truck; the remainder, by other means. Construction sand and gravel was used mainly for road base and coverings, with lesser amounts used for concrete aggregate, concrete products, fill, and other uses.

Table 3.—Delaware: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	340	$927	$2.73
Plaster and gunite sands	37	135	3.69
Concrete products	W	W	3.25
Asphaltic concrete	W	W	3.13
Road base and coverings	751	1,652	2.20
Fill	63	135	2.15
Other	110	346	3.15
Total[1] or average	1,300	3,197	2.46

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Data may not add to totals shown because of independent rounding.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	NA	NA	NA	379	$1,120	$2.96
Gravel	NA	NA	NA	618	1,413	2.29
Sand and gravel (unprocessed)	--	--	--	303	664	2.19
Total or average	e1,205	e$2,959	e$2.46	1,300	3,197	2.46

eEstimated. NA Not available.

Sulfur (Recovered).—Byproduct sulfur was recovered at the Getty Refining & Marketing Co. refinery located in Delaware City, New Castle County. The refinery, the largest of the Getty Oil Co. refineries, processed an average of 118,100 barrels per day of crude oil, including 11,200 barrels per day processed for others, a slight decrease in the former with an increase in the latter compared with 1981 levels. A second desulfurization system is being installed at the refinery, with an expected mid-1983 completion date. The second system will allow for refining of less expensive, high-sulfur crude oil. Also under construction is a 23-mile pipeline between the refinery and the coastal port at Marcus Hook, Pa. When completed, the 16-inch-diameter pipeline will be connected to an existing pipeline for transportation of finished products from the refinery to the New York City area.[3]

METALS

Iron and Steel.—Phoenix Steel, with a plant at Claymont, New Castle County, produced carbon, alloy, and clad plate used for construction of railroad cars and marine vessels. Armorplate was also produced and used for military vehicles. The company continued to produce Detaclad, an explosion-bonded product patented by E. I. du Pont de Nemours & Co. Inc. Detaclad is used mainly by the chemical industry.

At midyear, Phoenix Steel reduced its work force and temporarily closed operations owing to the lack of orders for steel products. A labor-management contract was also negotiated. At yearend, Creusot Loire of France, which owns controlling interest in Phoenix Steel, provided additional capital to keep the company operational.

Titanium Dioxide.—One of the Nation's

11 titanium dioxide pigment plants is located in Edgemoor, New Castle County, and owned by Du Pont. The plant has the capacity to produce 110,000 tons of pigment per year using the chloride process. The production from this plant, added to that of three company plants in other States, makes Du Pont the largest producer of titanium dioxide pigments in the Nation, with approximately 59% of the Nation's total output. Titanium dioxide is used mainly in the manufacture of paints and in paper coatings.

Du Pont also continued to expand the Newport plant near Wilmington, doubling capacity for chromium dioxide magnetic particles used in audio and visual equipment. A product developed by Berg Electronics, a division of Du Pont, consists of a palladium alloy coating for electronic connectors to compete with gold-coated connectors.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.
[2]Associate director, Delaware Geological Survey, University of Delaware, Newark, Del.
[3]Getty Oil Co. 1982 Annual Report. Pp. 19, 21.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Gypsum (calcined):			
Georgia-Pacific Corp	133 Peachtree St., NE. Atlanta, GA 30303	Plant	New Castle.
Iron and steel slag:			
International Mill Service Co	1500 Walnut St. Philadelphia, PA 19102	do	Do.
Magnesium compounds:			
The Barcroft Co	Box 474, Henlopen Dr. Lewes, DE 19958	do	Sussex.
Sand and gravel (construction):			
Barber Sand & Gravel	R.F.D. 1 Harrington, DE 19952	do	Kent.
Contractors Sand & Gravel Co	Box 2630 Wilmington, DE 19805	Pit	New Castle.
Dover Equipment & Machine Co	113 West 6th St. Dover, DE 19901	Dredge	Kent.
Parkway Gravel Inc	4048 New Castle Ave. New Castle, DE 19720	Pits	New Castle.
Staytons Sand & Gravel Inc	R.D. 1, Box 305 Felton, DE 19943	Pit	Kent.
Sulfur (recovered):			
Getty Refining & Marketing Co	Delaware City, DE 19706	Refinery	New Castle.

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 1982 in Florida was $1.2 billion, a decrease of $504.5 million from that of 1981. The decrease was the first drop in value since 1977. Florida ranked fourth nationally in total value of nonfuel minerals produced, and nonmetals accounted for over 97% of the value of the State's mineral output. The State ranked first in the production of phosphate rock; second in crushed stone, fuller's earth, and peat; and third in masonry 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.

Of the 37.4 million tons of phosphate rock produced in the United States, Florida remained the predominant producer and, for the 89th consecutive year, supplied more than any other State. Florida and North Carolina supplied 84.8% of the domestic phosphate rock output, and Florida supplied most of the exports.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	288	$20,757	231	$16,267
Portland do	3,518	199,064	2,651	136,190
Clays do	731	[2]35,319	672	[2]31,339
Gem stones	NA	6	NA	6
Lime thousand short tons	191	11,343	103	5,828
Peat do	157	2,885	120	1,575
Sand and gravel:				
Construction do	e14,910	e30,600	13,749	30,481
Industrial do	349	4,419	341	4,257
Stone (crushed) do	65,067	226,192	p53,100	p182,300
Combined value of clays (kaolin), magnesium compounds, phosphate rock, rare-earth metal concentrate, staurolite, titanium concentrates (ilmenite and rutile), and zircon concentrates	XX	1,197,304	XX	815,155
Total	XX	r1,727,889	XX	1,223,398

eEstimated. pPreliminary. 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.

The recession impacted on Florida's economy in 1982, resulting in an unemployment rate at yearend of 9.5% compared with 7.3% at yearend 1981. Phosphate workers experienced an unemployment rate of nearly 25% at midyear, dropping to 18% in December. Florida, the fastest growing State in the southeast in terms of population, had maintained a high level of residential construction until 1982. During the year, most construction activity decreased, adversely affecting the minerals industry, especially in the southern part of the State. Although Florida's business climate was rated one of the best in the Nation, new plant openings dropped sharply in 1982.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Alachua	$4,391	$3,429	Stone.
Bay	1,021	(3)	
Brevard	W	W	Stone, clays.
Broward	28,587	29,778	Stone.
Calhoun	46	(3)	
Charlotte	717	1,350	Stone.
Citrus	7,594	4,248	Stone, phosphate rock.
Clay	27,858	31,954	Titanium, zircon, staurolite, monazite.
Collier	8,339	9,500	Stone.
Dade	W	W	Cement, stone.
Escambia	617	(3)	
Gadsden	20,339	20,230	Clays.
Glades	W	W	Sand and gravel (industrial).
Gulf	W	W	Magnesium compounds, lime.
Hamilton	W	W	Phosphate rock.
Hardee	W	W	Do.
Hendry	534	319	Stone.
Hernando	W	W	Cement, stone, lime, clays.
Highlands	W	W	Peat.
Hillsborough	W	139,401	Phosphate rock, cement, stone, peat.
Jackson	W	W	Stone.
Lake	W	W	Peat, clays.
Lee	W	14,484	Stone.
Leon	W	(3)	
Levy	3,985	4,127	Stone.
Manatee	W	W	Cement, phosphate rock, stone.
Marion	W	W	Stone, clays, phosphate rock.
Monroe	4,020	W	Stone.
Okaloosa	17	(3)	
Orange	58	42	Stone.
Palm Beach	6,319	3,196	Do.
Pasco	3,437	2,883	Do.
Polk	784,741	869,928	Phosphate rock, sand and gravel (industrial), stone, peat.
Putnam	W	W	Sand and gravel (industrial), clays, peat.
St. Lucie	W	902	Stone.
Sarasota	W	660	Do.
Sumter	W	W	Lime, stone.
Suwannee	777	957	Stone.
Taylor	3,922	2,591	Do.
Walton	W	(3)	
Undistributed[4]	601,938	557,312	
Sand and gravel (construction)	XX	e30,600	
Total[5]	1,509,258	1,727,889	

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.

[2]County distribution for construction sand and gravel is not available; total 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 values indicated by symbol W.

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

Table 3.—Indicators of Florida business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	4,504.0	4,728.0	+5.0
Unemployment	do	307.0	386.0	+25.7
Employment (nonagricultural):				
Mining[1]	do	11.3	9.6	-15.0
Manufacturing	do	472.2	459.9	-2.6
Contract construction	do	283.1	253.6	-10.4
Transportation and public utilities	do	229.8	230.4	+.3
Wholesale and retail trade	do	987.2	999.6	+1.3
Finance, insurance, real estate	do	274.3	280.5	+2.3
Services	do	858.9	901.0	+4.9
Government	do	620.1	627.4	+1.2
Total nonagricultural employment[1]	do	3,736.9	3,762.0	+.7
Personal income:				
Total	millions	$103,502	$113,273	+9.4
Per capita		$10,165	$10,875	+7.0
Construction activity:				
Number of private and public residential units authorized		146,557	103,735	-29.2
Value of nonresidential construction	millions	$2,941.5	$2,768.4	-5.9
Value of State road contract awards	do	$416.0	$391.0	-6.0
Shipments of portland and masonry cement to and within the State	thousand short tons	5,724	4,398	-23.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,727.9	$1,223.4	-29.2
Value per capita, resident population		$177	$117	-33.9
Value per square mile		$29,467	$20,891	-29.1

[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.

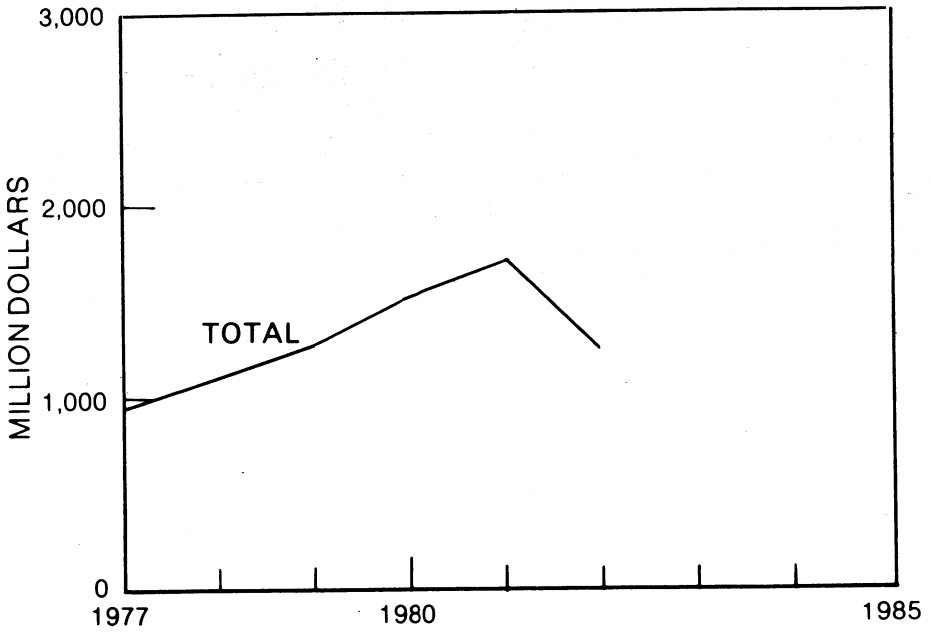

Figure 1.—Total value of nonfuel mineral production in Florida.

Trends and Developments.—The Port of Tampa, which handled nearly 40 million tons of cargo in 1982, shipped the major portion of exported phosphate. Phosphate rock and processed phosphate exports totaled nearly 13 million tons, about the same as in 1981. Exports of phosphate through Jacksonville totaled 557,000 tons, down from 585,000 tons in 1981. Port Manatee's phosphate shipments totaled nearly 2 million tons, mostly from Beker Phosphate Inc.'s new mine. Beker sent rock to its plant in Taft, La., for processing and distribution. Beker took delivery of a 42,000-deadweight-ton, self-unloading barge for transportation of phosphate rock. Reportedly, the largest self-unloading barge in the world, it is capable of discharging 4,000 tons per hour.

The Port of Tampa also imported about 650,000 tons of aragonite from The Bahamas for use in the manufacture of cement, down from 750,000 tons in 1981. Gypsum imports increased slightly, while those of coal and liquid sulfur decreased.

Family Lines Rail Systems completed a $21 million expansion of its Rockport phosphate export facility at Tampa. Capacity was increased 30% to 9.1 million tons per year.

Mobil Chemical Corp. plans to build a phosphate loading terminal in Tampa. The Tampa Port Authority authorized the sale of up to $85 million in bonds to finance construction. Bond payments will be covered by Mobil's lease arrangements with a guarantee of $300,000 per year in fees. Capacity will be 250,000 tons, and the facility may be shared with another company. Over one-half of Mobil's output was shipped out of Tampa.

Early in the year, The Anaconda Company was considering the Tampa Bay area as one of several sites nationwide for a copper and precious metals refining facility. The main advantage to the site would be a market for recovered sulfuric acid in the Florida phosphate industry. The required capital expenditure of $1.5 billion makes the project unlikely, considering the present state of the copper industry.

Mineral Aggregates Co. Inc. started construction of a multimillion dollar slag processing facility in southeastern Hillsborough County. The slag, a byproduct of Tampa Electric Co.'s coal-fired powerplants, will be processed for use as sandblasting grit and roofing materials.

Total oil and gas production declined, with oil and gas down 27% and 28.5%, respectively, from that of 1981.

Legislation and Government Programs.—The U.S. Bureau of Land Management, after competitive bidding, leased 80 acres of federally owned phosphate lands to W. R. Grace & Co., which presently mines phosphate on adjoining lands. The bonus bid was $140 per acre, with a 5% royalty rate, and an annual rental rising from $0.25 to $2.00 per acre over the first 4 years. Under the Mineral Leasing Act of 1920, the State received 50% of all revenues from Federal lands in the State. In fiscal year 1982, this amounted to $17,453.

During 1982, the U.S. Geological Survey published several open file reports pertaining to the State. The reports included "Potentiometric Surface of the Floridan Acquifer, Southwest Florida" (open file report 82-0753) and "Data on Subsurface Storage of Liquid Waste Near Pensacola, Fla." (open file report 82-0689).

Since 1972, the U.S. Bureau of Mines Tuscaloosa Research Center has been involved with various projects related to phosphate waste slimes, upgrading of marginal ores, and environmental problems. In-house Bureau project activity during the year included research on beneficiation of dolomitic phosphate ores, dewatering of mineral processing slime by flocculation, recovery of phosphate from dewatered slimes, uses for phosphogypsum wastes, and methodology for mining and reestablishment of wetland ecosystems.

Bureau Reports of Investigations (RI) issued during the year pertaining to the mineral industry of Florida included RI 8609, "Beneficiation of High-Magnesium Phosphate From Southern Florida"; RI 8611, "Large-Scale Dewatering of Phosphatic Clay Waste From Central Florida"; RI 8639, "Assessment of Environmental Impacts Associated With Phosphogypsum in Florida"; RI 8661, "Anion Characterization of Florida Phosphate Rock Mining Materials and U.S. Cement Kiln Dust by Ion Chromatography"; RI 8681, "Beneficiation of a Phosphate Ore Produced by Borehole Mining"; RI 8718, "Method for Producing Zirconyl Sulfate Solution From Zircon Sand"; and RI 8731, "Recovery of Phosphate From Florida Phosphate Operations Slimes."

In association with Agrico Chemical Co., the Bureau completed research on borehole mining in deep phosphate ore in St. Johns County. The research concluded that deep phosphate ores could be mined in an envi-

ronmentally compatible manner. Agrico planned to conduct additional borehole mining tests in 1983.

The Bureau had several contracts in Florida totaling over $400,000. The studies involved the development of engineering and cost data for foreign graphite, potash, and sulfur properties.

During the year, the Florida Bureau of Geology completed seven studies for publication or open file. Among the studies were a summary of Florida peat deposits and a history of the Bureau of Geology commemorating its 75th anniversary. Projects underway concerned the stratigraphy, lithostratigraphy, and geomorphology of specific formations in geographic areas. Included were a summary of Florida karst and a summary of the economic minerals of Florida. The Bureau of Geology, involved in mined land reclamation, adopted a Master Reclamation Plan, Chapter 16C-17, Florida Administrative Code. Approval was given to begin reclamation activities in 2,704 acres of nonmandatory land. Seven publications were issued during the year; the publications covered geology, minerals, guidebooks, and two map series. During the year, the Bureau added the Office of Reclamation Research, which will be responsible for evaluating the interrelationships of current mining processes and reclamation and to encourage reclamation research. Research is being encouraged on the restoration of wetlands mined for heavy minerals and hydrologic research needs related to phosphate mining and reclamation.

The Governor of Florida signed a law designed to prohibit phosphate mining in the Osceola National Forest. The bill prohibits the issuance of State permits for any activity that would degrade the air, water quality, or wildlife habitat of State or national forests.

The Florida Department of Revenue announced that the severance tax rate for phosphate was increased by 10% in 1982. The new rate, $1.84 per ton, was determined by a formula that reflects the change in ore value. The tax reportedly is the highest of any phosphate producing area in the world.

The Governor signed into law a bill that would return portions of the severance tax monies collected to counties. Each county where phosphate is mined will recover approximately 5% of the tax from the phosphate mined in the county. The measure, which went into effect July 1, also allows the Land Reclamation Trust Fund to be used to purchase mined lands.

The U.S. Geological Survey conducted mineral, energy, geochemical, geophysical, and marine geology studies in and offshore Florida. The studies included mineral potential in several Roadless Area Review and Evaluation (RARE II) areas, heavy minerals, offshore petroleum, peat in the Everglades, and measurement of stratigraphic sections in the phosphate districts.

The Florida Institute of Phosphate Research funded 25 projects for research and development with respect to mining and processing phosphate rock and reclamation of disturbed lands. The projects, all funded to some extent during the year, totaled over $3 million, and included utilization of byproduct gypsum, reduction of slime pond areas, evaluation of waste clay handling techniques, reclamation of phosphate lands, and innovative beneficiation and mining concepts.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of both portland and masonry cement decreased 24.6% and 19.8%, respectively, from that of 1981. Cement was the third leading commodity in value in the State. Production of masonry cement in Florida ranked third nationally, while portland cement ranked eighth. Four companies produced portland cement at five plants; masonry cement was also produced at five plants. A fifth company operated a grinding plant to produce portland cement from imported clinker. Most of the shipments of both cement types were to users within the State; Florida was a net importer of cement, with about 700,000 tons being imported, down from about 1 million tons in 1981. Portland cement shipments, mainly in bulk form, were made by truck and rail. Principal consumers were ready-mix concrete dealers, highway contractors, building materials dealers, and concrete products manufacturers, with the remainder being consumed by other contractors and government 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 well as small amounts of gypsum, clinker, fly ash, clays, iron ore, and slag; most were obtained from out-of-State sources.

Ten rotary kilns were operated at five plants. Of the 10, 8 were wet process and 2 were dry process. About 384 million kilowatt-hours of electrical energy, in addition to natural gas, fuel oil, and coal, were consumed in the manufacture of cement.

Reduced construction activities impacted severely on cement manufacturers in southern Florida, with companies operating at a loss or breaking even. Reduced workweeks and temporary closures of plants occurred during the year. Despite reduced output, the industry was optimistic on an economic recovery in 1983.

Moore McCormack Resources Inc., Brooksville, dedicated a second kiln in June. The new 1,700-ton-per-day kiln increased plant capacity to 1.2 million tons per year. The $68 million expansion included a grinding mill, heat exchanger, finish mill, packaging plant, and modification of its dust collection system.

Florida Crushed Stone Co. announced plans to build a cement plant in Brooksville. The $80 million facility would have a capacity of 600,000 tons per year. The proposal was under consideration by the State with action expected in 1983.

Clays.—Clays mined in Florida included common clay, fuller's earth, and kaolin. Total clay production and value decreased 59,000 tons and $4 million, respectively.

Common clay output and value increased for the fourth consecutive year. Common clay was produced by four companies at four pits in Clay, Gadsden, 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 the production of fuller's earth, but output and value decreased from that of 1981. Fuller's earth was mined by four producers at four pits in Brevard, 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 trucked to the plant where it was crushed, sized, and dried. End products were shipped nationwide.

Kaolin was produced by one company at one pit in Putnam County; production decreased for the first time since 1975. Material was dredged and slurried about 6,000 feet to the processing plant. Principal uses for kaolin were electrical porcelain, whiteware, and wall tile; major markets were 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, 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. Production and value increased 12.6% and 4.4%, respectively, from that of 1981. Florida gypsum wallboard was marketed primarily in southern Georgia and Florida. Byproduct gypsum was recovered by Occidental Petroleum Corp. at its plant in Hamilton County; output decreased from that of 1981.

Lime.—Quicklime and hydrated lime were produced in Florida. 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 decreased 46.1% and 48.6%, respectively, from that of 1981. Lime was used for water treatment, paper and pulp, magnesia, and sewage treatment systems.

Magnesium Compounds.—Florida ranked second nationally 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 decreased 30.9% and 26.2%, respectively, from that of 1981.

Peat.—Florida ranked second nationally in peat sales in 1982. Production and value decreased from that of 1981. Six plants produced 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. Late in the year, the State Department of Environmental Regulations denied permits for a proposed 148-acre peat mine in Putnam County. Georgia-Pacific Corp. had applied for per-

mits to mine the peat in Cow Bay Swamp on an experimental basis. The denial of permits was based on possible water quality degradation in Cow Bay Swamp and nearby Simms Creek.

Perlite (Expanded).—Four companies produced expanded perlite from crude ore shipped into the State. Production decreased to 28,300 tons, while value increased to nearly $4 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 of the State. Marketable production of phosphate rock in 1982 dropped 29.3% in quantity and 32.7% in value from that of 1981. Phosphate rock production remained at a low level during the year, continuing a trend started late in 1981, and resulting in temporary closure or reduction of output from most of the area's mines. The decrease in demand was caused by reduction in both domestic fertilizer sales and exports. At midyear, nearly 25% of the work force was unemployed, with nine mines and six plants temporarily shut down. The industry started a mild recovery in the fall, but by yearend, unemployment was at 18%. Decreased demand and large inventories of processed phosphates resulted in prices frequently below stated production costs. The Florida Phosphate Council reported that the industry spent $34 million on air quality monitoring and $146 million to protect and conserve water during 1982. The severance tax increased to $1.84 per ton, with approximately 5% returned to the individual producing counties.

Land-pebble phosphate was produced at 20 mines by 12 companies in Hamilton, Hardee, Hillsborough, Manatee, and Polk Counties. In 1982, agricultural uses accounted for about 72%; exports, 27%; and industrial uses, less than 1%. Normal superphosphate, triple superphosphate, wet-process phosphoric acid, and defluorinated phosphate rock were produced for agricultural purposes. Industrial chemicals were produced from the production of elemental phosphorus.

Agrico Chemical Co. operated the Fort Green and Payne Creek Mines during the year. At midyear the two mines and the South Pierce chemical complex were temporarily closed owing to the depressed market. In September, the Fort Green Mine was reopened. The Hardee County Commission approved Agrico's plan to expand its mining operations in the county by 3,741 acres. The new plan will result in the mining of 5,257 acres and extend the life of the mine about 9 years.

AMAX Phosphate Inc. operated one mine, the Big Four, during the year. In April, the mine and the Piney Point chemical plant closed temporarily. Capacity of the Big Four Mine was to be increased from 1.6 to 2.5 million tons per year with the addition of a new dragline. AMAX's Pine Level Mine development in De Soto and Manatee Counties was delayed. The mine, originally scheduled for startup in 1984, was expected to be in operation in the early 1990's.

Beker operated its Wingate Creek Mine in Manatee County with two floating dredges removing overburden and matrix. The 12,000-acre mine supplies a chemical plant in Louisiana, shipping through Port Manatee. Expansion plans were limited because of the dispute with county officials over truck transportation to the port. An agreement early in the year with the county limited production to 1.2 million tons per year for 12 months, pending construction of a rail system.

Brewster Phosphates, a partnership between American Cyanamid Co. and Kerr-McGee Corp., operated the Haynsworth and Lonesome Mines. Most of the output was shipped to an acid plant in Louisiana through the Port of Tampa. Brewster closed its mines for several months during the year because of weak demand.

CF Industries Inc.'s operations in Hardee County operated throughout the year. At yearend, CF Industries shut down its chemical complex at Bartow. Development at its South Pasture tract continued with construction of a 55-cubic-yard dragline. Construction of a new plant has been delayed pending improved market conditions.

Estech Inc. operated the Silver City and Watson Mines in Polk County. The mines operated intermittently during the year because of reduced market demands. Estech's proposed Duette Mine in Manatee County continued to be delayed because of environmental considerations; the company estimates an expenditure of about $10 million to date in attempts to develop the mine. The company has revised the anticipated startup to the late 1980's or early 1990's. During the year, the Royster Co., which had

a 20% interest in the mine, dropped out of the venture because the mine would not open in 1983 as originally planned. Royster obtained rock from International Minerals & Chemical Corp. (IMC).

Farmland Industries Inc. continued on the permitting stage for its proposed Hickory Creek Mine in Hardee County. Farmland started construction of 45-cubic-yard dragline early in the year, but stopped because of the weak market for phosphate. If the decision is made to proceed, date for startup for the 2-million-ton-per-year operation would be after 1986.

Gardinier Inc. produced phosphate ore at its Fort Meade Mine in Polk County. The company planned to expand its mining operations into Hardee County by 1990 if permits are approved. At the Fort Meade Mine, $20 million was being invested to install a waste slime dewatering system to eliminate slime ponds.

W. R. Grace operated its Bonny Lake and Hookers Prairie Mines in Polk County intermittently during the year. The Bonny Lake Mine was scheduled to close in 1983 because of depleted ore reserves. The mines were closed several months because of depressed markets. The development of W. R. Grace's Four Corners Mine, a joint venture with IMC, was postponed until late 1983 or early 1984. 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., planned to develop a 500,000-ton-per-year mine in Hillsborough County by 1984. The County Commission approved the rezoning of nearly 2,400 acres in southeastern Hillsborough County to permit mining. Hopewell will supply a Noranda fertilizer plant in Canada.

IMC, the world's largest private producer of phosphate and phosphate chemical products, operated the Clear Springs, Noralyn, and Kingsford Mines. The mines were closed for 6 weeks early in the year and a week at yearend. IMC completed a nearly $200 million project to increase capacity at its New Wales chemical complex by 50%. Included were two sulfuric acid plants, a diammonium phosphate plant, and storage facilities. IMC signed an agreement with Mississippi Chemical Corp.; Mississippi Chemical swapped 15,000 acres of phosphate land in exchange for a 22-year contract to buy phosphate rock. At one time, Mississippi Chemical planned to open a $225 million facility by 1985 at a site in Hardee County. IMC reportedly will not develop the area for 10 to 20 years.

Mobil operated the Nichols and Fort Meade Mines in Polk County. Mobil proceeded with the permitting process to develop the South Fort Meade Mine, scheduled for operation in 1988. The 3-million-ton-per-year mine will replace the Fort Meade and Nichols Mines as they are phased out over the next 20 years.

Occidental Chemical Co. produced phosphate ore from its Suwannee River and Swift Creek Mines, which operated intermittently during the year. About 70% of the output went to the Soviet Union in the form of superphosphoric acid in exchange for ammonia and other nitrates, under the terms of a 20-year trade agreement.

Sand and Gravel.—Florida produced both construction and industrial sand and gravel in 1982. Production was from 27 companies operating 47 operations in 18 counties. Total output decreased about 8% from that of 1981.

Construction.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Production of construction sand and gravel decreased for the third straight year. During 1982, 25 companies operated 40 pits in 18 counties; leading producing counties were St. Lucie, Lake, and Polk. Transportation was primarily by truck, with the balance shipped by railroad and waterway. Principal uses included concrete aggregate and fill. One company produced over 1 million tons; the top 11 companies, with 24 operations, mined 89% of the total construction sand and gravel mined in the State.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	8,675	$22,242	$2.56
Gravel	NA	NA	NA	W	W	6.87
Sand and gravel (unprocessed)	NA	NA	NA	W	W	1.17
Total or average	e14,910	e$30,600	e$2.05	13,749	30,481	2.22
Industrial sand	349	4,419	12.66	341	4,257	12.47
Grand total or average	e15,259	e35,019	e2.29	[1]14,091	34,738	2.47

eEstimated. 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.

Table 5.—Florida: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	7,198	$18,026	$2.50
Plaster and gunite sands	757	2,519	3.33
Concrete products	382	968	2.53
Asphaltic concrete	639	3,452	5.40
Road base and coverings	74	119	1.61
Fill	4,699	5,397	1.15
Total or average	13,749	30,481	2.22

Industrial.—Six companies produced industrial sand, one as a byproduct of kaolin operations; production decreased slightly from that of 1981. Industrial sand was used for glass manufacture and for foundry sands; markets were in Alabama, Florida, and Tennessee.

Staurolite.—Florida was the only State with a recorded production of staurolite. 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 removed by electrical and magnetic separation from heavy minerals concentrates. Production and value decreased for the second straight year.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and finalized the following year.

Florida ranked second in the Nation in crushed stone production, which included limestone, marl, and oyster shell. Output decreased for the second straight year; construction activity decreased, adversely affecting crushed stone and other aggregate output. Most quarries operated at reduced levels during the year, with no reported closures. Crushed stone was transported mainly by truck and railroad, and was used for dense-graded road base, concrete, bituminous aggregate, and cement manufacture. Oyster shell was used primarily for roadbed material.

Sulfur (Recovered).—Florida ranked seventh in the Nation in the production of byproduct elemental sulfur. Recovered sulfur from Exxon Corp.'s natural gas desulfurization plants in Santa Rosa County decreased for the fourth straight year.

Vermiculite (Exfoliated).—Exfoliated vermiculite was produced by two operations at four plants in Broward, Duval, and Hillsborough Counties from crude ore shipped into the State. Production and value decreased 20.9% and 2.7%, respectively, from that of 1981. Principal uses were for concrete aggregate, horticulture, and insulation.

METALS

Iron and Steel.—Florida Steel Corp.'s minimills were adversely affected by economic conditions. Early in the year, the company closed its Indiantown operation and reduced production at its Jacksonville and Tampa operations. Output, mainly rebars, was shipped to markets within 300 miles of the plants. Two companies produced ferrophosphorus in 1982. Shipments of ferroalloys decreased 20%, while value decreased 54% from that of 1981.

According to the Directory of Florida Industries, nine gray iron foundries and eight steel foundries operated intermittently during the year. With the exception of one steel foundry in Jacksonville, all foundries were relatively small.

Rare-Earth Minerals.—Florida was the only domestic producer of rare earth from mineral sands mining. Associated Minerals recovered monazite concentrate as a byproduct from its operations in Clay County. Production and value increased over that of 1981.

Titanium.—Du Pont and Associated Minerals produced concentrates from their heavy minerals operations in Clay County. Both rutile and ilmenite shipments increased over that of 1981.

Zircon.—Production and value of zircon concentrate from Du Pont and Associated Minerals operations in Clay County decreased 22.6% and 15.2%, respectively. Florida was the only producer of zircon concentrate in the United States. Zircon was recovered as a byproduct of mineral sands operations and was used in the foundry, ceramic, and refractory industries.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, Ala.
[2]State geologist, Florida Bureau of Geology, Tallahassee, Fla.

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	1500 North Dale Mobry Tampa, FL 33607	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 32589	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 3166 Tulsa, OK 74101	Open pit mines and plants.	Polk.
AMAX Phosphate Inc	402 South Kentucky Ave. Lakeland, FL 33801	Open pit mine and plant.	Hillsborough.
Beker Phosphate Inc	Box 9034 Bradenton, FL 33506	____do ____	Manatee.
Brewster Phosphates	Bradley, FL 33835	____do ____	Hillsborough and Polk.
CF Industries Inc	Box 790 Plant City, FL 33566	____do ____	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	____do ____	Do.
International Minerals & Chemical Corp.	Box 867 Bartow, FL 38830	Open pit mines	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	Polk.
Sand and gravel:			
Florida Rock Industries Inc., Shands & Baker Div.	Box 6984 Fort Myers, FL 33901	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, Hendry, 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, Sumter, Taylor.
Florida Rock Industries Inc	Attn: Nat C. Hughes, Pres. Box 6984 Fort Myers, FL 33901	____do ____	Collier, Hernando, Lee, Levy, St. Lucie.
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 7324-A Birmingham, AL 35223	____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 James R. Boyle[1] and Bruce J. O'Connor[2]

The value of Georgia's nonfuel mineral production in 1982 was $718.0 million, a decrease of $82.8 million from that of 1981. The decrease in total value was the first since 1975. Production and value of most nonfuel minerals decreased or remained at 1981 levels. Clays and crushed stone accounted for 87.6% of the total production value. Mining was the third largest industry in Georgia, ranking behind agriculture and textiles.

Georgia ranked eighth nationally in value of nonfuel mineral output. The State led the Nation in the production of fuller's earth, kaolin, and dimension stone; was second in kyanite; third in bauxite, feldspar, and crude iron oxide pigments; and fourth in barite, byproduct gypsum, and mica. In terms of value, kaolin was the leading mineral commodity produced in Georgia, accounting for 62% of the State's mineral value in 1982.

National economic conditions continued to affect the State's mineral industry. Mineral producers supplying raw materials for construction and to the automotive, paper,

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

Mineral		1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
Cement:					
Masonry	thousand short tons	89	$4,392	W	W
Portland	do.	1,150	45,423	W	W
Clays	do.	8,029	553,726	6,773	$475,768
Gem stones		NA	20	NA	20
Sand and gravel:					
Construction	thousand short tons	e3,364	e8,308	3,166	8,361
Industrial	do.	W	W	541	6,793
Stone:					
Crushed	do.	35,730	153,751	p34,800	p153,500
Dimension	do.	268	17,894	p271	p18,510
Talc	do.	26	182	20	141
Combined value of barite, bauxite, feldspar, iron oxide pigments (crude), kyanite, mica, peat, and values indicated by symbol W		XX	17,067	XX	54,880
Total		XX	r800,763	XX	717,973

eEstimated. pPreliminary. 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 Georgia, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Baldwin	W	(3)	
Barrow	--	$830	Stone.
Bartow	W	W	Barite, iron oxide pigments, clays.
Bibb	W	W	Clays.
Carroll	W	W	Stone.
Charlton	W	(3)	
Chatham	W	(3)	
Cherokee	W	(3)	
Clarke	W	W	Stone.
Clayton	$2,764	W	Do.
Cobb	W	W	Do.
Columbia	W	W	Stone, clays.
Columbus (city)	W	W	Do.
Cook	W	(3)	
Coweta	W	W	Stone.
Crawford	W	W	Sand and gravel (industrial).
Decatur	W	W	Clays.
De Kalb	W	12,789	Stone.
Dougherty	W	(3)	
Douglas	W	W	Stone, clays.
Effingham	W	(3)	
Elbert	W	3,144	Stone.
Evans	207	(3)	
Fannin	W	W	Stone.
Fayette	W	W	Do.
Floyd	W	W	Stone, clays.
Forsyth	W	W	Stone.
Fulton	W	W	Cement, stone, clays.
Gilmer	6,015	W	Stone.
Glynn	W	(3)	
Gordon	2,300	3,496	Stone.
Greene	W	(3)	Feldspar.
Gwinnett	W	W	Stone.
Habersham	W	W	Do.
Hall	7,175	5,615	Do.
Hart	W	W	Mica.
Henry	W	W	Stone.
Houston	W	W	Cement, clays, stone.
Jasper	W	W	Feldspar.
Jefferson	W	W	Clays.
Jones	W	W	Stone.
Laurens	W	(3)	
Lee	W	W	Stone.
Lincoln	W	W	Kyanite.
Lowndes	--	--	
Lumpkin	839	W	Stone.
Madison	2,789	2,842	Do.
Marion	W	4,111	Sand and gravel (industrial).
Miller	W	--	
Monroe	4,418	W	Stone.
Montgomery	450	(3)	
Murray	116	W	Stone, talc.
Newton	W	W	Stone.
Oglethorpe	3,357	3,946	Do.
Paulding	W	W	Do.
Pickens	W	W	Do.
Pike	69	(3)	
Polk	W	W	Cement, stone.
Rabun	862	844	Stone.
Richmond	W	W	Clays, stone.
Screven	W	W	Peat.
Seminole	W	(3)	
Spalding	1,591	W	Stone.
Stephens	W	W	Do.
Sumter	W	W	Clays, bauxite.
Talbot	W	(3)	
Taylor	W	(3)	
Thomas	10,928	13,155	Clays.
Towns	--	128	Stone.
Troup	W	W	Do.

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Twiggs	$96,465	$91,343	Clays.
Union	W	(3)	
Walker	W	W	Stone, clays.
Ware	W	(3)	
Warren	W	W	Clays, stone.
Washington	149,809	195,124	Clays.
Wheeler	W	(3)	
Whitfield	3,822	W	Stone.
Wilkes	W	W	Do.
Wilkinson	68,794	77,418	Clays.
Undistributed[4]	408,510	377,672	
Sand and gravel (construction)	XX	e8,308	
Total[5]	771,287	800,763	

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, Brantley, 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, Long, McDuffie, McIntosh, Macon, Meriwether, 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.

[2]County distribution for construction sand and gravel is not available; total State value is shown separately under "Sand and gravel (construction)."

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

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

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

Table 3.—Indicators of Georgia business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,596.0	2,658.0	+2.4
Unemployment	do	165.0	207.0	+25.5
Employment (nonagricultural):				
Mining[1]	do	7.7	7.4	-3.9
Manufacturing	do	524.6	500.9	-4.5
Contract construction	do	104.2	103.3	-.9
Transportation and public utilities	do	144.9	145.9	+.7
Wholesale and retail trade	do	512.0	520.3	+1.6
Finance, insurance, real estate	do	114.7	116.4	+1.5
Services	do	359.5	372.3	+3.6
Government	do	431.1	434.9	+.9
Total nonagricultural employment[1 2]	do	2,198.6	2,201.5	+.1
Personal income:				
Total	millions	$49,803	$53,648	+7.7
Per capita		$8,935	$9,514	+6.5
Construction activity:				
Number of private and public residential units authorized		31,231	40,771	+30.5
Value of nonresidential construction	millions	$915.1	$873.3	-4.6
Value of State road contract awards	do	$493.0	$425.0	-13.8
Shipments of portland and masonry cement to and within the State	thousand short tons	2,033	1,920	-5.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$800.8	$718.0	-10.3
Value per capita, resident population		$147	$127	-13.6
Value per square mile		$13,664	$12,195	-10.8

pPreliminary.

[1]Includes bituminous coal 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.

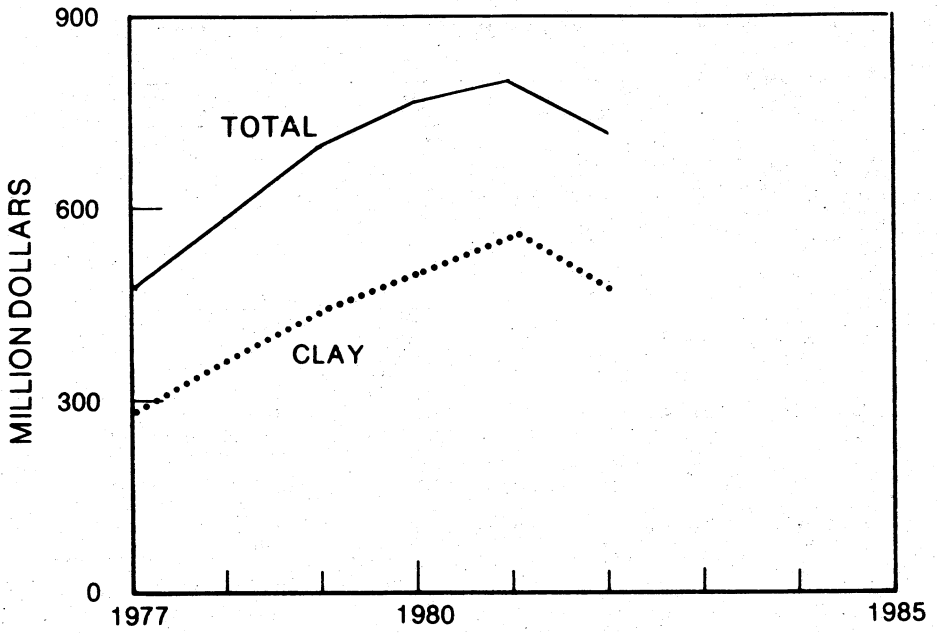

Figure 1.—Value of clays and total value of nonfuel mineral production in Georgia.

and steel industries experienced reduced output. Especially hard hit was the State's kaolin industry; reduction in sales accounted for much of the State's decrease in mineral value in 1982.

Georgia's economy, which eased into the recession late in 1981, appeared to remain relatively constant throughout 1982. Unemployment at the end of 1982 was 7.9% compared with 7.2% at yearend 1981.

Trends and Developments.—The Georgia Port Authority's (GPA) Savannah facilities handled most of the exported mineral commodities in 1982. Minerals exported included kaolin, kyanite, mullite, fuller's earth, and dimension granite. Although exports of kaolin were lower than in 1981, kaolin was the top total tonnage export from Savannah, which included exports through private facilities. Georgia Kaolin Co. has a capacity to handle about 250,000 tons per year through its facility, while Southern Bulk Industries can handle 350,000 tons per year. Late in the year, Georgia Kaolin was considering closing its export facility at Savannah and utilizing other facilities to export kaolin. The Brunswick facility, which will become the center of GPA's bulk activities, was basically an import facility during 1981. Imports included pig iron, limestone, gypsum, clays, phosphate, salt, potash, bauxite, and sulfur. The GPA was developing the Brunswick facilities to increase bulk handling capacity. The Colonel's Island operations at Brunswick will be modified to handle 2,000 tons per hour of minerals and other bulk cargos. The $50 million expansion is expected to handle kaolin, fuller's earth, bauxite, and industrial sands, with a scheduled completion date by 1984.

Katalistiks Inc. completed a $25 million plant in Savannah that will produce a fluid cracking catalyst used in oil refining. Capacity is 60,000 tons per year; approximately 40,000 tons per year of kaolin from Georgia will be required.

American Cyanamid Co. continued expansion of its Savannah titanium dioxide plant with completion scheduled for late in the year. The expansion will increase capacity by 10% to about 100,000 tons per year. The company operates both sulfate and chloride plants, and both units were involved in the expansion.

Taracorp Inc., Atlanta, a leading secondary lead producer, filed Chapter 11 bankruptcy during the year. The company operated three smelters, one in Atlanta and two in Illinois. Sander's Lead Co., Cedartown, also closed its secondary lead smelter during the year.

Exploration Activities.—According to the Georgia Geologic Survey, exploration activities continued throughout the State; both foreign and domestic companies were involved. Several companies were active in the Piedmont region seeking deposits of feldspar and base and precious metals. Activities included field mapping, sampling, drilling, and leasing programs. Companies also sampled and conducted field mapping in the Cartersville area for barite, throughout the State for common clay for ceramic tiles, along the Fall Line for kaolin, and in the southeastern part of the State for heavy minerals.

Legislation and Government Programs.—During the year, the U.S. Bureau of Mines had contracts with the Georgia Institute of Technology (Fundamental Investigation of Phosphate Bonding) and with Spelman College (Further Study of Detoxication of Arsenic). The Bureau published several reports concerning minerals and beneficiation of minerals in Georgia. They included Report of Investigations (RI) 8627, "Amphiboles in Soapstone Ridge, Ga."; RI 8668, "Recovery of Ultrafine Barite From Mill Wastes"; RI 8673, "Recovery of High-Grade Barite From Waste Pond Materials"; RI 8712, "Alumina Miniplant Operations—Production of Misted Raw Kaolin Feed"; RI 8636, "Alumina Miniplant Operations—Calcination of Kaolin in a Direct-Fired Rotary Kiln"; and RI 8744, "Leaching Rates for the HCl Extraction of Aluminum From Calcined Kaolinitic Clay." Also completed was a report on the mineral investigation of Blood Mountain Roadless Area Review and Evaluation (RARE II) and Raven Cliff RARE II Wilderness Areas in national forest lands in Georgia.

The Georgia Geologic Survey continued basic geologic mapping, mineral resources investigations, ground water investigations, and expanded technical programs. An 8-year program was initiated to improve the data base of the State's potential economic minerals. The purpose of the program is to attract commerical exploration of mineral commodities that have potential for development. Projects underway included an evaluation of gold deposits, study of the kaolin district, evaluation of granites and granite gneisses, evaluation of shale in northwestern Georgia, and evaluation of the mafic and ultramafic rocks of the State. Future projects under consideration will center on manganese and associated metals, heavy minerals, sulfides, high-silica sands, magnesium compounds, and sand and gravel.

The State Department of Natural Resources, through the Surface Mined Land Reclamation Program, was responsible for enforcement of the State Surface Mining Act of 1968, requiring licensing and reclamation of mined land. During the year, 365 mining operations were active in 118 counties in the State, with 37,609 acres under permit. Major commodities mined, by acreage permitted, were kaolin, granite, sand, and limestone, which together accounted for 75% of total acres permitted.

The Governor of Georgia proclaimed October 18-24 as "Mining and Reclamation Industry Week." He said that the State is a major producer of industrial minerals, and that mined land reclamation was being accomplished at a significant rate by many Georgia mining companies.

The U.S. Geological Survey conducted mineral resource studies in the State on lead, zinc, and heavy minerals. Mineral investigations under the RARE II program continued. Various geologic studies on energy resources (oil, coal, and uranium), geologic mapping, and geochemical and geophysical studies continued throughout the State. Among published reports was Professional Paper 1222, "Upper Cretaceous Subsurface Stratigraphy and Structure of Coastal Georgia and South Carolina."

The Mining and Mineral Resources and Research Institute at the Georgia Institute of Technology in Atlanta, which was created under title 111 of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for nearly all of the State's total mineral production value in 1982. Principal nonmetals produced, in descending order of value, were clays, crushed stone, cement, dimension stone, and sand and gravel.

Barite.—Georgia ranked fourth nationally in the production of barite. Production and value decreased 8.8% and 4.4%, respectively, from that of 1981. Output has trend-

ed downward since 1971; imports into the market region have impacted on local producers. Production was limited to the Cartersville district in Bartow County in northwestern Georgia, with New Riverside Ochre Co. and Paga Mining Co. the only producers. Georgia's barite concentrates were used in the manufacture of barium chemicals and as fillers and extenders in paint and rubber products. Imports from China have adversely impacted on Georgia producers.

Cement.—Two companies, Martin Marietta Corp. and Medusa Cement Co. produced portland and masonry cement from plants in Fulton and Houston Counties, respectively. Masonry cement accounted for less than 10% of the total output.

Major sales of portland cement in 1982 were for ready-mix concrete, to highway contractors, and for concrete products. The majority of shipments were by truck. Production of both portland and masonry cement decreased for the fourth consecutive year.

Raw materials used were mainly cement rock, limestone, and shale, with smaller amounts of clay, sand, iron ore, and gypsum. Of the five kilns, four used the dry process.

Clays.—Georgia continued to lead the Nation in the production of clays. Clays mined in the State, in order of decreasing value, were kaolin, fuller's earth, and common clay; all clay types experienced a decrease in output and value from that of 1981.

Georgia led the Nation in the production of kaolin, accounting for 82.8% of the Nation's output. Kaolin was also the leading commodity in the State in terms of value. The State's industry in 1982 was composed of 18 companies operating in east-central Georgia. Production in 1982 totaled 5.3 million tons valued at $445.4 million, compared with 6.2 million tons valued at $519.5 million in 1981. Major uses for premium-grade kaolin were paper coating and filler applications. Other uses associated with the automotive and construction industries experienced reduced demand because of the recession in these industries.

Table 4.—Georgia: Kaolin sold or used by producers, by use

(Short tons)

Use	1981				1982			
	Air-float	Unprocessed[1]	Water-washed[2]	Total	Air-float	Unprocessed[1]	Water-washed[2]	Total
Domestic:								
Adhesives	5,685	--	41,906	47,591	28,086	--	29,965	58,051
Alum (aluminum sulfate) and other chemicals	58,769	229,717	260	288,746	8,708	185,440	697	194,845
Animal feed	3,131	--	209	3,340	--	242	200	442
Asphalt tile and linoleum	--	4,955	--	4,955	3,433	--	--	3,433
Catalysts (oil-refining)	--	--	99,093	99,093	39,272	--	94,515	133,787
China and dinnerware; crockery and earthenware	7,915	2,490	8,444	18,849	15,675	4,574	1	20,250
Electrical porcelain	11,923	--	--	11,923	7,387	7,263	--	14,650
Face brick	--	27,524	--	27,524	--	16,000	29,842	45,842
Fiberglass and mineral wool	14,698	--	12,690	27,388	57,241	11,477	37,729	106,447
Firebrick, block and shapes	464	11,121	--	11,585	140	926	--	1,066
Floor and wall tile, ceramic	W	--	--	W	21,014	--	--	21,014
Flue linings and high-alumina brick, glazes, glass, enamel	64,291	2,934	--	67,225	38,548	--	--	38,548
Foundry sand	571	--	235	806	--	--	501	501
Grogs and crudes, refractory	W	445,789	--	445,789	2,970	213,917	--	216,887
Ink	W	--	W	11,805	W	--	W	13,163
Kiln furniture, mortar, cement	W	W	--	22,422	W	W	--	19,185
Medical, pharmaceutical, cosmetic	W	--	W	980	W	--	W	1,660
Paint	9,239	--	66,886	76,125	28,964	--	68,198	97,162
Paper coating	--	--	2,405,505	2,405,505	--	--	2,026,511	2,026,511
Paper filling	421,275	--	758,503	1,179,778	63,463	--	803,397	866,860
Plastics	7,472	--	44,889	52,361	1,158	--	34,733	35,891
Pottery	5,821	5,500	--	11,321	7,210	1,117	--	8,327
Roofing granules	9,747	--	--	9,747	6,265	7,316	--	13,581
Roofing and structural tile	106	--	--	106	--	--	--	--
Rubber	32,620	--	42,545	75,165	29,123	--	31,196	60,319
Sanitary ware	36,794	--	52	36,846	29,394	18,984	5,646	54,024
Miscellaneous, air float: Common brick (1982), animal oil (1981), fertilizers, gypsum products, oil and grease absorbents (1981), pesticides and related products, textiles (1981), waterproofing and sealing (1981), unknown (1981), and other	39,625	--	--	39,625	13,473	--	--	13,473
Miscellaneous, unprocessed: Drain tile, flower pots (1981), gypsum products (1981), other (1981), fertilizers, pesticides, and related products	--	19,441	--	19,441	--	10,968	--	10,968
Miscellaneous, water-washed: Gypsum products, pesticides and related products, waterproofing and sealing, anodes, graphite, textiles, and other	--	--	73,800	73,800	--	--	45,554	45,554

See footnotes at end of table.

Table 4.—Georgia: Kaolin sold or used by producers, by use —Continued

(Short tons)

Use	1981				1982			
	Air-float	Unprocessed[1]	Water-washed[2]	Total	Air-float	Unprocessed[1]	Water-washed[2]	Total
Domestic —Continued								
Undistributed	9,035	17,646	11,360	[3]2,834	7,415	13,433	13,160	--
Total	739,181	767,117	3,566,377	5,072,675	408,939	491,657	3,221,845	4,122,441
Exports:								
Paint	87	--	31,310	31,397	--	--	31,256	31,256
Paper coating	--	--	604,296	604,296	26,396	--	833,430	859,826
Paper filling	--	--	77,992	77,992	9,437	--	87,299	96,736
Plastics	--	--	23,895	23,895	--	--	20,572	20,572
Refractories	--	219,372	--	219,372	19,821	103,286	--	123,107
Rubber	55	--	364	419	2,400	--	465	2,865
Undistributed	14,607	--	191,214	205,821	929	--	10,626	11,555
Total	14,749	219,372	929,071	1,163,192	58,983	103,286	983,648	1,145,917
Grand total	753,930	986,489	4,495,448	6,235,867	467,922	594,943	4,205,493	5,268,358

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes high-temperature calcined.
[2]Includes low-temperature calcined and delaminated.
[3]Incomplete total; difference included in totals for specific uses.

Table 5.—Georgia: Kaolin sold or used by producers, by kind

Kind	1981		1982	
	Short tons	Value	Short tons	Value
Air float	753,930	$29,574,295	467,922	$16,778,096
Calcined[1]	1,075,769	124,061,091	727,742	97,160,884
Delaminated	470,998	43,603,922	612,591	56,251,295
Unprocessed	313,841	3,435,670	277,245	3,856,568
Water washed	3,621,329	318,821,686	3,182,858	271,342,422
Total	6,235,867	519,496,664	5,268,358	445,389,265

[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	1981	1982
Domestic:		
Adhesives	47,591	58,051
Chemicals	288,746	194,845
Fiberglass and mineral wool	27,388	106,447
Firebrick, block and shapes	r11,585	1,066
Floor and wall tile, ceramic	W	21,014
Paint	76,125	97,162
Paper coating	2,405,505	2,026,511
Paper filling	1,179,778	866,860
Plastics	52,361	35,891
Rubber	75,165	60,319
Sanitary ware	36,846	54,024
Whiteware	18,849	20,250
Other	r852,736	580,001
Exports	1,163,192	1,145,917
Total	6,235,867	5,268,358

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

Table 7.—Georgia: Kaolin sold or used by producers, by county

County	1981			1982		
	Number of mines	Quantity (thousand short tons)	Value (thousands)	Number of mines	Quantity (thousand short tons)	Value (thousands)
Twiggs	5	1,098	$91,343	4	1,122	$94,203
Warren	3	837	52,669	2	W	W
Washington	6	2,222	195,124	5	2,047	172,449
Wilkinson	6	823	77,418	6	712	75,902
Other[1]	7	1,255	102,942	8	1,388	102,835
Total[2]	27	6,236	519,497	25	5,268	445,389

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes Columbia; Houston, Richmond, and Sumter Counties and items indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

Despite reduced output, expansion programs continued at all the major operations producing kaolin. Expansions were primarily aimed at meeting proposed increases in paper production, but expansion plans appeared to exceed the proposed demand. J. M. Huber Co. was constructing a 40,000-ton-per-year calcined clay products plant near Macon. The plant is Huber's first calcined product plant and was scheduled for

completion late in 1983. To upgrade their mining operations, Huber was spending $14 million for a new pipeline and dragline. To expand their market line in the plastics, rubber, and paint industries, Huber purchased the assets of Mitchell Mining and Manufacturing Inc., a small mica company in Spruce Pine, N.C. Anglo-American Clays Corp., Sandersville, was undergoing an $8 million expansion that included a multiple-hearth calciner intended to double output of Alphatex Kaolin. Completion was scheduled for early 1983. In addition, Freeport Kaolin Co., Gordon, and Engelhard Minerals & Chemicals Corp., McIntyre, ordered new large-bead spray dryers for their facilities. Georgia Kaolin, Huber, and Thiele Kaolin Co. installed magnetic separators for use in wet processing of kaolin. Many kaolin operations export through facilities in Savannah, which also handled kaolin from South Carolina operations.

Georgia ranked first in the Nation in the production of fuller's earth. Fuller's earth was the fourth ranking commodity in terms of value in the State, behind kaolin, crushed stone, and cement. Output and value decreased from that of 1981; output decreased for the first time since 1975. In 1982, eight companies in Decatur, Houston, Jefferson, and Thomas Counties produced 534,000 tons valued at $27.6 million, down from 584,000 tons valued at $30.1 million in 1981. Material mined was mainly calcium montmorillonite and attapulgite. Major uses were in liquid fertilizer, paints, as a pet waste absorbent, and for oil well drilling muds; markets were worldwide.

Common clay and shale, used in brick, cement, and tile, was produced by 10 companies operating 13 pits in 7 counties. Production in 1982 was 1.0 million tons valued at $2.8 million, compared with 1.2 million tons valued at $4.2 million in 1981. The decline was the fourth consecutive yearly decrease in output of common clay. Late in the year, Camp Lightweight Inc. started construction of a $4.6 million lightweight aggregate plant in Clay County, south of Fort Gaines. The plant, with a coal-fired kiln, was financed through a bond issue by the Clay County Development Authority. The plant, adjacent to the Chattahoochee River, was expected to be completed by mid-1983. The clay, from the Tuscahoma Formation, was evaluated by the U.S. Bureau of Mines Tuscaloosa (Alabama) Research Center under agreement with the Georgia Department of Natural Resources. A report was published in 1980; RI 8421, "Evaluating Clay Resources From Clay County, Ga., for Structural Clay Products."

Feldspar.—Production of feldspar decreased 16.9% while value increased 13.7%, respectively, from that of 1981; production has decreased for 3 consecutive years. Georgia ranked third nationally in production of feldspar. Low potash feldspar was mined from the Shady Dale deposit in Jasper County by The Feldspar Corp. The company also mined a granite saprolite from a pit near Siloam in Greene County. The material from Siloam, after beneficiation, was a mixture of feldspar and quartz sand that was trucked 50 miles to Monticello for further processing.

Gypsum (Calcined).—Calcined gypsum and gypsum board products were produced by three companies from material mined in other States or imported. National Gypsum Co. and Genstar Building Products Co. in Chatham County, and the Gypsum Div. of Georgia-Pacific Corp. in Glynn County produced wallboard, plaster, fillers, and agricultural land plaster. American Cyanamid recovered gypsum as a byproduct in its titanium dioxide plant in Savannah. Production and value of both calcined and byproduct gypsum decreased from that of 1981.

Kyanite-Mullite.—Georgia was one of two States producing kyanite; production and value decreased from that of 1981. C-E Minerals Inc., a division of Combustion Engineering Inc., operated a surface mine and flotation plant at Graves Mountain in Lincoln County. The material (pyrite and kyanite quartzite) was crushed and ground, with kyanite recovered by flotation. The material, at 35 mesh, was dried and trucked 20 miles to the company's Little River plant. The material was then ground and/or calcined for use by C-E refractories or for other high-temperature ceramic uses.

Synthetic mullite, a product of sintering a mixtue of aluminous and siliceous material, was produced by the Mulcoa Div. of C-E in Sumter County. The output was used for the manufacture of refractories or chemicals; demand was down because the steel industry, one of the major consumers, was in a depressed condition. The ore was ground, pelletized, and calcined, with about one-third of production exported through the Port of Savannah. The plant, with seven kilns, had a rated capacity of about 600,000 tons per year of synthetic mullite and calcined kaolin.

Mica.—Georgia ranked fourth in the Nation in the production of crude mica. Franklin Mineral Products Co. Inc. mined mica from the Airline and Hartwell pits in Hart County. Production and value decreased 16.7% and 2.4%, respectively, from that of 1981. The wet-ground mica was used as an extender and filler in various products including paint, wallpaper, and rubber products. Material was also mined and trucked to North Carolina for grinding. Expansion was continuing to increase output, which will allow the company to use imported material as well as domestic ore. Byproduct sand was used locally for construction purposes.

Peat.—Production of peat increased substantially over that reported in 1981. Two companies in Lowndes and Screven Counties produced peat for use as a potting medium and general soil conditioner.

Perlite (Expanded).—Armstrong World Industries Inc. expanded perlite at its plant near Macon in Bibb County; production and value increased over that of 1981. The product was used in formed products. Raw material was obtained from mines in the Western United States.

Sand and Gravel.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Production for both construction and industrial sand and gravel was from 31 companies operating 35 pits in 27 counties; total output decreased from that of 1981.

Table 8.—Georgia: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	2,673	$7,198	$2.69
Gravel	NA	NA	NA	399	1,046	2.62
Sand and gravel (unprocessed)	--	--	--	93	117	1.25
Total or average	e3,364	e$8,308	e$2.47	[1]3,166	8,361	2.64
Industrial sand	W	W	10.07	541	6,793	12.55
Grand total or average	W	W	e3.40	3,707	15,154	4.09

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

Construction.—Construction sand and gravel was produced by 29 companies operating 32 pits in 26 counties. Output and value decreased from that of 1981 with production decreasing for the third straight year. Leading counties were Crawford, Talbot, and Seminole. Operations were relatively small, with none producing over 500,000 tons per year; 89% of the total production came from only 19 pits. Output was dependent upon proximity of construction activities that varied throughout the State.

Industrial.—Output of industrial sand increased over that of 1981. Production was reported from six companies operating in six counties. Principal uses were for filtration, glass containers, sand blasting, and mold sand cores.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers. Beginning with the collection of 1982 production data, the survey of stone producers will be conducted for odd-numbered years only. Therefore, this chapter contains only preliminary estimates for crushed and dimension stone production. The preliminary estimates for even-numbered years will be revised and finalized the following year.

Table 9.—Georgia: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,446	$6,628	$2.71
Plaster and gunite sands	W	W	2.36
Concrete products	126	349	2.77
Asphaltic concrete	W	W	2.04
Road base and coverings[1]	257	712	2.77
Fill	113	180	1.60
Other	223	491	2.20
Total[2] or average	3,166	8,361	2.64

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (cement).
[2]Data may not add to totals shown because of independent rounding.

Crushed.—Output and value of crushed stone remained at about the same level as that of 1981. Georgia ranked seventh nationally in crushed stone production, which was the second leading commodity in value in the State. Material mined included limestone, granite, marble, sandstone, and slate.

Crushed stone was used mainly for dense-graded road base, concrete and bituminous aggregate, railroad ballast, and cement manufacture. Crushed marble was basically used for calcium products with markets developing for use as a paper filler. Individual operations experienced various degrees of demand, depending on nearby construction activities, with some operations closing. Interstate construction in the Atlanta area kept producers in the area operating at or slightly exceeding 1981 levels. Florida Rock Industries Inc. closed its Smith Road quarry in Muscogee County. Attempts to expand the operation were prevented by legal problems and resulted in closure of the quarry. Florida Rock's Rome quarry won a Showplace award in the National Crushed Stone Association's About Face Program for quarry beautification. The award recognizes exceptional achievement in creating an operation that is visually appealing and compatible with its surroundings. The quarry is adjacent to the campus of Berry College.

Dimension.—Georgia led the Nation in the production of dimension stone, which included granite, marble, and sandstone. Output and value increased slightly over that of 1981.

The State's dimension granite industry was centered in Elbert County, northeast of Atlanta, while the dimension marble and sandstone industries were located in Pickens County, north of Atlanta. The Elberton Granite Association, Elberton, lists 30 companies with one or more quarries, with improvements occurring at many of the operations during the year; the association reported sales in 1982 of $47 million, an increase of 3% over that of 1981. The Elberton granite industry was converting from wire saws to diamond block saws, with about 60 in operation. The association was developing a high-pressure water jet for cutting stone. About 90% of the granite output was used for monuments, with 60% of stone mined being discarded. In the dimension marble industry, about 25% of stone mined was used for dimension purposes, with the balance crushed and used for calcium products.

Talc.—Georgia ranked sixth nationally in the production of talc. Depression in the housing and automotive industries resulted in a drastic reduction in output in 1982. Southern Talc Co. produced talc from two mines in the Fort Mountain area of Murray County. Crude talc was trucked to the company's mill in Chattsworth where it was dried and ground to size. The sized talc was used in ceramics, insecticides, roofing, rubber, paper, and various other products.

METALS

Base and Precious Metals.—Although no base or precious metals were reported mined in Georgia in 1982, exploration continued throughout the northwestern part of the State for base and precious metals. U.S. Borax and Chemical Corp. leased about 170 acres of land near Tallapoosa, west of Atlanta. Some preliminary drilling was done,

but further exploration was planned. The property is near an old abandoned gold mine, but the company was also reportedly interested in base metals. Several prospectors were also active in the Dahlonega gold district. A small amount of gold was reportedly recovered and sold as a curiosity to tourists.

Bauxite.—Georgia was one of three bauxite-producing States in the Nation. Production and value decreased significantly from that of 1981. Bauxite was used in refractories and aluminum-based chemicals.

Iron Oxide Pigments.—Georgia ranked third nationally out of four States producing crude iron oxide pigments. Shipments decreased from that of 1981, with value increasing slightly. Ochre and umber were produced by New Riverside Ochre from surface mined material in Bartow County. Shipments of finished iron oxide pigments also decreased with value increasing.

Iron and Steel.—Atlantic Steel Co., a subsidiary of Ivaco Inc., Canada, operated two miniplants in Georgia. The plant in Atlanta operated two 90-ton electric furnaces, a bar mill, a rod mill, and a wire mill, while the Cartersville plant operated one 100-ton electric furnace and a bar mill for producing steel products in coils. Reduced demand for products resulted in periodic shutdowns and reduced operating levels during the year.

Slag.—Georgia was 1 of 20 States that reported processing and utilization of steel slag. One company processed and sold steel slag from electric furnaces for use as road base and fill. Production and value increased.

Ferrous Foundries.—Georgia is not considered a major State with regards to operating ferrous foundries. According to the Georgia Manufacturing Director, 16 gray iron foundries, 9 steel foundries, and 6 malleable iron foundries were located in the State. Of the 31 ferrous foundries, 5 had employment of 250 or more, with the remaining foundries relatively small operations.

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[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, Ala.
[2]Senior economic geologist, Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Barite (primary):			
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 and plant.	Sumter.
Mullite Co. of America	Box 37 Andersonville, GA 31711	____do ___	Do.
Cement:			
Martin Marietta Corp	6901 Rockledge Dr. Bethesda, MD 20817	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 1066 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.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
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.
Peat:			
Colonial Peat Co	Box 161 Newington, GA 30446	Bog	Screven.
Georgia Global Peat Inc	Box 238 Twin Lakes, GA 31605	Bog	Lowndes.
Perlite (expanded):			
Armstrong World Industries Inc	1010 Concord Lancaster, PA 17604	Plant	Bibb.
Sand and gravel:			
Atlanta Sand & Supply Co	3166 Maple Dr., NE. Atlanta, GA 30305	Open pit mine	Crawford.
Brown Bros. Sand Co	Howard, GA 31039	Open pit mines.	Talbot.
Howard Sand Co	Box 118 Butler, GA 31006	do	Talbot and Taylor.
Stone:			
Florida Rock Industries Inc	Box 2586 Columbus, GA 31902	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 30013	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, Haber-sham, Hall, Stephens, Walker.
Vulcan Materials Co	Box 7324-A, 1 Office Park Birmingham, AL 35223	do	Carroll, Cobb, Coweta, Douglas, Fulton, Gwinnett, Henry, Troup.
Talc:			
Southern Talc Co	Box F Chatsworth, GA 30705	Mines and mill.	Murray.

[1]Also produced 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 $47 million in 1982, a decrease of 18% from that of 1981, and 27% less than the record year of 1979. All production was from nonmetals—cement, gem stones, lime, pumice, sand and gravel, and stone. Except for gem stones and lime, all of the mineral commodities were used in the construction industry. Construction activity was down in all but two categories during 1982, and was down for every region of the State except Kauai.

Cement was manufactured at two plants in Honolulu County—Kaiser Cement Corp. and Lone Star Hawaiian Cement Corp. Lone Star Hawaiian Cement was formerly Cyprus Hawaiian Cement Corp. until October 7, 1982, when its acquisition by Lone Star Industries was finalized. Annual capacity for the plant is 270,000 tons, but it was shut down for 8 weeks during the year because of high inventory. Kaiser Cement has an annual plant capacity of 320,000 tons. The company dedicated a new barge in July that will be used to haul cement to the neighboring islands.

Interest is still being focused on the deposits of manganese nodules on the ocean floor near Hawaii. A 4-day conference on marine mining was held at Hilo in July to review the latest findings on mining and processing of minerals from the seabed. Also, a study on manganese nodule mining by the Hawaii Department of Planning and

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	10	$807	6	$554
Portland	do	302	23,024	227	18,122
Sand and gravel (construction)	do	e459	e1,198	449	1,221
Stone:					
Crushed	do	6,036	31,403	p4,500	p26,600
Dimension	do	(2)	4	(2)	p4
Combined value of gem stones, lime, and pumice		XX	589	XX	388
Total		XX	r57,025	XX	46,889

eEstimated. pPreliminary. rRevised. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Less than 1/2 unit.

Economic Development was completed after 2-1/2 years. The report hypothesized processing sites on the island of Hawaii in either the Kohala, Puna, or South Hilo districts.

Table 2.—Value of nonfuel mineral production in Hawaii, by county

(Thousands)

County	1980	[1]1981	Minerals produced in 1981 in order of value
Hawaii	W	W	Stone (crushed), pumice, stone (dimension).
Honolulu	W	W	Cement and stone (crushed).
Kauai	W	$2,663	Stone (crushed).
Maui	$4,427	W	Stone (crushed), lime, pumice.
Sand and gravel (construction)	XX	1,198	
Total	59,717	57,025	

W Withheld to avoid disclosing company proprietary data; included in "Total." XX Not applicable.
[1]County distribution for construction sand and gravel is not available; total State value shown separately under "Sand and gravel (construction)."

Table 3.—Indicators of Hawaii business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	450.0	458.0	+1.8
Unemployment	do	24.0	31.0	+29.2
Employment (nonagricultural):				
Manufacturing	do	23.0	22.5	-2.2
Contract construction	do	21.9	18.0	-17.8
Transportation and public utilities	do	31.9	31.7	-.6
Wholesale and retail trade	do	105.4	105.9	+.5
Finance, insurance, real estate	do	31.7	31.7	--
Services	do	101.9	101.0	-.9
Government	do	89.0	90.3	+1.5
Total nonagricultural employment	do	404.8	401.1	-.9
Personal income:				
Total	millions	$10,818	$11,530	+6.6
Per capita		$11,032	$11,602	+5.2
Construction activity:				
Number of private and public residential units authorized		6,262	5,790	-7.5
Value of nonresidential construction	millions	$290.4	$250.3	-13.8
Value of State road contract awards	do	$50.5	$69.0	+36.6
Shipments of portland and masonry cement to and within the State	thousand short tons	312	235	-24.7
Nonfuel mineral production value:				
Total crude mineral value	millions	$57.0	$46.9	-17.7
Value per capita, resident population		$61	$47	-23.0
Value per square mile		$9,105	$7,270	-20.2

[p]Preliminary.

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

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Kaiser Cement at Waianae and Lone Star Hawaiian Cement at the Campbell Industrial Park operated the two cement plants in Honolulu County (Oahu). Production decreased 25%, and value was down 22% from that of 1981.

In processing cement, the plants consumed limestone, coral, basalt rock, silica sand, pyrite, and gypsum. Both plants used coal and fuel oil, and compared with other industries, were the largest single consumers of electricity in the county.

Of the total amount of portland cement sold, 78% was used by ready-mix concrete companies, 12% by concrete product manufacturers, 7% by building materials dealers, and 3% by others.

To produce cement in Hawaii, all of the limestone and basalt was mined from nearby quarries on Oahu; the other raw material was imported from either Australia or Mexico. Coal was also imported from Australia.

Gem Stones.—A profitable Hawaiian industry is the taking and processing of coral.

Coral of black, pink, red, and gold hue is mined and made into jewelry. This industry grosses more than $16 million annually and employs about 300 people.

Lime.—The Hawaiian Commercial & Sugar Co. Ltd. produced calcined lime from its pit at Paia, Maui County. The plant produced sufficient quantities of lime for their three sugar refineries on the island of Maui.

Brewer Chemical Corp. at Kawaihae produced fine-ground calcium carbonate for agricultural purposes on the island of Hawaii. Brewer's source was the spoils from periodic dredging of Kawaihae Harbor and surrounding small boat harbors as coordinated with the State Department of Transportation.

Pumice and Volcanic Cinder.—Volcanic cinder was produced by Puna Sugar Co. Ltd. and pumice by Volcanite Ltd. on the big island of Hawaii. Maui Pineapple Co. Inc. and Maui Concrete & Aggregate Co. both produced volcanic cinder from quarries near Lahaina in Maui County. All material was used for road construction, landscaping, and insulation.

Sand and Gravel.—As a result of the new canvassing procedures implemented by the Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. In 1982, sand and gravel production was down 2% in quantity but increased 2% in value over that of 1981. Operations were by four companies, each producing from its single-owned or leased pit. Amelco Corp. produced in Maui County, Pacific Equipment Rental & Sales produced in Hawaii County, and Kekaha Sugar Co. Ltd. and Lihue Plantation Co. Ltd. produced in Kauai County. Amelco on Maui was the major sand and gravel producer. The distribution of the major use categories is given in table 5. All sand and gravel production was transported by truck.

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

	1981			1982[p]		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	NA	NA	NA	W	W	$4.26
Gravel	NA	NA	NA	W	W	4.78
Sand and gravel (unprocessed)	NA	NA	NA	425	$1,111	2.61
Total or average	[e]459	[e]$1,198	[e]$2.61	449	1,221	2.72

[e]Estimated. [p]Preliminary. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

Table 5.—Hawaii: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	W	W	$5.56
Road base and coverings	W	W	2.81
Fill	405	$1,066	2.63
Other	44	155	3.52
Total or average	449	1,221	2.72

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

Stone.—To reduce reporting burdens and costs, the Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and preliminary estimates, only, for crushed and dimension stone production will be published for even-numbered years. The estimates will be revised the following year. In view of the above, principal producers shown for stone (table 6) are based on 1981 data.

Major companies have reported that the construction industry in Hawaii has suffered from economic depression over the past 2 years, affecting the crushed stone production. This was due to the general recession, but also because of the State's unique and somewhat isolated economy.

[1]State Liaison Officer, Bureau of Mines, Spokane, Wash.

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 400 Alabama St. San Francisco, CA 94110	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.
Sand and gravel:			
Amelco Corp., Maui Concrete	Box 488 Kaluhui, HI 96732	Plant and pit	Maui.
Stone:			
Ameron Honolulu Construction & Drayage Ltd.	Box 29968 Honolulu, HI 96820	Quarries	Honolulu and Maui.
Grove Farm Rock Co. Inc	Puhi Rural Station Lihue, HI 96766	do	Kauai.
Lone Star Industries	400 Alabama St. San Francisco, CA 94110	Quarry	Honolulu.
Pacific Concrete & Rock Co. Ltd	2344 Pahounui Dr. Honolulu, HI 96819	Quarries	Honolulu and Maui.

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 Bureau of Mines and Geology, Idaho Department of Lands, for collecting information on all nonfuel minerals.

By F. V. Carrillo,[1] E. H. Bennett,[2] and M. M. Miller[3]

Idaho's nonfuel mineral production value declined in 1982 to $300 million, a 29% decrease from the recorded $425 million in 1981. Lower metal and nonmetal prices coupled with mine shutdowns and permanent closures were the primary causes of the decline.

Silver continued to be the leading commodity in terms of revenue, followed by phosphate rock, lead, and zinc. Metallic minerals accounted for more than 55% of total nonfuel mineral revenue for the year.

In February, following the announced closure of the Bunker Hill Mine in August 1981, The Bunker Hill Co. (a wholly owned subsidiary of Gulf Resources and Chemical Corp.) began a reduction in the work force and the selloff of equipment at its Kellogg operation, one of the largest lead-zinc-silver mining, smelting, and refining plants in the United States. The last metal production at Bunker Hill was completed in late July. All Bunker Hill assets were purchased in November by Bunker Ltd. Partnership, a newly formed mining syndicate. Bunker Ltd. announced that an increase in metal prices and an improved economy were necessary before the mine and surface plant would reopen, restoring some of the 2,100 jobs lost during the year.

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

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
Antimony ore and concentrate, antimony content ____ short tons	432	W	294	W
Clays ____ thousand short tons	26	$288	8	$101
Copper (recoverable content of ores, etc.) ____ metric tons	4,245	7,966	3,074	5,035
Gem stones	NA	75	NA	75
Lead (recoverable content of ores, etc.) ____ metric tons	38,397	30,923	W	W
Phosphate rock ____ thousand metric tons	5,361	108,964	W	W
Sand and gravel (construction) ____ thousand short tons	e3,063	e7,329	2,340	6,258
Silver (recoverable content of ores, etc.) ____ thousand troy ounces	16,546	174,033	14,830	117,901
Stone (crushed) ____ thousand short tons	1,437	6,206	p1,200	p6,000
Combined value of cement, garnet (abrasives), gold, gypsum, lime, perlite, pumice, sand and gravel (industrial), stone (dimension), tungsten, vanadium, zinc, and values indicated by symbol W ____	XX	89,093	XX	164,810
Total ____	XX	r424,877	XX	300,180

eEstimated. pPreliminary. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Ada	$3,573	W	Gold, lead, silver.
Adams	W	W	Copper, silver.
Bannock	W	W	Cement, stone (crushed).
Benewah	W	W	Garnet.
Bingham	W	W	Phosphate rock.
Blaine	W	W	Silver, zinc, lead, copper.
Boise	W	W	Silver.
Bonner	250	W	Silver, stone (crushed), gold, lead, zinc, copper.
Bonneville	2,746	W	Pumice, stone (dimension).
Boundary	W	$2	Stone (crushed).
Camas	--	W	Gold, silver, lead, zinc.
Canyon	W	W	Lime.
Caribou	102,308	W	Phosphate rock, stone (crushed).
Cassia	W	W	Stone (dimension).
Clark	40	1	Clays.
Clearwater	688	W	Stone (crushed).
Custer	W	W	Silver, lead, gold, zinc, copper.
Elmore	W	W	Clays.
Franklin	102	121	Stone (crushed).
Fremont	49	(3)	
Gem	W	W	Sand and gravel (industrial).
Gooding	W	(3)	
Idaho	883	W	Stone (crushed), gold, silver.
Jerome	W	(3)	
Kootenai	W	787	Silver, gold, stone (crushed), copper, lead.
Latah	W	W	Clays, stone (crushed).
Lemhi	680	W	Lead, silver, gold, zinc, copper.
Lewis	45	W	Stone (crushed).
Lincoln	W	(3)	
Madison	365	(3)	
Minidoka	W	W	Lime.
Nez Perce	584	137	Stone (crushed).
Oneida	W	W	Perlite, pumice.
Owyhee	W	W	Silver, gold.
Payette	114	(3)	
Power	W	(3)	
Shoshone	W	W	Silver, zinc, lead, copper, gold, antimony, stone (crushed).
Twin Falls	W	W	Lime.
Valley	W	W	Tungsten.
Washington	W	W	Gypsum.
Undistributed[4]	409,665	416,509	
Sand and gravel (construction)	XX	e7,329	
Total[5]	522,095	424,877	

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

[1]Bear Lake, Butte, Jefferson, and Teton Counties are not listed because no nonfuel mineral production was reported.

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

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

Table 3.—Indicators of Idaho business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	428.0	439.0	+2.6
Unemployment	do	32.0	43.0	+34.4
Employment (nonagricultural):				
Mining	do	5.2	3.6	-30.8
Manufacturing	do	52.7	47.8	-9.3
Contract construction	do	16.7	13.6	-18.6
Transportation and public utilities	do	20.0	19.0	-5.0
Wholesale and retail trade	do	80.7	78.3	-3.0
Finance, insurance, real estate	do	23.1	22.6	-2.2
Services	do	60.1	58.7	-2.3
Government	do	69.2	67.5	-2.5
Total nonagricultural employment[1]	do	327.8	311.2	-5.1
Personal income:				
Total	millions	$8,573	$8,938	+4.3
Per capita		$8,937	$9,259	+3.6
Construction activity:				
Number of private and public residential units authorized		3,382	2,385	-29.5
Value of nonresidential construction	millions	$111.6	$116.0	+3.9
Value of State road contract awards	do	$50.0	$53.0	+6.0
Shipments of portland and masonry cement to and within the State	thousand short tons	313	242	-22.7
Nonfuel mineral production value:				
Total crude mineral value	millions	$424.9	$300.2	-29.3
Value per capita, resident population		$456	$311	-31.8
Value per square mile		$5,155	$3,593	-30.3

[p]Preliminary.
[1]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.

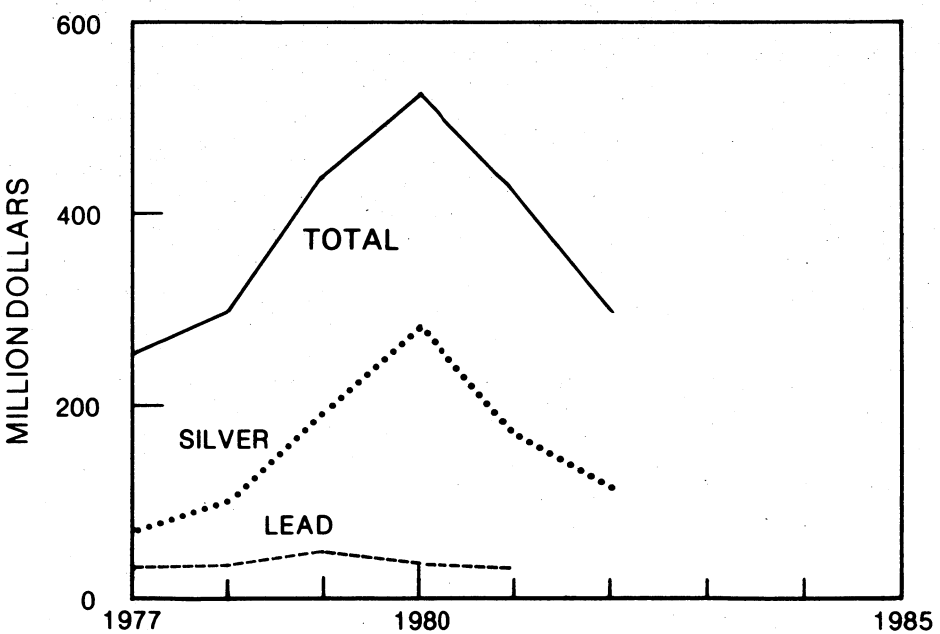

Figure 1.—Value of silver and lead and total value of nonfuel mineral production in Idaho.

Trends and Developments.—The Bunker Hill closure was indicative of other developments in metal mining operations of the Coeur d'Alene district. Hecla Mining Co. closed its Star Mine, the Sunshine Mine on Big Creek was temporarily closed in June, and a $3.5 million exploration project by ASARCO Incorporated on property adjacent to the Coeur Mine was placed on standby in June.

Hecla announced the closure in June of the Star Mine in Shoshone County, the deepest lead-zinc mine in the United States. The closure came after a reported operating loss of $2.3 million in the first 5 months of 1982 and resulted in a loss to the Coeur d'Alene area of about 350 jobs. Pumps on the 8100-foot level were turned off on September 7, and the mine began to flood. At the Consolidated Silver Project, Hecla continued work on the deep-level shaft, although the effort was reduced to a single shift; at yearend the shaft was at the 5400-foot level. Shaft development at the Silver Shaft Project of Hecla's Lucky Friday Mine reached the 5800-foot level in December.

The Sunshine Mining Co. suspended operations at its Sunshine Mine on June 12, laying off approximately 450 workers. By November, only 37 employees were reportedly working at the minesite. Work at the Sunshine Mine resumed in December and about 250 employees were called back. Prior to the closure, sinking was completed on the No. 12 shaft in March. This shaft bottomed at 5,235 feet. Work continued on the Copper Vein drift that will connect the 5000-foot level of the No. 12 shaft to the No. 10 shaft and allow for more efficient production from the Copper Vein between the 4800- and 5000-foot levels. Other work in the mine included initial work in reopening the 3400-foot level and repairs to the No. 4 shaft. Preparations were also made to open a new sand tank on the 3100-foot level adjacent to the No. 10 shaft. Sunshine's new refinery in Big Creek was placed in operation during the year. The first 1,000-ounce silver bar was poured in April. The company's goal is to produce its capacity of 10 million ounces of silver per year to become independent as a silver producer and refiner.

Asarco's Galena and Coeur Mines were, respectively, the number two and three producers of silver in the State during 1982. With closure of the Star Mine, the Sunshine Mine, and the Bunker Hill complex, Asarco became the top employer in the district with 230 employees at the Galena Mine, 130 at the Coeur Mine, and 26 at the company office in Wallace.

The $3.5 million exploration project conducted by Asarco on property adjacent to the Coeur Mine was placed on standby in June pending better economic conditions. An access tunnel about 3,000 feet long was driven from the 3400-foot level of the Coeur Mine and a drilling program started. A siderite vein was crossed in the tunnel, but there were no reports of silver mineralization. Several diamond drill holes were completed prior to the suspension. More than $1.2 million has been expended on the project. Partners in the venture include Coeur d'Alene Mines Corp., Callahan Mining Co., and Hecla.

Work continued throughout the year at the Thompson Creek Molybdenum Project in Custer County, owned and operated by Amoco Minerals Inc. Progress at the site near Challis, which is projected to become the largest open pit mining operation in the State's history, involved employment of more than 450 people and a 1982 expenditure estimated at $100 million of the $360 million budgeted for the project. The 200-million-ton ore body, which grades 0.18 MoS_2, contains enough molybdenum to last 20 years at the planned mining schedule. Concern for the surrounding environment was exemplified by the posting of over $2.5 million in reclamation bonds.

The DeLamar Mine in Owyhee County in southwest Idaho continued with full production throughout the year. The open pit silver-gold mine is owned 52-1/2% by MAPCO Minerals Corp. and 47-1/2% by Superior Mining Co., formerly Canadian Superior (U.S.) Ltd. Ore was mined from the Sommercamp and North DeLamar and a new pit named Glen Silver was placed in operation. The company employs 175 people at the remote minesite and at the closed cyanide leach system mill.

The Clayton Silver Mines operation near Clayton in east-central Idaho's Custer County was forced to close down in June because of low metal prices. Construction of five leach pads was completed during the year at the Stibnite heap leach operation of Superior Mining in Valley County. The pads measure 250 by 325 feet each and hold 25,000 to 30,000 tons of ore per pad.

A 100-foot adit was completed in the Center Star gold mine near Elk City. In October, Center Star Gold Mines Inc. reached an agreement with the Midas Group to rehabilitate the Center Star mill. Stock-

piling of ore for milling was underway during the latter part of the year. Initial mill capacity was projected to be 50 tons per day. The Blackstone Mine southwest of Fairfield was reopened and initial shipments from a 10,000-ton ore stockpile were made to the millsite.

The Missouri Mine in the Boise Basin did not operate during the year because of low metal prices. Mobil Energy & Mining Co. did some geologic mapping and sampling at the property. The Overlook Mine and the Morning Star Mine adjacent to the Missouri Mine were examined. Other mines reported active in the Boise Basin area included the Silver Bar Mine north and east of Idaho City, near the Banner, King, and Weatherby Mines.

Shoshone Silver Mining Co. opened up and rehabilitated about 200 feet of old tunnel at the Idaho Lakeview Mine in the Lakeview district near Pomme de Terre Lake. A new leach circuit was installed at the 70- to 100-ton-per-day Webber mill. Mill feed will come from the Webber, Keep Cool, and Idaho Lakeview Mines, which have a past production of gold, silver, lead, and zinc.

Rocky Mountain Energy Co. extended the adit to 800 feet at the Bartlett Creek Uranium Prospect on the North Fork of the Big Lost River. Three diamond drill holes were drilled inside the adit. The company reduced its efforts at the property later in the year because of the economic crunch.

About 300 feet of shaft were cleared out and rehabilitated at the Concord Mine in the Buffalo Hump area south of Grangeville. Ore was discovered in a new drift at the Bachelor Mine on the Yankee Fork of the Salmon River.

Galey Construction Co. opened up the tunnels at the Red Horse Mine in the Little Smokey district and did some diamond drilling. Additional activity in the district occurred at the King of the West Mine and prospects near Careytown.

A pilot test was run on 1,000 tons of ore at a heap leach venture operated by the Yellow Jacket Mining Co. near the Yellow Jacket Mine in Lemhi County. The Lone Pine mill near Elk City was being rehabilitated by Havilah Mines.

A geologic mapping and sampling program was initiated at the Talache Mine near Atlanta that is under option to the Yanke Machine Co. About 600 feet of drift were reopened in the upper level and 15 tons of high-grade ore was mined that averaged 20 ounces per ton of gold and 80 ounces per ton of silver.

There was little activity at the Dewey Mine in the Thunder Mountain district this year.

The Big Buffalo Co. operated an 8-ton-per-day pilot mill at the Big Buffalo Mine in the Buffalo Hump district south of Elk City. About 1,000 tons of ore mined last year were run through the mill. The mine is an open pit operation on a 30- to 40-foot-wide vein.

Approximately six holes were drilled at the Hercules silver property approximately 6 miles southeast of Brownley Dam in Washington County. The Atlantis Mining Co. built a small mill in Colorado Gulch about 10 miles from Haley. The mill will process ore from the Magdalena Mine. Mines with activity in the Warren area included the Varx Mine on War Eagle Mountain, the Silver Eagle Mine near Pony Creek, the Rescue Mine south of Warren, and the Robinson Dike Mine.

Approximately 6,000 tons of ore were shipped from the Silver Strand Mine near Lakeview in Bonner County from ore stockpiled in 1981. Underground repair work and percussion drilling were completed during the summer.

In industrial minerals, continuing soft markets during the year plagued the Idaho phosphate rock industry. The J. R. Simplot Co. was forced to lay off 216 workers in August at its Conda Mine near Soda Springs, following previous layoffs earlier in the year at the mine and the layoff of 35 employees in April at its fertilizer plant near Pocatello. Simplot announced that calcined phosphate from the Conda plant would be shipped via rail to Simplot's Sim-Cal Chemical Co. in Fresno, Calif.

Simplot continued development of its Smokey Canyon Mine about 25 miles east of Soda Springs in Caribou County. The mine-site is on a Federal lease, and the operation will eventually cover about 1,300 acres. A road was completed to the site, and the right-of-way laid out for an 8-inch slurry pipeline that will transport beneficiated phosphate ore from the mine to the company's plant at Conda. A millsite adjacent to the Federal lease was cleared in the fall of 1982. Topsoil has been stockpiled for reclamation purposes.

A new flotation process that will enable Simplot to recover 10% to 15% more phosphate was installed at the company's Conda plant. The process was developed in conjunction with the U.S. Bureau of Mines and

will allow 80% to 90% recovery of the phosphate feed to the flotation plant. The process also may enable lower grade phosphate ores to be economically mined in the future. The Conda facility can handle up to 100 tons of waste per hour.

Production resumed in July at the Conda Partnership's (Beker Industries Corp. and Western Cooperative Fertilizers) North Maybie Canyon Mine. The Partnership's Champ Lease, 5 miles south of the Maybie Canyon Mine, was opened in September to supply higher grade phosphate ore to blend with Maybie Canyon ore.

Beker Industries reopened its wet acid plant at Conda, as more favorable gas rates were obtained from Southwest Gas Corp.

Stauffer Chemical Co.'s Wooley Valley Mine, which supplies phosphate ore to its Silver Bow, Mont., elemental phosphorus plant, ceased operations in May. Monsanto Co. operated the Henry Mine and its elemental phosphorus plant near Soda Springs.

Exploration.—In September, Anaconda Minerals Co. acquired from Kennecott Corp.'s Bear Creek Mining Co. subsidiary, one of the largest land packages ever put together for exploration purposes in the Coeur d'Alene district. The total land package consists of over 25,000 acres and extends from south of the Caladay property to the Idaho-Montana line. Anaconda is required to spend at least $120,000 on the properties during the 1st year, with annual increases leading to $220,000 in the 5th year and $665,000 in the 10th year.

Exploration activity continued throughout the year in the Coeur d'Alene area. The shaft at Callahan's Caladay Project, about 1-1/2 miles south of the Galena Mine, reached 3,000 feet in October. A pump station and diamond drilling station were cut at that level. Also in October, Callahan and Hecla agreed to use the Caladay shaft as a base from which to explore the Horn Silver and Peerless Claim Groups that adjoin the south and east boundaries of the Caladay Project area.

As a result of last year's merger with four smaller companies, Sunshine Mining now holds a 24% interest in the Consolidated Silver Corp. that is exploring the Silver Summit Mine near Osburn. Encouraging mineralization was reported from drill holes near Mullen, on property held by the Allied Silver Corp.

Coeur Explorations Inc., the exploration arm of Coeur d'Alene Mines Corp., performed geologic work on properties in the silver belt north of the Osburn Fault. Diamond drilling continued from the Camp Project's new exploration drill site, the Chilcott Tunnel, to explore the Polaris Fault Zone between the Consolidated Silver Mine and the Coeur d'Alene Mine.

Exploration was undertaken at the Royal Apex Silver property 2 miles north of the Osburn Fault. Reconnaissance mapping and sampling were conducted on the Capital Silver Mines' property.

The Burke Mining Co. signed an exploration agreement with Pacific Coast Mines Inc., a United States Borax & Chemical Corp. subsidiary, covering 197 claims north of the Snow Storm-National Copper Belt.

Champion Gold and Silver Inc. reached a similar 10-year agreement with Pacific Coast on 171 claims north of the Sunset Monitor Mine area and on the 51-claim Calumet Group that is surrounded by Burke Mining's claims.

Helena Silver Mines Inc. conducted an exploration program on its claims in the Dobson Pass area west of the Day Rock Mine. Highland Aurora Mining Co. conducted detailed surface mapping and geochemical sampling along the Highland Aurora Vein.

Employment.—Annual average employment in the State's mining industry fell 28.8% in 1982, to 3,700 workers. Metal mining employment declined to 2,300, an even greater loss of 36.1% of the jobs compared with the 3,600 workers in 1981. Mine closures and suspended operations owing to low metal prices were responsible for the declines. Layoffs and closures of phosphate mines in southeast Idaho, as fertilizer sales dropped 10% during the year, were responsible for a loss of 500 jobs in that industry. In December, metal mining employment had dropped to 2,000 workers, a 42.9% decline from December 1981. A 2.9% increase from the previous month to 3,600 employees for the total mining industry was reported in December, as 200 miners returned to work at the reopened Sunshine Mine.

Average weekly earnings for mine workers in December were the highest of any manufacturing or production group in the State at $525.69, despite a $2.10 drop from the previous year.

Legislation and Government Programs.—During the 46th Idaho Legislature, second regular session, attempts by the State attorney general's office to make ma-

jor changes to the Surface Mining and Dredge Mining Act were rejected in senate committee. A new hazardous waste law proposed by the Idaho Department of Health and Welfare also died in committee after it was determined not to be the proper time to fund a new regulatory body.

Legislation was passed to allow county recorders to increase fees for recording mining claims, as was a fee increase to $2 per page on the recording of mining partnership papers. Also, a sales tax exemption for the collection of sales tax from the sale of precious metal bullion (gold, silver, etc.) was approved. A bill was passed amending the existing law to allow extensions for filing mine license tax returns and to allow the State to collect interest during the extension period.

The second year of a joint $800,000 research program conducted by the U.S. Geological Survey and the University of Idaho's College of Mines and Earth Resources was continued. The program involved surface mapping, remote sensing, and geological studies that aided further geologic knowledge of the Coeur d'Alene mining district.

The Idaho Bureau of Mines and Geology (IBMG) completed several new projects during 1982. An alphabetical index, listing over 8,000 mines and prospects in the State, was finished as an index for the 1:250,000 scale Mines and Prospects Series. A paper describing a geologic reconstruction of the Coeur d'Alene mining district was published. A report describing the State and Fed-

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
1980, total	21	--	2,198,556	W	W	13,694,902	$282,662,776
1981, total	33	--	r2,517,027	W	W	16,545,648	174,033,250
1982:							
Bonner	1	--	W	--	--	W	W
Butte	1	--	W	--	--	--	--
Camas	1	--	W	--	--	W	W
Clark	1	--	W	W	W	W	W
Custer	4	--	W	W	W	W	W
Idaho	2	2	W	W	W	W	W
Kootenai	1	--	3,063	341	$128,185	34,710	275,945
Lemhi	1	--	W	W	W	W	W
Owyhee	2	--	W	W	W	W	W
Shoshone	6	--	718,466	2,726	1,024,731	13,048,549	103,735,965
Valley	1	--	158,953	8,332	3,132,082	3,307	26,291
Total[3]	21	2	1,582,057	W	W	14,830,351	117,901,293

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1980, total	3,103	$7,005,766	38,607	$36,139,250	27,722	$22,876,264	W
1981, total	4,245	7,966,106	38,397	30,923,495	W	W	$258,468,805
1982:							
Bonner	--	--	W	W	--	--	W
Butte	--	--	W	W	--	--	W
Camas	--	--	W	W	--	--	W
Clark	--	--	--	--	--	--	W
Custer	W	W	W	W	W	W	W
Idaho	--	--	--	--	--	--	W
Kootenai	8	13,278	5	3,018	--	--	420,426
Lemhi	W	W	W	W	W	W	W
Owyhee	--	--	W	W	--	--	W
Shoshone	3,024	4,954,732	W	W	W	W	128,528,705
Valley	--	--	--	--	--	--	3,158,373
Total[3]	3,074	5,035,259	W	W	W	W	155,170,298

rRevised. W Withheld to avoid disclosing company proprietary data.
[1]Operations from which gold, silver, copper, lead, or zinc, were recovered only from tailings, or as byproduct from sand and gravel, or cleanup are not counted as producing mines.
[2]Does not include gravel washed.
[3]Includes items indicated by symbol W; therefore, data may not add to totals shown.

Table 5.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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	4	159,065	W	3,375	--	--	--
Gold-silver	3	W	W	W	W	W	--
Silver	11	628,215	W	12,649,936	3,054	W	W
Lead	2	W	--	W	--	W	--
Lead-zinc	1	W	--	W	W	W	W
Total	21	W	W	W	W	W	W
Other lode material:							
Lead cleanup	--	W	--	W	W	W	--
Total lode material[2]	21	1,582,057	W	14,830,351	3,074	W	W
Placer	2	--	W	--	--	--	--
Grand total[2]	23	1,582,057	W	14,830,351	3,074	W	W

W Withheld to avoid disclosing company proprietary data.
[1]Operations from which gold, silver, copper, lead, and zinc were recovered only from cleanup are not counted as producing mines. Does not include gravel washed.
[2]Includes items indicated by symbol W; therefore, data may not add to totals shown.

eral laws for staking mining claims was released. A final map in support of the Survey's Challis-Counterminous U.S. Map Program was completed. Three 1:250,000 scale maps in IBMG's new surficial geology map series were released. Mapping of the Snake River in Owyhee 1:1,000,000 sheets was completed for the Survey's cooperative Quaternary Project.

The Mining and Mineral Resources and Research Institute at the University of Idaho received a 1982 annual allotment of $410,000. It was announced that Idaho's mineral institute would be one of four to assist Nevada in the establishment of a Mineral Industry Waste Treatment and Recovery Center that will perform research in the treatment of mineral industry waste for the recovery of critical metals and minerals.

Table 6.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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	1,639,994	--	--	--
Smelting of concentrates	W	13,152,968	3,065	W	W
Direct smelting of:					
Ore	W	W	W	W	--
Cleanup	--	W	W	W	--
Total lode material[1]	W	14,830,351	3,074	W	W
Placer	W	--	--	--	--
Grand total[1]	W	14,830,351	3,074	W	W

W Withheld to avoid disclosing company proprietary data.
[1]Includes items indicated by symbol W; therefore, data may not add to totals shown.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Antimony.—Idaho's only antimony producer, Sunshine Mining in Shoshone County, announced suspension of production in June owing to the depressed price of silver, but resumed production in November as the silver price again increased. Antimony was

produced as a byproduct of treatment of tetrahedrite from the Sunshine Mine in the Coeur d'Alene mining district. The temporary closure resulted in a 32% decrease in production for the year to 294 short tons of antimony concentrates.

Exploration and development was conducted at Rancher's Exploration and Development Corp.'s Yellow Pine Mine in Valley County by American Independent Mines and Minerals Co.

Cobalt.—Noranda Mining Co. Inc. curtailed plans for opening the Blackbird Mine in Lemhi County because of a decline in the price of cobalt. Exploration continued in the Special Management Zone of the River of No Return Wilderness Area and the U.S. Geological Survey began a study of the Special Management Zone to evaluate the potential of the area for cobalt and other minerals.

Copper.—Output and value both decreased in 1982, as only 11 mines reported copper production compared with 18 in 1981. More than 3,000 metric tons was produced with a value of approximately $5 million. The largest producers, all from Shoshone County, were the Sunshine, Lucky Friday, Coeur, and Galena Mines. No production was reported from the Copper Cliff Mine in Adams County. Idaho ranked ninth in 1982 copper output. Nearly 99% of total State production came from seven mines in the Coeur d'Alene district. Additional production was reported from Kootenai, Lemhi, and Custer Counties.

Gold.—Idaho ranked eighth nationally in the amount and value of gold produced during 1982. Output increased 20% from that of 1981, although value decreased slightly, reflecting somewhat lower prices. The DeLamar Mine of MAPCO in Owyhee County continued to be the State's largest producer. Production of more than 1,000 ounces was also reported from the West End Mine in Valley County, which produced in excess of 8,000 ounces, and from Hecla's Lucky Friday Mine in Shoshone County.

Superior Mining processed over 200,000 tons of ore from five heap leach pads at its West End gold mine near Stibnite.

Center Star Gold Mines began stoping operations at its Center Star Mine near Elk City, and renovation was begun on the existing 50-ton-per-day mill near yearend.

Placer gold operations, ranging from small hobby-type suction dredges to large-scale mining efforts using heavy equipment, were scattered throughout the State. The Idaho Department of Water Resources issued 649 stream alteration permits for such operations during the year. The U.S. Forest Service opened for mining a 22-mile stretch of the Salmon River from Long Tom Bar to Riggins.

Lead.—Idaho ranked second in 1982 lead production, although the amount produced was less than 10% of the total amount mined in Missouri, the major producing State. Over 90% came from three mines in the Coeur d'Alene mining district. Production declined 36% from that of 1981 because the Bunker Hill Mine, formerly the State's largest producer, was closed during the year.

Silver.—Idaho remained the top silver producer in the Nation, accounting for 37% of total domestic production. Six mines in the Coeur d'Alene district accounted for more than 90% of the total output reported from 20 mines in the State.

At its annual meeting, Hecla announced that for the second year in a row it was the number one silver producer in the Nation. Its Lucky Friday Mine at Mullan reported the largest mine production in the State for 1982, as full production continued throughout the year. Work on the new Silver Shaft passed the 1-mile depth in May.

In mid-January, Hecla curtailed production at its $12 million Consolidated Silver Project, the former Silver Summit Mine, near Osborne, resulting in the loss of approximately 77 jobs.

Sunshine Mining's Sunshine Mine, formerly the Nation's largest silver mine, dropped to fourth in the State after a temporary closure from June to December. The Galena and Coeur units of Asarco were ranked second and third in the State, respectively. The only significant producer outside of the Coeur d'Alene district was the DeLamar Mine in Owyhee County.

Tungsten.—A small amount of scheelite production was reported from Valley County. Work by Inspiration Development Co. on a 150-foot-long development drift at the Ima Mine in Lemhi County was stopped owing to lower tungsten demand and prices.

Vanadium.—Idaho ranked third out of four producing States in the recovery of vanadium from ferrophosphorus.

Ferrophosphorus from Bingham and Caribou Counties was shipped to the Kerr-McGee Chemical Corp. plant in Soda Springs and to the Union Carbide Corp.

plant in Hot Springs, Ark.

Zinc.—Zinc output during 1982 was only 19% of the 1981 production, as the State's former leading producer, the Bunker Hill Mine in the Coeur d'Alene mining district, was shut down throughout the year. Zinc production was reported from seven mines in 1982. Hecla's Lucky Friday Mine and Star Unit Area were the principal producers, even though the Star Mine operated for only about one-half of the year prior to its closure.

Idaho ranked seventh nationally in the 1982 production of primary zinc.

NONMETALS

Cement.—Cement shipments in 1982 were principally portland cement from the Inkom plant of Oregon Portland Cement Co. in Bannock County. A small amount was shipped for masonry use.

Garnet.—Production of garnet sands in the State was reported from the Fernwood and Emerald Creek Mines in Benewah County.

Gem Stones.—Fire opals, jasper, and star garnet contributed to the estimated $75,000 in gem stones recovered and sold in the State during 1982.

Gypsum.—All gypsum production came from the Consumers Coop Association deposit in Washington County. Reported output was similar to that of 1981.

Lime.—Amalgamated Sugar Co.'s three quicklime operations in Canyon, Minidoka, and Twin Falls Counties accounted for all of the State's 1982 lime production. Total output was slightly lower than that reported for 1981, but the value increased 32%.

Perlite.—Oneida Perlite Corp. mined perlite from its Malad City operation in Oneida County for use in horticulture, fillers, and masonry.

Phosphate Rock.—Idaho ranked second in the Nation in production of marketable phosphate rock, producing 11.2% of the total output.

Six mines in southeastern Idaho (Bingham and Caribou Counties) accounted for all of the production. The largest phosphate producer in the State was J. R. Simplot, which operated two mines (Fort Hall and Conda). Additional production was reported by Monsanto, Stauffer Chemical, and Conda Partnership.

Pumice.—Pumice output from three properties in Bonneville and Oneida Counties declined 22% from that of 1981; value declined 33%.

Amcor Inc. was the State's largest pumice producer from its Fan Claim operation near Idaho Falls; it was utilized as lightweight concrete aggregate. Producers Pumice (Bonneville County) and Hess Pumice Products (Oneida County) also mined pumice for building and decorative block.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Sand and gravel production was reported from 52 operations in 22 Idaho counties. Canyon, Ada, and Bonneville Counties accounted for 47% of the total production reported. Nearly all of the sand and gravel produced was classified as construction sand and gravel; industrial uses accounted for less than 1% of the reported State total. Output of sand and gravel in 1982 declined more than 50% from that of 1980 when the last complete canvass was taken. The decline was attributed to drops in construction and road building throughout the State.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	608	$1,744	$2.87
Gravel	NA	NA	NA	1,313	3,873	2.95
Sand and gravel (unprocessed)	--	--	--	418	642	1.54
Total[1] or average	[e]3,063	[e]$7,329	[e]$2.39	2,340	6,258	2.67
Industrial sand	W	W	17.50	W	W	19.47
Grand total or average	W	W	[e]2.92	W	W	3.28

[e]Estimated. 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: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	929	$3,202	$3.45
Plaster and gunite sands	W	W	2.19
Concrete products	28	81	2.89
Asphaltic concrete	167	624	3.74
Road base and coverings	774	1,539	1.99
Fill	322	483	1.50
Snow and ice control	5	7	1.40
Railroad ballast	W	W	3.29
Other	112	323	2.88
Total[1] or average	2,340	6,258	2.67

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Data may not add to totals shown because of independent rounding.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and preliminary estimates, only, for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be finalized the following year. In view of the above, principal producers shown for stone (table 9) are based on 1981 data.

[1]State Liaison Officer, Bureau of Mines, Spokane, Wash.
[2]Associate chief, Idaho Bureau of Mines and Geology, Moscow, Idaho.
[3]Chief, Idaho Bureau of Mines and Geology, Moscow, Idaho.

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:			
Oregon Portland Cement Co	Old National Bank, Rm 622 Inkom, ID 83245	Surface mine and plant.	Bannock.
Clays:			
A. P. Green Refractories (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	Mine, mill, plant	Do.
Sunshine Mining Co	Box 1080 Kellogg, ID 83837	Mine and mill	Do.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Gold:			
Hecla Mining Co	Box 320 Wallace, ID 83873	Mine and mill	Shoshone.
MAPCO Minerals Corp	Box 52 Jordan Valley, OR 97910	Surface mine and mill.	Owyhee.
Superior Mining Co	Box 385 Spokane, WA 99210	Surface and underground mine.	Valley.
Gypsum:			
Consumers Coop Association	265 East Commercial Weiser, ID 83672	Surface mine	Washington.
Lead:			
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.
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	800 North Lindbergh Blvd. St. Louis, MO 63166	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.
Producers Pumice	6001 Fairview Ave. Boise, ID 83704	Quarry	Do.
Sand and gravel:			
Ada Sand & Gravel Inc	357 East Amity Meridan, ID 83642	Pit	Ada.
Bonneville County Engineer	605 North Capitol Ave. Idaho Falls, ID 83401	Pit	Bonneville.
Kloepfer S & G	Box 87 Paul, ID 83318	Pits	Cassia and Minidoka.
Monroc Inc., RTP Concrete	Box 537 Salt Lake City, UT 84110	do	Various.
Nelson Deppe Inc	Box 768 Nampa, ID 83651	Pit	Canyon.
Sludder Construction Co	Box 370 Bellevue, ID 83313	Pit	Blaine.
Silver:			
ASARCO Incorporated	Box 440 Wallace, ID 83873	Mine and mill	Shoshone.
Hecla Mining Co	Box 320 Wallace, ID 83873	do	Do.
MAPCO Minerals Corp	Box 52 Jordan Valley, OR 97910	Surface mine and mill.	Owyhee.
Sunshine Mining Co	Box 1080 Kellogg, ID 83837	Mine and mill	Shoshone.
Stone (1981):			
FMC Corp	Box 4111 Pocatello, ID 83201	Quarry	Bannock.
Monsanto Co	800 North Lindbergh Blvd. St. Louis, MO 63166	do	Caribou.
Oregon Portland Cement Co	Old National Bank, Rm. 622 Inkom, ID 83245	Quarry and plant	Bannock.
Seubert Excavators Inc	Box 57 Cottonwood, ID 83522	Quarry	Idaho.
Vanadium:			
Kerr-McGee Chemical Corp	Box 478 Soda Springs, ID 83276	Plant	Caribou.
Zinc:			
ASARCO Incorporated	Box 440 Wallace, ID 83873	Mine and mill	Shoshone.
Hecla Mining Co	Box 320 Wallace, ID 83873	do	Do.

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]

The value of nonfuel mineral production in Illinois was $389.6 million in 1982. For the third consecutive year the value of mineral production declined, dropping $37.9 million below the figure reported in 1981. Crushed stone, sand and gravel, cement, and lime accounted for most of the State's production value. Illinois ranked 18th nationally in value of nonfuel mineral production and, as in 1981, led the Nation in output of fluorspar, industrial sand, and tripoli.

Barite, lead, silver, and zinc were extracted as byproducts of fluorspar production. Slag from steelmaking operations was processed in the State and sulfur was recovered at refining operations. Among the mineral commodities shipped into the State for processing were gypsum, iron oxide pigments, perlite, and vermiculite.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement (portland)	thousand short tons	1,574	$61,536	1,757	$78,444
Clays[2]	do.	322	1,540	455	2,305
Gem stones		NA	15	NA	15
Peat	thousand short tons	46	1,502	W	W
Sand and gravel:					
Construction	do.	e25,150	e68,970	21,557	59,149
Industrial	do.	4,646	49,186	3,989	45,665
Stone:					
Crushed	do.	44,159	165,218	p42,900	p148,300
Dimension	do.	2	85	p2	p98
Combined value of barite, cement (masonry), clays (fuller's earth), fluorspar, lead, lime, silver, tripoli, zinc, and value indicated by symbol W		XX	79,434	XX	55,618
Total		XX	r427,486	XX	389,594

eEstimated. pPreliminary. 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 Illinois, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Adams	W	$12,410	Stone (crushed).
Alexander	W	W	Tripoli.
Bond	$1,050	142	Clays.
Boone	W	W	Stone (crushed).
Brown	738	441	Do.
Bureau	1,535	93	Do.
Calhoun	87	86	Do.
Carroll	970	748	Do.
Cass	--	228	Do.
Champaign	1,266	(3)	
Christian	W	W	Stone (crushed).
Clark	W	W	Do.
Clay	1,078	W	Do.
Clinton	W	17	Do.
Coles	W	W	Do.
Cook	87,340	94,857	Lime, stone (crushed), clays, peat.
Crawford	W	(3)	
Cumberland	705	(3)	
De Kalb	W	W	Stone (crushed).
De Witt	11	(3)	
Douglas	W	W	Stone (crushed).
Du Page	5,371	W	Do.
Effingham	W	(3)	
Fayette	W	W	Stone (crushed).
Ford	918	(3)	
Fulton	W	(3)	
Gallatin	W	(3)	
Greene	W	W	Stone (crushed).
Grundy	W	W	Clays.
Hancock	W	1,417	Stone (crushed).
Hardin	20,853	28,174	Fluorspar, stone (crushed), zinc, barite, lead, silver.
Henderson	W	W	Stone (crushed).
Henry	1,877	1,818	Do.
Jackson	W	W	Do.
Jersey	W	W	Do.
Jo Daviess	W	784	Do.
Johnson	W	W	Do.
Kane	14,508	3,121	Stone (crushed), stone (dimension).
Kankakee	W	4,958	Stone (crushed), clays.
Kendall	W	W	Stone (crushed).
Lake	W	W	Peat.
La Salle	W	78,080	Sand (industrial), cement, stone (crushed), clays.
Lawrence	W	(3)	
Lee	W	W	Cement, stone (crushed).
Livingston	W	W	Stone (crushed), clays.
Logan	W	W	Stone (crushed).
McDonough	W	W	Stone (crushed), clays.
McHenry	14,365	(3)	
McLean	1,991	(3)	
Macon	W	(3)	
Madison	4,780	2,819	Stone (crushed).
Marshall	W	(3)	
Mason	39	(3)	
Massac	W	W	Cement.
Menard	W	W	Stone (crushed).
Mercer	296	109	Do.
Monroe	W	W	Do.
Montgomery	4,058	2,250	Do.
Moultrie	W	(3)	
Ogle	W	W	Sand (industrial), stone (crushed).
Peoria	1,304	657	Stone (crushed).
Piatt	415	(3)	
Pike	W	1,962	Stone (crushed).
Pulaski	W	W	Clays, stone (crushed).
Putnam	W	(3)	
Randolph	W	W	Stone (crushed).
Rock Island	W	4,296	Do.
St. Clair	W	5,363	Do.
Sangamon	2,772	(3)	
Schuyler	W	W	Stone (crushed).
Scott	W	W	Do.
Shelby	539	128	Do.
Stephenson	1,216	751	Do.
Tazewell	W	W	Clays.
Union	W	W	Stone (crushed).
Vermilion	W	W	Do.
Wabash	291	(3)	
Warren	W	W	Stone (crushed).
Washington	W	W	Do.
White	W	(3)	

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Whiteside	W	W	Peat, stone (crushed).
Will	$17,854	$14,337	Stone (crushed).
Winnebago	3,876	1,620	Do.
Woodford	3,248	(3)	
Undistributed[4]	247,935	96,853	
Sand and gravel (construction)	XX	e68,970	
Total[5]	443,281	427,486	

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

[1]Edgar, Edwards, Franklin, Hamilton, Iroquois, Jasper, Jefferson, Knox, Macoupin, Marion, Morgan, Perry, Pope, Richland, Saline, Stark, Wayne, and Williamson Counties are not listed because no nonfuel mineral production was reported.

[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 values indicated by symbol W.

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

Table 3.—Indicators of Illinois business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	5,578.0	5,587.0	+0.2
Unemployment	do	474.0	632.0	+33.3
Employment (nonagricultural):				
Mining[1]	do	26.9	27.7	+3.0
Manufacturing	do	1,131.4	1,019.5	-9.9
Contract construction	do	167.5	156.0	-6.9
Transportation and public utilities	do	286.7	274.6	-4.2
Wholesale and retail trade	do	1,103.5	1,078.6	-2.3
Finance, insurance, real estate	do	320.0	326.7	+2.1
Services	do	961.8	981.8	+2.1
Government	do	734.5	725.5	-1.2
Total nonagricultural employment[1]	do	4,732.3	[2]4,590.5	-3.0
Personal income:				
Total	millions	$132,638	$139,231	+5.0
Per capita		$11,572	$12,162	+5.1
Construction activity:				
Number of private and public residential units authorized		16,551	16,365	-1.1
Value of nonresidential construction	millions	$1,583.8	$1,156.9	-27.0
Value of State road contract awards	do	$386.0	$510.0	+32.1
Shipments of portland and masonry cement to and within the State	thousand short tons	2,393	2,363	-1.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$427.5	$389.6	-8.9
Value per capita, resident population		$38	$34	-10.5
Value per square mile		$7,594	$6,908	-9.0

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.

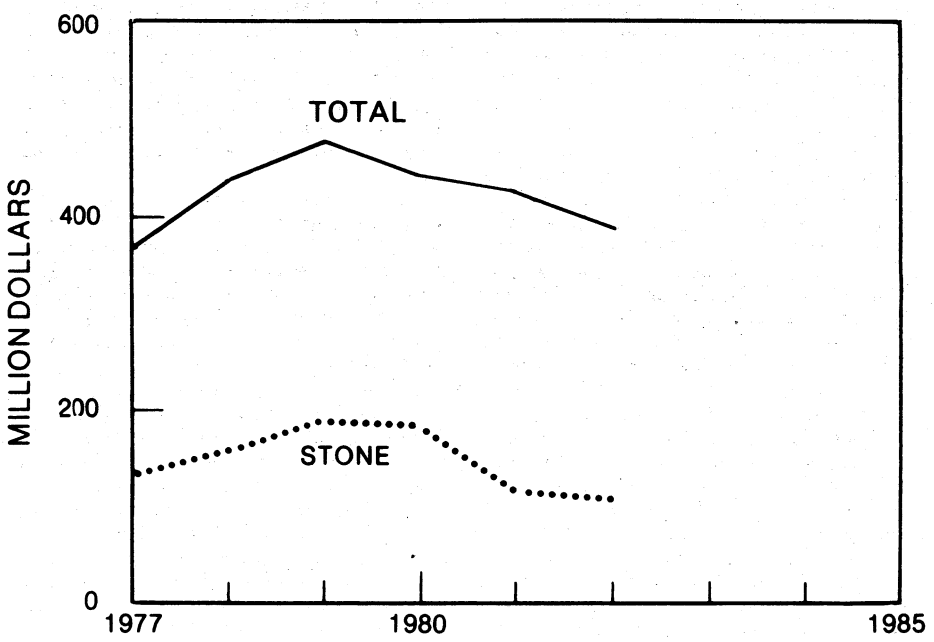

Figure 1.—Value of stone and total value of nonfuel mineral production in Illinois.

Trends and Developments.—Nonfuel mineral production in Illinois declined for the third consecutive year as a result of the nationwide recession and the depressed State economy. On the national level, unemployment averaged 9.7%, compared with 7.6% in 1981. Illinois' average annual rate of unemployment was 11.3% in 1982, compared with 8.5% in 1981. Employment in the manufacturing and contract construction sectors of the State's economy suffered the most. Factories operated at reduced levels and manufacturers of farm machinery, construction equipment, and other durable goods were forced to shut down plants and lay off personnel to reduce inventories. This, in turn, had a ripple effect on the State's steel industry, which was also forced to close mills and furlough employees. Construction activity was also down during most of the year, affecting sales of many mineral commodities. Only two commodities used in construction (portland cement and common clay) had increased production; all others dropped below 1981 levels.

During the year, several developments occurred within the State's nonmetallic mineral industry. Ozark-Mahoning Co.'s exploration program in the Harris Creek bedded fluorspar district in Hardin County resulted in the discovery of a new ore body northeast of the firm's Denton shaft, which was completed in late 1979. Shaft sinking at the new minesite began late in the year. The mine will be named the Annabel Lee.

The U.S. Bureau of Land Management issued a prospecting permit, effective January 1, 1983, to Ozark-Mahoning for the Lusk Creek area in the Shawnee National Forest, Pope County. An environmental assessment of the area will be conducted by the U.S. Forest Service to determine if any restrictions need to be placed on the company's proposed exploration activities. The firm continued to actively explore on privately owned tracts within the Shawnee National Forest.

Inverness Mining Co. ceased mining at its fluorspar operations in April because of economic conditions. The firm began drying fluorspar imported from Mexico at its Cave In Rock facilities to serve customers.

On December 28, 1982, the Illinois Central Gulf Railroad filed an application for a permit to close its 26.3-mile spur line from Reevesville to Rosiclare in Pope, Johnson, and Hardin Counties. The proposed abandonment would leave the fluorspar industry without rail service. A decision on the closure will be made in early 1983.

Early in the year, National Gypsum Co. closed its calcining plant in Waukegan,

Lake County, for economic reasons.

In April, Lone Star Industries Inc. purchased Marquette Co. from Gulf + Western Industries Inc. The sale included the Marquette Co. dry-process cement plant near Oglesby in La Salle County.

United States Gypsum Co. announced plans in July to move its research facility in Des Plaines to a newly acquired site in Libertyville within a year. Existing buildings at the new site would be expanded and a new testing laboratory would be constructed in a $1 million program. The new facilities will house United States Gypsum's research group that develops new products for the construction field and studies ways to improve productivity and quality control on the firm's production lines.

Union Oil Co. of California awarded a contract in late July for engineering and construction of a 130,000-ton-per-year needle coke complex at its refinery in Lemont. Construction will start early in 1983, with initial production planned for the first quarter of 1985. The new complex will use a proprietary process developed by Union's Science and Technology Div., the company's research arm. Needle coke is used to manufacture graphite electrodes used in electric arc furnaces to produce steel.

There were also several developments within the State's metal industry. Anaconda Industries and Anaconda Aluminum Co., divisions of Atlantic Richfield Co., began construction early in the year on a $14 million technical research center in Arlington Heights, a northwest suburb of Chicago. The new center, expected to be in full operation by mid-1983, will replace the firm's research facility in Waterbury, Conn. The research center will be used to develop fabricating and forming techniques on aluminum, brass, steel, and related materials. In July, Atlantic Richfield announced that it was consolidating the two metal divisions into a new company called Arco Metals Co. with headquarters based in Rolling Meadows.

Gould Inc., at Rolling Meadows, transferred assets and operations of its battery group to a newly created subsidiary, GNB Batteries Inc. The new subsidiary includes Gould's Automotive Battery Div., Industrial Battery Div., Metals Div., and Activair Div., along with two existing subsidiaries in Loiret, France, and Fort Eire, Ontario, Canada. The firm shut down its secondary lead smelter in Savanna, Ill., for a period of time in April because of depressed market conditions. The company's research efforts to develop a lithium-iron sulfide battery for the electric vehicle market were ended owing to the lack of interest in electric vehicles. Instead, the firm planned to modify its lithium battery technology for use as onboard power sources in defense-related satellites.

Several events occurred in the State's secondary aluminum industry. The Alcan Ingot & Powders Div. of Alcan Aluminum Corp. ceased production of secondary casting alloys at its Joliet plant and began to use the facility to recycle can scrap. The plant had produced alloy ingots primarily for the automotive market.

American Can Co. announced plans to sell within the next 2 years its U.S. Reduction Co. subsidiary, a large domestic secondary aluminum producer. U.S. Reduction's smelter in East Chicago was closed for 3 months because of a strike by the Oil, Chemical, and Atomic Workers Union.

Harco Aluminum Inc., a secondary aluminum smelter in Chicago, halted operations in September and filed a voluntary petition for reorganization under Chapter 11 of the United States Bankruptcy Code.

Allied Metal Co. of Chicago, an aluminum and zinc alloyer and refiner, completed installation of a new 175,000-pound reverberatory furnace, the latest addition in its series of modernization programs. Previously, the company erected a 20-million-pound-per-year zinc plant, constructed a specially designed aluminum breakdown furnace, built a 14,000-gallon fuel depot for trucks, and acquired nearby land for expansion.

Sherwin-Williams Co., Chemical Div., closed its zinc oxide plant at Hillsboro in early July, laying off 75 workers. The firm ceased production of zinc oxide because of low-priced foreign imports and the collapse of the housing market. ASARCO Incorporated's Hillsboro zinc oxide plant operated intermittently.

Several setbacks occurred in the State's ferrous scrap industry in 1982. Price-Watson Co. and three of its affiliated companies in Chicago filed for Chapter 11 bankruptcy during the year. It was one of the largest ferrous scrap processors in the Midwest and serviced several steel mills.

Stainless Processing Co. of Chicago also filed for bankruptcy. It supplied a number of major consumers of stainless and specialty alloy scrap, including McLouth Steel Corp., Crucible Steel Div. of Colt Industries Inc., Republic Steel Corp., and United

States Steel Corp.

Scrap Corp. of America, a large Chicago-region supplier, divested itself of three operations and closed several more during the year. Scrap Corp. is a subsidiary of Tang Industries, which acquired McLouth Steel assets in Detroit.

Two Illinois metal firms received contracts from the U.S. Bureau of the Mint during the year. La Salle Rolling Mills Inc., La Salle, was awarded an $11.5 million contract to supply 30 million pounds of copper-plated zinc 1-cent blanks. The Olin Brass Group in East Alton, a division of Olin Corp., was awarded a $4.96 million contract to provide 10-cent and 25-cent coinage strip.

Legislation and Government Programs.—In May, Illinois received approval from the U.S. Office of Surface Mining for its program to regulate surface coal mining and reclamation of abandoned coal-mined lands in the State. With this approval, the State became eligible for more than $24.1 million in mined-land reclamation funds. The State also receives Federal assistance for part of the cost of its enforcement program.

Coal mine operations are required by the Federal Surface Mining Control and Reclamation Act of 1977 to pay a tax of 35 cents per ton of surface-mined coal and 15 cents per ton of underground coal. One-half of the money collected from Illinois operations is held in an account for the State's reclamation programs; the other one-half is for use at the discretion of the Secretary of the Interior. The Office of Surface Mining, within the U.S. Department of the Interior, monitors the State's performance through an oversight program.

Illinois signed a cooperative agreement with the Mine Safety and Health Administration (MSHA) for the inspection and monitoring of State-maintained mine rescue stations. As part of the agreement, MSHA inspects each station, examines equipment and storage conditions, and checks the records of team members' training and equipment maintenance. Unsafe conditions are reported to the proper State authorities so they can be remedied promptly. Inspections occur when a station is first opened and then once every 6 months thereafter.

The State Geological Survey Division continued research in geology, geochemistry, hydrology, mineral resources, mineral economics, and environmental geology. Several reports were published during the year dealing with the State's mineral resources, economics, and geology. Work continued on a directory of Illinois mineral producers. A listing of aggregate producers was computerized, and all mineral producers operating in the State will be added in the future to facilitate easy updating.

The U.S. Bureau of Mines had several active contracts and grants with industrial firms, educational institutions, and consulting firms during the year. Funding for these projects was nearly $500,000. Southern Illinois University at Carbondale, the State's Mining and Mineral Resources and Research Institute, was awarded a $150,000 grant under title III of Public Law 95-87.

The Bureau's Tuscaloosa Research Center studied the potential for recovering marketable barite concentrates that meet oil well-drilling mud specifications from barite waste pond materials. Samples of varying character were obtained from Georgia, Illinois, Missouri, and Nevada. Tests indicated that high-grade concentrates that meet oil well-drilling mud specifications can be produced with a high recovery of barite. Results were published as a Bureau of Mines Report of Investigations.[2]

Late in the year, the Bureau released an open file report (OFR 174-82), "Impact of Surface Mining on Soil Compaction in the Midwestern U.S.A.," prepared by an outside contractor. The report presents case studies of four mines in Illinois, Indiana, and Missouri, and compares the extent of soil compaction of reclaimed and undisturbed soils. In addition, analysis of costs associated with preventing soil compaction and a reference to State and Federal regulations on reclamation of prime farmlands are presented.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives (Manufactured).—Silicon carbide was manufactured by ESK Corp., a subsidiary of Wacker Chemical Co., at its plant near Hennepin, Putnam County. The plant, which has been in operation for more than 3 years, produces silicon carbide from petroleum coke and silica sand in onsite furnaces.

Two grades of material are produced; metallurgical and crystalline. The softer

metallurgical material is used in the manufacture of steel and cast iron. Harder, crystalline silicon carbide is used in grinding wheels and polishing stones and as a refractory lining for blast furnaces. Silicon carbide is also used as a cutting agent for wire sawing granite.[3]

Production and value of silicon carbide dropped 26% and 17%, respectively, compared with 1981 figures.

Barite.—Ozark-Mahoning recovered barite as a byproduct at its fluorspar operations in Hardin County. Inverness Mining, which had produced barite in 1981, shut down its mining operation in April and reported no barite production. The State's production dropped considerably compared with 1981 figures because of the depressed economy and the loss of one producer.

Cement.—Illinois ranked ninth in shipments of portland cement. Three companies produced cement during the year. Lone Star operated a plant near Dixon, Lee County, and the Marquette Co. plant near Oglesby, La Salle County. Lone Star purchased Marquette Co. from Gulf + Western in April. Centex Corp. operated its Illinois Cement Co. plant near La Salle, La Salle County, and Missouri Portland Cement Co. operated a plant near Joppa in Massac County. Gray portland cement was manufactured at all four plants; only Lone Star's Dixon plant manufactured white portland cement and prepared masonry cement.

After several years of depressed sales, shipments of cement to consumers increased approximately 12% in 1982. Most cement sales were to ready-mix concrete companies, followed by concrete product manufacturers, highway contractors, building material dealers, and other consumers. Cement was transported to consumers mainly by truck.

Table 4.—Illinois: Portland cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	4	4
Production	1,701,207	1,544,154
Shipments from mills:		
Quantity	1,573,750	1,757,270
Value	$61,536,383	$78,444,165
Stocks at mills, Dec. 31	360,618	198,208

Clays.—Nationally, Illinois was ranked 19th of 44 States in total clay production. Output increased approximately 31% during the year. Clay was produced by 13 companies having operations in 9 counties. Common clay, which accounted for most of the State's output, was mined in seven counties. Livingston County led the State in production of common clay, followed by Cook County. Common clay was used in the manufacture of cement, common and face brick, drain pipes, sewer tile, and pottery.

Two companies mined fuller's earth in Pulaski County, which was used as an oil and grease absorbent and in animal litter. Fire clay was mined by one company in Grundy County for use in the manufacture of fire brick and other refractory products.

Fluorspar.—Illinois continued to lead the Nation in the production of fluorspar although shipments declined approximately 31% compared with those of 1981. Three companies had operations in the southeastern Illinois fluorspar district. Hastie Mining Co. operated a surface mine near Cave In Rock in Hardin County and produced a metallurgical-grade gravel spar. Inverness Mining closed its underground mining operation in April for economic reasons and began processing fluorspar imported from Mexico to service its customers. Ozark-Mahoning, which operates several mines in the Cave In Rock area, produced both acid- and metallurgical-grade fluorspar. Ozark-Mahoning began sinking a shaft late in the year on a newly discovered ore body northeast of its Denton Mine. The new mine will be called the Annabel Lee.

Gem Stones.—Value of gem stones and mineral specimens collected by mineral dealers and amateur collectors was estimated at $15,000 in 1982.

Gypsum (Calcined).—National Gypsum stopped calcining gypsum at its Waukegan plant early in the year for economic reasons.

Iron and Steel Slag.—Illinois ranked seventh nationally in the production of processed iron and steel slag. Four companies processed slag from the State's steel mills for use by the construction industry. Sales dropped approximately 9% in quantity between 1981 and 1982 because of the depressed economy.

Lime.—Nationally, Illinois ranked ninth in the production of lime. Two companies had plants in the State. Marblehead Lime Co., an operating unit of General Dynamics Corp., operated plants at South Chicago and Thornton in Cook County, producing both quicklime and hydrated lime. Marblehead's South Chicago plant ranked seventh nationally in output. Vulcan Materials Co. produced quicklime at McCook, also in Cook

County. Production and value dropped about 37% compared with 1981 figures because of the depressed economy. Lime was used in steelmaking and for sewage and waste treatment, water purification, and road stabilization.

Peat.—Illinois ranked fourth nationally in sales of peat. Four companies mined peat in Cook, Lake, and Whiteside Counties. Whiteside County with two operations led the State in production. Sales and value of sales increased slightly compared with those of 1981. Peat was sold both in bulk and packaged form for general soil improvement and potting soil, and to golf courses and nurseries.

Perlite (Expanded).—Illinois ranked fourth in sales of expanded perlite, following Mississippi, California, and Pennsylvania. Quantity and value of sales dropped about 15% and 20%, respectively, because of the depressed state of the construction industry. Three companies expanded crude perlite shipped in from out-of-State sources in Cook, De Kalb, and Will Counties. Will County led the State in sales. Expanded perlite was used for roof board manufacture, horticultural purposes, plaster and concrete aggregate, filler, and insulation.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Nationally, Illinois ranked fifth in the production of sand and gravel for construction purposes. This output accounted for approximately 15% of the State's total nonfuel mineral value. Production occurred in 57 of the State's 102 counties by 112 companies and government agencies. Kane County led the State in production, followed by McHenry. These two counties accounted for 39% of the State's output. Most construction sand and gravel was transported to site of use by truck.

Industrial.—Illinois ranked first in the production of industrial sand. Five companies had operations in La Salle and Ogle Counties, which accounted for all of the State's production. Both output and value declined compared with those of 1981 owing to the depressed economy. Major sales were for glass manufacture and foundry applications. Most industrial sand was transported by truck.

Table 5.—Illinois: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	8,615	$23,986	$2.78
Plaster and gunite sands	141	518	3.66
Concrete products	890	2,660	2.99
Asphaltic concrete	4,068	11,270	2.77
Road base and coverings[1]	4,827	13,794	2.86
Fill	2,510	5,062	2.02
Snow and ice control	W	W	2.05
Railroad ballast	W	W	7.00
Other	507	1,859	3.67
Total or average	[2]21,557	59,149	2.74

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (cement and lime).
[2]Data do not add to total shown because of independent rounding.

Table 6.—Illinois: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	9,386	$23,423	$2.50
Gravel	NA	NA	NA	10,229	31,810	3.11
Sand and gravel (unprocessed)	NA	NA	NA	1,943	3,916	2.02
Total[1] or average	e25,150	e$68,970	e$2.74	21,557	59,149	2.74
Industrial sand	4,646	49,186	10.59	3,989	45,665	11.45
Grand total[1] or average	e29,796	e118,156	e3.97	25,547	104,813	4.10

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and finalized the following year.

Sulfur (Recovered).—Elemental sulfur was recovered by six companies as a byproduct of refining operations in seven counties. The value of sales was approximately $21 million.

Tripoli.—Illinois ranked first of four States in the production of tripoli, a fine-grained, porous, siliceous material used as an abrasive and as a filler and extender. Two companies produced in the State; Illinois Minerals Co. at Elco and Tammsco Inc. at Tamms, both in Alexander County in the extreme southwestern part of the State. Production was underground by room-and-pillar methods via adits driven into the nearly horizontal deposits that are up to 30 feet thick. Crude production increased slightly during the year, although the quantity of material processed for sale declined approximately 3% owing to the economy. Most of the material processed for sale was used as a filler and extender in paint, plastic, rubber, and various enamels. Lesser quantities were sold for use as a mild abrasive in toothpaste, soaps, and buffing and polishing compounds.

Interest has been growing in the possible use of southern Illinois tripoli, including iron-stained material currently rejected for conventional uses, as a source of silica and iron for cement manufacture. Lone Star has mined some material for use at its Marquette Co. plant at Cape Girardeau, Mo.

Vermiculite (Exfoliated).—Three companies exfoliated crude vermiculite shipped into the State from outside sources. Plants were operated by W. R. Grace & Co., DuPage County; Strong-Lite Products of Illinois Corp., De Kalb County; and International Vermiculite Co., Macoupin County. Sales declined approximately 30% in quantity and 31% in value compared with 1981 figures, owing to the depressed state of the construction industry. Sales were for loose fill and block insulation, fireproofing and high temperature insulation, horticultural purposes, and concrete aggregate.

METALS

Iron Oxide Pigments (Finished).—Plants in four counties (Adams, Kane, St. Clair, and Sangamon) shipped finished iron oxide pigments to consumers for use in paint and coatings. Shipments were about 31,000 tons valued at $29.3 million.

Iron and Steel.—Illinois ranked sixth of 14 States in shipments of pig iron. Sales plummeted during the year as the iron and steel industry went through one of its most trying periods in history, owing to the recession and the surge in foreign steel imports. Pig iron shipments dropped to 2.3 million tons in 1982 compared with shipments of 4.5 million tons in 1981. Value of shipments was $449 million compared with $929 million in 1981. The year was filled with news of plant closings and employee layoffs as the State's steel industry tried to restructure, reduce inventories, and cut costs. Companies asked for and received concessions from union workers, cut salaries of management and nonunion workers, and phased out uneconomic operations.

Lead, Silver, and Zinc.—Inverness Mining and Ozark-Mahoning continued to recover minor amounts of byproduct lead, silver, and zinc at their fluorspar operations in Hardin County. Output of all three commodities dropped during the year, reflecting the decline in fluorspar production.

[1]State Liaison Officer, Bureau of Mines, Minneapolis, Minn.

[2]Lamont, W. E., and G. V. Sullivan. Recovery of High-Grade Barite From Waste Pond Materials. BuMines RI 8673, 1982, 13 pp.

[3]Pit and Quarry. ESK Plant Meets the Test of Processing Hard Silicon Carbide. V. 75, No. 3, September 1982, pp. 66-69.

Table 7.—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:			
Illinois Cement Co., a subsidiary of Centex Corp.	Box 442 La Salle, IL 61301	Plant	La Salle.
Lone Star Industries Inc.:	1 Greenwich Plaza Box 5050 Greenwich, CT 06836		
Cement and Construction Materials Group.		do	Lee.
Marquette Co. Div		do	La Salle.
Missouri Portland Cement Co	Box 147 Joppa, IL 62953	do	Massac.
Clays:			
Absorbent Clay Products Co	Box 120 Anna, IL 62906	Pits and plant	Pulaski.
Lowe's Inc	Box 68 Olmsted, IL 62970	Pit and plant	Do.
Streator Brick Systems Inc	West 9th St. Streator, IL 61364	Pits and plant	La Salle and Livingston.
Fluorspar:			
Hastie Mining Co	Cave In Rock, IL 62919	Open pit	Hardin.
Inverness Mining Co., a subsidiary of Seaforth Mineral & Ore Co.[1]	do	Underground mines, mill, plant.	Do.
Ozark-Mahoning Co.[1]	Box 57 Rosiclare, IL 62982	do	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	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.	20th and State Sts. Granite City, IL 62040	Iron and steel furnaces.	Madison.
Interlake Inc	13500 South Perry Ave. Riverdale, IL 60627	Iron furnaces	Cook.
Republic Steel Corp	Suite 550, Commerce Plaza Oak Brook, IL 60521	Iron and steel furnaces.	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.
Peat:			
Anderson Peat Co. of Illinois	Route 3 Morrison, IL 61270	Bog and processing plant.	Whiteside.
Markman Peat Co	do	do	Do.
Perlite (expanded):			
Manville Products Corp	Route 6, Box 864 Joliet, IL 60434	Plant	Will.
Silbrico Corp	6300 South River Rd. Hodgkins, IL 60525	do	Cook.
Sand and gravel (construction):			
Elmhurst-Chicago Stone Co	Box 57 Elmhurst, IL 60126	Pits and plants	Du Page and Will.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel (construction) —Continued			
General Dynamics Corp.:			
Material Service Corp., a subsidiary of General Dynamics Corp.	300 West Washington St. Chicago, IL 60606	Pits and plants	Grundy, Kane, McHenry.
Yackley Materials Corp	1504 Ogden Ave. Lisle, IL 60532	Pit and plant	Will.
McHenry Sand & Gravel Co. Inc	Box 511 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 Rt. 173 Antioch, IL 60002	Pit and plant	Lake.
Vulcan Materials Co	Box 6 Countryside, IL 60525	Pits and plants	Champaign and McHenry.
Sand (industrial):			
Manley Bros. of Indiana Inc	Box 538 Chesterton, IN 46304	Pit and plant	La Salle.
Martin Marietta Corp., Industrial Sand Div.	2 Crossroads of Commerce Rolling Meadows, IL 60008	Pits and plants	La Salle and Ogle.
Ottawa Silica Co	Box 577 Ottawa, IL 61350	Pit and plant	La Salle.
UNIMIN Corp	50 Locust Ave. New Canaan, CT 86840	do	Do.
Stone (limestone, 1981):			
Crushed:			
Anna Quarries Inc	Box 180 Anna, IL 62906	Quarry and plant	Union.
Columbia Quarry Co	Box 128 Columbia, IL 62236	Quarries and plants.	Monroe and Pulaski.
Material Service Corp., a subsidiary of General Dynamics Corp.	300 West Washington St. Chicago, IL 60606	Underground mine, quarries, plants.	Cook, Vermilion, Will.
Medusa Aggregates Co., a subsidiary of Crane Co.	Box 5529 Lafayette, IN 47903	Quarries and plants.	Clark, Henderson, Kankakee, Livingston.
Moline Consumers Co	313 16th St. Moline, IL 61265	do	Rock Island.
Vulcan Materials Co	Box 6 Countryside, IL 60525	do	Cook and Will.
Dimension:			
Fox River Stone Co	Route 1 South Elgin, IL 60177	Quarry and plant	Kane.
Sulfur (recovered):			
Mobil Oil Corp	Box 874 Joliet, IL 60434	Plant	Will.
Shell Oil Co	Box 2463 Houston, TX 77001	do	Madison.
Union Oil Co. of California	1650 East Golf Rd. Schaumburg, IL 60196	do	Cook.
Tripoli:			
Illinois Minerals Co[1]	2035 Washington Ave. Cairo, IL 62914	Underground mine.	Alexander.
Tammsco Inc	Box J Tamms, IL 62988	do	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 of Illinois Corp	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]

The value of Indiana's nonfuel mineral production was $215 million in 1982, compared with $251 million in 1981. For the third consecutive year, value dropped below the record $317 million set in 1979. Nationally, Indiana ranked 29th in value of nonfuel mineral output and continued to lead in pig iron shipments. The State ranked third in production of dimension stone and sales of peat and slag, and fourth in the production of masonry cement. Other commodities produced were natural abrasives, portland cement, clays, gypsum, lime, sand and gravel, and crushed stone. In 1982, Indiana became the leading steel producing State in the Nation, while Pennsylvania dropped from first place to third behind Ohio. The State is also a major producer of primary aluminum, ranking fifth among the 17 producing States. Sulfur was recovered as a byproduct of oil refining, and perlite was shipped into the State for processing.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	252	$10,972	W	W
Portland	do	1,538	59,344	1,523	$58,055
Clays	do	691	1,602	501	1,221
Gem stones		NA	1	NA	1
Peat	thousand short tons	105	3,140	89	2,112
Sand and gravel:					
Construction	do	e15,870	e41,330	13,097	34,579
Industrial	do	257	1,179	W	W
Stone:					
Crushed	do	25,349	79,910	p20,300	p65,500
Dimension	do	145	13,672	p135	p13,337
Combined value of abrasives (natural), gypsum, lime, and values indicated by symbol W		XX	40,212	XX	40,199
Total		XX	r251,362	XX	215,004

eEstimated. pPreliminary. 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 Indiana, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Adams	W	W	Stone (crushed).
Allen	W	W	Stone (crushed), peat.
Bartholomew	W	W	Stone (crushed).
Blackford	W	--	
Boone	W	(3)	
Carroll	W	W	Stone (crushed).
Cass	W	W	Cement, stone (crushed), clays.
Clark	W	W	Do.
Clay	$619	$462	Clays.
Clinton	W	(3)	
Crawford	7,789	9,224	Stone (crushed).
Daviess	W	(3)	
Dearborn	W	(3)	
Decatur	W	W	Stone (crushed).
De Kalb	768	(3)	
Delaware	W	693	Stone (crushed).
Dubois	W	46	Do.
Elkhart	1,007	W	Do.
Fayette	W	(3)	
Floyd	W	(3)	
Fountain	1,470	W	Clays.
Franklin	W	W	Stone (dimension), stone (crushed).
Fulton	W	1	Peat.
Gibson	W	(3)	
Grant	W	W	Stone (crushed).
Greene	W	(3)	
Hamilton	W	6,273	Stone (crushed), peat.
Hancock	W	(3)	
Harrison	W	941	Stone (crushed).
Henry	W	(3)	
Howard	987	W	Stone (crushed).
Huntington	W	W	Stone (crushed), clays.
Jackson	W	W	Clays.
Jasper	W	W	Peat, stone (crushed).
Jay	W	W	Stone (crushed).
Jennings	W	W	Do.
Johnson	168	(3)	
Knox	1,089	(3)	
Kosciusko	W	W	Peat.
Lagrange	W	(3)	
Lake	W	W	Lime, cement.
La Porte	W	W	Peat, sand and gravel.
Lawrence	W	W	Cement, stone (dimension), stone (crushed).
Madison	W	1,231	Stone (crushed).
Marion	9,403	3,996	Do.
Marshall	W	(3)	
Martin	W	W	Gypsum.
Miami	W	1,331	Stone (crushed).
Monroe	9,959	9,103	Stone (dimension), stone (crushed).
Montgomery	W	(3)	
Morgan	W	W	Clays, stone (crushed).
Newton	3,160	W	Stone (crushed).
Noble	W	(3)	
Ohio	8	(3)	
Orange	W	W	Stone (crushed), abrasives.
Owen	W	W	Stone (crushed).
Parke	W	W	Clays.
Perry	2,419	W	Stone (crushed).
Porter	W	W	Sand and gravel (industrial).
Pulaski	W	W	Stone (crushed).
Putnam	31,434	W	Cement, stone (crushed), clays.
Randolph	W	W	Stone (crushed).
Ripley	W	W	Do.
Rush	W	W	Stone (crushed), stone (dimension).
St. Joseph	2,847	W	Stone (crushed), peat.
Scott	W	W	Stone (crushed).
Shelby	W	W	Do.
Steuben	803	(4)	Do.
Sullivan	W	66	Do.
Switzerland	W	159	Do.
Tippecanoe	W	(3)	
Tipton	W	--	
Union	W	(3)	
Vanderburgh	175	(3)	
Vermillion	W	W	Clays.
Vigo	W	(3)	
Wabash	W	(3)	

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Warren	$1,623	$135	Sand and gravel (industrial).
Washington	443	809	Stone (crushed).
Wayne	W	W	Do.
Wells	W	W	Stone (crushed), peat.
White	W	W	Stone (crushed).
Whitley	W	(3)	
Undistributed[5]	212,299	175,563	
Sand and gravel (construction)	XX	[6]41,330	
Total	288,470	[6]251,362	

[6]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, Brown, Hendricks, Jefferson, Pike, Posey, Spencer, Starke, and Warrick.

[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]Less than 1/2 unit.

[5]Includes sand and gravel (1980) 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 Indiana business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,627.0	2,594.0	-1.3
Unemployment	do	264.0	310.0	+17.4
Employment (nonagricultural):				
Mining[1]	do	10.0	10.3	+3.0
Manufacturing	do	652.6	583.3	-10.6
Contract construction	do	86.2	74.5	-13.6
Transportation and public utilities	do	107.4	103.4	-3.7
Wholesale and retail trade	do	471.9	453.6	-3.9
Finance, insurance, real estate	do	102.1	102.1	--
Services	do	344.6	354.3	+2.8
Government	do	339.7	328.9	-3.2
Total nonagricultural employment[1 2]	do	2,114.4	2,010.3	-4.9
Personal income:				
Total	millions	$53,185	$55,303	+4.0
Per capita		$9,727	$10,109	+3.9
Construction activity:				
Number of private and public residential units authorized		14,380	12,534	-12.8
Value of nonresidential construction	millions	$529.1	$455.6	-13.9
Value of State road contract awards	do	$84.0	$139.2	+65.7
Shipments of portland and masonry cement to and within the State	thousand short tons	1,217	1,076	-11.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$251.4	$215.0	-14.5
Value per capita, resident population		$47	$39	-17.0
Value per square mile		$7,132	$5,924	-16.9

[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.

Trends and Developments.—Although the year ended with signs of economic improvement, annual averages and year-to-year comparisons showed that 1982 was yet another year in which Indiana did not make many economic advances. According to the Division of Research at the Indiana University School of Business, most indicators of Indiana's economy were at a lower point by yearend than they had been in either 1981 or in several previous years.

The State's manufacturing index showed a slight decline in 1982. The December 1982 index was down 2.3% from that of December 1981, yet had fallen a total of 18.5% since the same period in 1978. Indiana raw

steel production slipped 27% from 22.7 million net tons in 1981 to 16.5 million net tons in 1982. Yet, Indiana's production drop was far less dramatic than that of the country as a whole, where production dipped 39% from 1981 levels. Interestingly, in 1982, the State became the Nation's leading steel producer and has steadily increased its share of total domestic steel production. In 1979, Indiana steel mills produced 16.9% of the Nation's raw steel. During 1982, that percentage rose to 22.6%.[2]

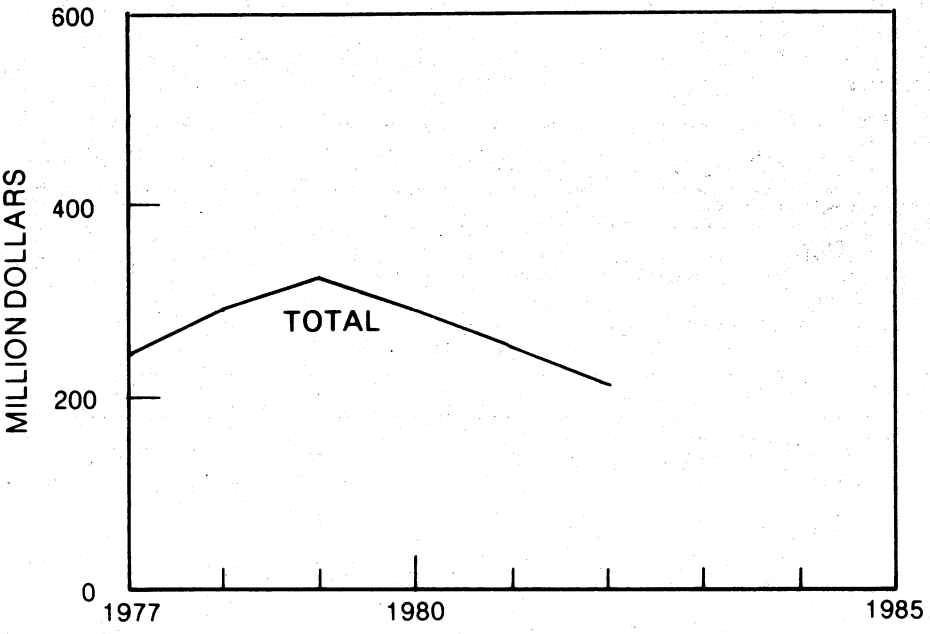

Figure 1.—Total value of nonfuel mineral production in Indiana.

Most indicators of construction activity showed signs of improvement in 1982, especially during the latter months. Indiana's December index for total construction activity was up 18% over that of December 1981. Unfortunately, the 1982 figure still represents a 58% drop from the 1978 index. Residential housing starts ended 1982 with a strong surge of new housing construction, up 87% from that of November 1982 and 66% from that of December 1981. In terms of annual housing starts, however, 1982 did not compare well with that of 1981. Only 14,718 dwelling units were started in 1982, down 26% from those of 1981. Indiana's residential construction expenditure index rose 16% in 1982, but it was still down 46% from the December 1978 level. Nonresidential expenditures were the only December construction index that failed to exceed the 1981 level, dropping 5%. However, the 1982 figure is above the December 1978 index. Public works and utilities construction fared considerably better in 1982 than in 1981, up 91% from that of 1981 but far below the 1978 December index.[3]

Indiana's unemployment rate of 12.5% at yearend (14% in November 1982) continued to exceed the national rate of 10.7%. The largest reductions in employment were found in the primary metal industries, which lost 16,600 jobs. Continued unemployment claims rose to 560,000 at yearend, a 36.3% increase from December 1981.[4]

Production of crushed stone aggregate and sand and gravel was down substantially in 1982, mirroring the depressed highway, housing, and general construction markets. In spite of the 1982 increase in the value of State road contract awards, the 1982 value was 19.5% below the 1979 level.

The dimension limestone industry, operating on longer term contracts than those of the aggregate industry, found 1982 to be a good year, according to the Indiana Limestone Institute. Although the entire dimension stone industry did not have a full order book, all the quarries and mills were

working.

Workers at Indiana dimension stone quarries ratified a new 3-year contract that negated the possibility of a strike. For the first time in years, contracts were consummated and ratified before expiration of present agreements and without a strike taking place. Contracts for several stonecutters' unions were scheduled to expire April 30, with the remainder expiring later in the year. Ratification of a common contract should help maintain a healthy and closely competitive industry.

Exploration Activities.—Cyprus Industrial Minerals Co. continued to evaluate cores from an extensive drilling project it conducted at and near the Pipe Creek Jr. quarry near Marion in northeastern Indiana. The quarry produces from a high-purity limestone reef of Silurian age.

The Indiana Geological Survey (IGS) increased its exploration activities with the purchase of a new drilling rig. It is rated to 2,000 feet and designed to core more efficiently than the older IGS equipment.

Transportation.—In June, a formal groundbreaking ceremony was held for Indiana's newest port facility on the Ohio River. The $30 million Clark Maritime Center will open the southern Indiana city of Jeffersonville to commercial traffic on the Ohio. The river port will have facilities to ship and store grain, coal, and sand and gravel.

Legislation and Government Programs.—Early in the year, the U.S. Supreme Court upheld an Indiana mining law: the Dormant Mineral Interests Act. The 1971 law provides for the forfeiture of severed mineral rights to the surface landowners if the mineral estate owners did not exercise their rights for 20 years by actual mineral production, payment of taxes, or filing a claim. In July, the U.S. Department of the Interior granted conditional approval to Indiana's regulatory program for controlling surface coal mining and reclamation. Indiana, 1 of 25 States that have received primacy under the Federal Surface Mining Act, became eligible for $16.7 million in reclamation funds.

Personnel from the Industrial Minerals Section of IGS were largely responsible for organizing the 18th Forum on Geology of Industrial Minerals, sponsored by IGS and the Geology Department at Indiana University in Bloomington. The IGS staff have had extensive involvement in planning field trips associated with the 1983 annual meeting of the Geological Society of America in Indianapolis. With the Indiana Limestone Institute, the IGS developed jigs to test the holding power of anchors in stone used in buildings.

The Geophysics Section completed the establishment of a gravity-control network of 106 base stations for the State. Values of absolute acceleration due to gravity for all base stations were tied and adjusted to the Intermountain Gravity Bureau bases in Louisville and Chicago that are included in the International Gravity Standardization Net. An open file report titled "Land-Use Suitability of Geologic Confinement of Hazardous Waste in Indiana" was completed and submitted to the State Board of Health.

The IGS's Petroleum Section studied the Maquokita Shale as a possible source of oil in the Trenton Field. Continued oil shale investigations resulted in published maps showing the thickness of overburden in the three southern counties that have received the most consideration for development. The Coal Section continued compilation and organization of a large amount of coal data for inclusion in the National Coal Resources Data System of the U.S. Geological Survey. Slurry ponds and gob piles received much attention from IGS coal geologist and geochemists.

In August 1982, the U.S. Forest Service began processing 139 applications for leases to explore and drill for oil and gas in Hoosier National Forest. The applications were forwarded to the Bureau of Land Management (BLM), U.S. Department of the Interior. Since the mid-70's, the Forest Service had received 157 applications. The area includes approximately 150,000 acres of Federal mineral lands beneath the 187,300-acre forest, but does not include the recently created Charles C. Deam Wilderness Area. BLM issues such leases for the Secretary of the Interior. Recommendations concerning the applications had been delayed in anticipation of completion of the Hoosier Forest Plan, which would address, in general terms, the environmental impacts of such actions. In April 1983, BLM decided not to issue leases until the forest management plan is completed. A draft version of the plan is expected in June 1983.

In December, the President signed into law an act establishing the Charles C. Deam Wilderness. The name commemorates a famed Indiana botanist who later became the first State forester. The Forest Service does not expect that any of this 12,953-acre

addition to the wilderness system will be used for either exploration or development.

Mulzer Crushed Stone Co., a potentially large mining operation on national forest land in the Derby area, was closed late in the year owing to a cave-in on adjacent private land. The Forest Service had issued a permit for underground mining of limestone that could have yielded about $500,000 of Federal revenue throughout the life of the permit. Shortly after the permittee moved from private land to national forest land, however, the roof fell in.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—Hindostan Whetstone Co., Indiana's sole producer of natural abrasives, quarried sandstone in 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. Since artificial oilstone and whetstone dominate the abrasives industry, Indiana whetstone production has declined to this single operation. However, the unique properties of this natural stone ensure its small market.

Metallic abrasives were produced by Wheelabrator-Frye Inc. in Mishawaka, St. Joseph County, and Jumbo Manufacturing Co. in Tippecanoe, Marshall County. Wheelabrator-Frye sales included chilled and annealed iron shot and grit and aluminum cut wire shot, as well as steel shot and grit that was produced in 1982. Jumbo Manufacturing produced and sold chilled and annealed iron shot and grit. This year was the lowest level of production reported for manufactured abrasives since 1963 and reflected the worldwide economic decline, especially in the industrial segment.

Cement.—Nationally, Indiana ranked 14th in portland cement shipments and 4th behind Pennsylvania, Texas, and Florida in shipments of masonry cement. Three companies manufactured cement in the State. Lehigh Portland Cement Co., a subsidiary of Heidelberger Zement AG of the Federal Republic of Germany, produced calcium aluminate cement at its Buffington Station plant in Gary, Lake County, and portland cement at its Mitchell plant in Lawrence County. Lehigh also operated a distribution terminal in Anderson, Madison County. All raw materials for the Buffington Station plant were from out of State. Lone Star Industries Inc. produced portland and masonry cements at its Greencastle plant in Putnam County. Louisville Cement Co. plants produced portland in Logansport, Cass County, and portland and masonry at Speed in Clark County.

Portland cement production remained essentially unchanged from last year's output, but 14% below 1980 levels. Eighty-eight percent of shipments was used by ready-mix concrete companies; other sales were to building material dealers (6%) and highway contractors (3%).

Clays.—Nationally, Indiana ranked 19th out of 44 States in the production of common clay in 1982. Production and value declined 27% and 24%, respectively, compared with that of 1981. Clay was produced by 9 companies from 13 pits in 8 of Indiana's 92 counties. Morgan County led the State in the production of clay for the manufacture of concrete block and face brick. A small amount was mined for pottery in Dubois and Porter Counties, while most was used in the manufacture of cement, lightweight aggregate in cement blocks, and face and common brick. Other uses included sewer pipe, drain tile, flue linings, pottery, and electrical porcelain.

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
1978	1	15	1,276	2,480	1,277	2,495
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

[1]Data do not add to total shown because of independent rounding.
[2]Less than 1/2 unit.

Yellow Banks Clay Products Inc. expanded its operation from pottery manufacturing to making clay and limestone fillers. The company obtains underclays from coal strip mines within a 10-mile radius of Huntingburg, Dubois County, and limestone from south-central Indiana. Clay fillers were first shipped in January and limestone fillers were shipped later in the year. These materials have penetrated a wide Midwestern manufacturing market, which includes rubber, paint, caulking, ceramics, and polishing compounds.

Gypsum.—Nationally, Indiana ranked fifth in the production of crude gypsum and sixth in the production of calcined gypsum in 1982. Output of crude gypsum remained essentially unchanged from that of 1981, while value increased by 5%. In 1981, both output and value had decreased by 16% and 18%, respectively, compared with 1980 levels. Since 1980, production of calcined gypsum decreased 4%, while value decreased 2%. National Gypsum Co. and United States Gypsum Co. mined gypsum from underground mines at Shoals, Martin County, in south-central Indiana. Both companies calcined gypsum at minesite plants. United States Gypsum also operated a calcining plant in East Chicago, Lake County. In order of total domestic output, United States Gypsum and National Gypsum's Shoals Mines were ranked third and seventh, respectively, in 1982. These individual minesite plants were among the top 10 in the Nation for total production. Most gypsum was used in wallboard. Some was used in cement and plaster products.

Lime.—Indiana ranked eighth among 39 States in lime production. Both production and value decreased 31% from that of 1981. Two companies, both in Lake County, produced quicklime during the year for steelmaking operations. Marblehead Lime Co. operated a plant at Buffington Station in Gary. Inland Steel Co. operated a plant near its Indiana Harbor Works in East Chicago. Both plants imported crushed limestone from out of State by lake freighter. In total output, they are among the 10 leading individual plants in the Nation.

Peat.—Indiana, behind Michigan and Florida, ranked third nationally among the States that account for almost two-thirds of domestic production. Peat was mined from eight bogs by eight companies.

In 1982, sales of peat decreased by 15% to 89,000 tons while value fell by 33% to $2.1 million compared with that of 1981. La Porte County led in production and, along with Hamilton and Jasper Counties, accounted for over 80% of sales. Peat was sold in bulk or packaged for agricultural and horticultural uses.

Perlite (Expanded).—Indiana ranked 11th nationally in production and 7th in value of expanded perlite sold in 1982. In the State, value increased by 8%, while production and sales decreased about 5% to 19,000 tons in 1982. U.S. consumption decreased 12% in the fourth straight year of decline. Four companies expanded crude perlite, received from out of State sources, at five plants. National Gypsum and United States Gypsum operated plants at Shoals in Martin County. United States Gypsum also operated a plant at East Chicago in Lake County. Grefco Inc. and Chemrock Corp. operated plants in Montgomery and Tippecanoe Counties, respectively. Principal end uses for expanded perlite were as a filter aid and as plaster aggregate. Other uses included masonry and cavity fill insulation, high-temperature insulation, horticultural aggregates, and paint texturizer.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

In 1982, Indiana ranked 14th nationally in the production of construction sand and gravel. During the year, 100 companies operated 140 pits and 129 processing plants in 60 of Indiana's 92 counties and produced 13.1 million tons of sand and gravel valued at $34.6 million.[5] While production fell 2.8 million tons (17%) from that of 1981, value dropped $6.8 million (16%) to an average value per ton of $2.64.

Eighty-four percent of the material was transported by truck, while an insignificant amount was shipped by rail or barge. About 16% was consumed at the site of the operation. Construction sand and gravel was used for concrete aggregate (37%), asphaltic concrete aggregate (22%), and various concrete products (6%). Other uses include road base and coverings and fill.

Industrial.—In 1982, two companies produced industrial sand from deposits in La Porte and Porter Counties with onsite processing plants.

Crisman Sand Co. Inc. in Portage, Porter County, produced blast furnace runner sand, both natural and black. The bankrun natural runner sand contains 6% to 8% clay. The natural runner sand with fire clay, bentonite, or gilsonite additives was sold as black, blast furnace runner sand. A specialty sand was also sold as a golf green topping mix.

Martin Marietta Aggregates, Industrial Sand Div., in Michigan City, La Porte County, produced mold and core sand, and a minor amount of blasting and traction (engine) sand.

Table 5.—Indiana: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,801	$13,322	$2.77
Plaster and gunite sands	W	W	3.04
Concrete products	726	2,127	2.93
Asphaltic concrete	2,836	8,812	3.11
Road base and coverings	2,187	4,959	2.27
Fill	1,896	3,581	1.89
Snow and ice control	209	440	2.11
Railroad ballast	W	W	2.50
Other	443	1,339	3.02
Total[1] or average	13,097	34,579	2.64

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Data may not add to totals shown because of independent rounding.

Table 6.—Indiana: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	5,982	$15,048	$2.52
Gravel	NA	NA	NA	5,413	16,276	3.01
Sand and gravel (unprocessed)	NA	NA	NA	1,703	3,255	1.91
Total or average	e15,870	e$41,330	e$2.60	[1]13,097	34,579	2.64
Industrial sand	257	1,179	4.59	W	W	9.38
Grand total or average	e16,127	e42,509	e2.64	W	W	2.71

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

Slag.—Indiana ranked second of 14 States in sales of processed blast furnace (iron) slag in 1982, and ranked eighth of 20 States in sales of processed steel slag. Levy Co. Inc. at Burns Harbor in Portage, Porter County, and Vulcan Materials Co. at Indiana Harbor in East Chicago, Lake County, processed air-cooled iron slag obtained from area blast furnaces. Levy Co. and Heckett Co. of East Chicago processed steel slag from area steelmakers. The slag was used for road base, fill, asphaltic concrete, and concrete aggregate.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

One-half of Indiana's 92 counties produced limestone to be broken, ground, calcined, or cut to fill industry's needs for construction aggregate, cement, flux, lime, filler, building stone, and numerous chemical products.

Crushed.—Based on preliminary estimates, total sales of crushed stone in Indiana decreased 20% from that of 1981 to 20.3 million tons. Total value decreased by $14.4 million, while the average unit value rose

from $3.15 to $3.23 per ton. The State, with sales valued at $65.5 million, ranked 16th nationally in the production of crushed stone. Virtually all production was limestone; a minor amount was marl.

In 1982, Martin Marietta Aggregates started production at a new underground mine in Indianapolis. It also reported that its 1-million-ton-per-year plant at Charlestown exceeded performance expectations.

Mulzer closed its 30-year-old limestone mining operation at Derby but retained the site for stone storage and sales. The company at one time operated slope, drift, and surface limestone mines simultaneously at this site. Mulzer's crushed stone operations in Indiana include two processing plants (500 and 800 tons per year), two quarries, and a barge loading dock common to both plants at Cape Sandy on the Ohio River about 50 land miles west of Louisville; a quarry and underground mine in Eckerty; and a quarry in Temple. The Mulzer subsidiary, Evansville Materials Inc. also operates two sand and gravel dredges on the Ohio River and an inland sand and gravel processing plant. In addition to direct shipments of construction aggregate from these production sites, the Mulzer organization services its southern Indiana market area through a network of material distribution yards.

At yearend, Calcium Carbonate Co., a division of J. M. Huber Corp., had yet to begin construction of a pulverized limestone plant at Camden in northern Indiana. The site is at a high-purity limestone reef of Silurian age, which was discovered by IGS in 1976.

All agricultural limestone producers participated in a Statewide sampling program to provide Indiana farmers with the information necessary to properly evaluate and select agricultural limestone and to provide them a sound basis for adjusting application rates on the basis of quality. The project was jointly sponsored by the Indiana Mineral Aggregates Association, the Indiana Farm Bureau Corp., and Purdue University. Seventy-four samples were tested for fineness (percent material passing 8-, 30-, and 60-mesh sieves), calcium carbonate equivalent, and percentage of calcium and magnesium. According to U.S. Bureau of Mines tabulations for 1981, 68 quarries produced 2 million tons of agricultural limestone for a total value of $7 million. These figures represent 8% of the total production of crushed stone and 9% of the total value.

Dimension.—Preliminary estimates indicate that the production of dimension stone in Indiana decreased by 7% to 135,000 tons from that of 1981. Total value decreased by $335,000, while the average unit value rose from $94.29 to $98.79 per ton.

The State, with sales valued at $13 million, ranked third behind Georgia and Vermont in the production of dimension stone. More than 98% of production was limestone; the remainder was sandstone. Indiana Limestone Co. Inc., in Lawrence County, ranked eighth nationally in estimated total sales value.

Limestone quarrying is one of the oldest industries in the State, and Indiana has dominated the Nation's domestic dimension limestone market since the late 1800's. The famous Salem Limestone quarries are located in an narrow belt extending from Bloomington to Bedford in south-central Indiana. This even-textured stone is also called Bedford Stone and Indiana Oolitic Limestone, and is generally known as Indiana Limestone. Buff stone is the more desirable for some purposes but the gray is more abundant. Mixed gray and buff stone is termed variegated. Architects either mix the colors or specify a single variety. Once used mainly as a structural building material for load-bearing masonry, Indiana Limestone currently finds most of its uses as veneer or exterior cladding that protects, insulates, and beautifies buildings.

Although 1982 was not a favorable year for the construction industry, Indiana's dimension limestone producers fared rather well. Industry tied to residential and small commercial building suffered most, whereas dimension stone producers involved in larger scale government and corporate building fared better. Favorable factors included an increase in historic preservation projects and a moderate swing in architectural preference toward stone and away from synthetic materials.

The limestone industry has also noted a substantial change from textured to smooth surfaces. Post-tensioning increased in building limestone, as did use of epoxy bond and steel framing for large assemblies. Automation increased in fabrication and would have advanced more had more capital been available. Some quarries foresee a trend toward restriction of geographic markets, since transporation costs in 1982 were greater than producers were able to cover.

Projects completed in recent years that used stone provided by Indiana limestone producers included the following:

Project	Cubic feet	Producer
American United Life Insurance Co. Building, Indianapolis, Ind	86,000	Indiana Limestone Co. Inc.
Terrace Tower I, Denver, Colo. (the first of seven office buildings)	30,000	Do.
American Electric Power Building, Columbus, Ohio	70,000	Do.
School of Public Environmental Affairs, Bloomington, Ind. (addition to the Indiana University Business Building).	9,000	Woolery Stone Co. Inc.
Channel 13 TV Building, Indianapolis, Ind	7,800	Bybee Stone Co.
St. Meinrad Library Building, Jasper, Ind	1,000	Fluck Cut Stone Co.
Herald News Publishing Facility, Springfield, Ill	2,000	Do.
Martin County State Bank, Shoals, Ind	3,200	Do.
Seelbach Hotel, Louisville, Ky. (renovation)	800	Bybee Stone Co.
First National Bank, Rogers, Ark	2,800	Architectural Stone Sales Inc.

Projects now underway or planned include the following:

Project	Cubic feet	Producer
Dade County Administration Building, Miami, Fla	96,000	Harding & Cogswell Corp.
Museum of Fine Arts, Dallas, Tex	60,000	Do.
Massey residence, Goochland, Va. (private home)	1,000	Do.
Prudential Life Insurance Co. Building,[1] Princeton, N.J	9,000	Do.
Cathedral of St. John the Divine, New York, N.Y. (continuing construction)	14,500	Indiana Limestone Co. Inc.

[1]The energy efficiency of this limestone masonry construction will be compared to that of an identical building constructed primarily of glass.

At midyear, Victor Oolitic Stone Co. received a setback variance and a conditional use permit from the Monroe County Board of Zoning Appeals that allowed the expansion of its quarry on 150 acres of industrially zoned land in Indian Creek Township. The quarry will be 195- by 100-feet, 68 feet from the road, screened by topography and trees, and will have a small slurry pond. There will be no blasting since the stone will be cut.

There are abandoned sandstone quarries in at least 20 counties that provided building material until the early 1900's. The dimension sandstone industry has now consolidated and diminished in size, so that only three counties—Brown, Lawrence, and Morgan—have commercial dimension sandstone operations.

Sulfur (Recovered).—Amoco Oil Co., Lake County, recovered elemental sulfur at its East Chicago facility from refinery gases. Standard Oil Co. (Indiana), the parent company, was the fifth largest producer of recovered elemental sulfur in the Nation. Energy Cooperative Inc., of East Chicago, Lake County, discontinued its sulfur recovery operations in late 1981. Stauffer Chemical Co. at its Hammond plant in Lake County produced liquid sulfur dioxide by the contact process. Stauffer is the largest producer of this product. The company also produced sulfuric acid and liquid sulfur trioxide.

Most sulfur was converted to sulfuric acid prior to end use. Agricultural chemicals (fertilizers) accounted for most of the sulfur demand. Other uses included organic and inorganic chemicals, petroleum refining, and metal mining.

METALS

Aluminum.—Aluminum Co. of America (Alcoa), the State's only primary aluminum producer, operated a smelter and fabricating plant in Newburgh near Evansville in southwestern Indiana. Bauxite for the plant's alumina was mined in Australia, Suriname, Jamaica, the Dominican Republic, and Guinea. The alumina was shipped from Alcoa refineries in Mobile, Ala.; Point Comfort, Tex.; Australia; Jamaica; and Suriname. Alcoa is Warrick County's largest employer, with about 3,400 workers. The Warrick operations, which consist of smelting, recycling, ingot-casting, and fabricating facilities, produce rigid container sheets for the beverage can industry. It is one of the world's largest producers of aluminum for beverage cans. The six potlines in the smelter consume 87% of the power produced by Alcoa Generating Corp. (AGC), which owns 582 megawatts of installed generating capacity at the Warrick powerplant. Annually, 2 million tons of washed coal are

railshipped from a surface mining operation north of Boonville to AGC, its only customer. The AGC facilities provide electric power, hot water, steam, and potable water exclusively to Alcoa's Warrick operations.

At the Anaconda Aluminum Co. plant in Terre Haute, unemployment reached 14% in November due to the continuing loss of orders from the automobile and housing industries. The plant is also a major supplier of aluminum used in household foil. Anaconda's normal work force is about 1,000.

American Can Co. announced plans to sell its U.S. Reduction Co. subsidiary, one of the Nation's largest secondary aluminum smelters, within the next 2 years. The East Chicago facility has the largest capacity of the several plants operated by U.S. Reduction. Its financial losses resulted from reduced demand for recycled aluminum alloys, as U.S. automobile production hit its lowest level in 20 years. American Can continued to phase out its MRI Corp., a subsidiary and detinner of steel scrap. Its MRI facility in East Chicago was closed in 1981. In late October, the union ratified a new contract at the U.S. Reduction plant, ending a walkout that began August 4 when the previous contract expired.

At Atwood in Kosciusko County, MK Metals Inc. patented a process that shreds bimetallic beverage cans and separates the end-lids from the bodies of two-piece, two-alloy beverage cans. The process will allow the recycling industry to recover most of the aluminum in bimetallic beverage containers.

Intrametco EF, Evansville, installed a 10,000-pound capacity electric furnace to produce aluminum scrap from nearby aluminum mills. Intrametco is a joint venture of Intra-American Metals Inc., Indianapolis, a metal trading and brokerage firm, and Henry Fligeltaub Co., Evansville, a processor of industrial scrap.

Iron and Steel.—Pig iron and raw steel production in Indiana, fell to the lowest level since 1946 because of the recession and the global oversupply of steel. The Gary district, which includes mills in neighboring Illinois, became the largest steel producing area in the Nation in 1982; yet production dipped to Depression-era levels and unemployment was about 30% among steelworkers. More than 14,000 were on permanent layoff, and many thousands more were on shortened work schedules as the district's integrated producers operated at 45% to 60% of capacity.

By yearend, Bethlehem Steel Corp. at Burns Harbor had reduced its work force to 5,700. At its operating peak, the facility had about 8,000 workers. Layoffs at Inland Steel in East Chicago reached a high during December when 5,800 steelworkers were out of work. At its peak 1980-81 employment, Inland Steel had 18,500 steelworkers.

Year	Pig iron production (million net tons)		Percent of U.S. production in Indiana	Indiana's U.S. ranking
	Indiana	U.S. total		
1977	16.5	81.5	20.2	2
1978	18.8	87.7	21.4	2
1979	18.0	87.0	20.7	2
1980	15.8	68.7	23.0	1
1981	18.3	73.8	24.8	1
1982	13.5	43.5	31.0	1

In 1982, Indiana increased its lead over Pennsylvania as the leading domestic producer of pig iron, having taken that lead in 1980. Indiana's production at 13.5 million tons represented 31% of domestic output. Indiana also led the Nation in pig iron shipments and consumption. Shipments at 18.3 million tons and value at $3.6 billion were down 26% from that of 1981. During the year, 14 of 22 operating blast furnaces were down for more than 180 days.

Year	Raw steel production (million net tons)		Percent of U.S. production in Indiana	Indiana's U.S. ranking
	Indiana	U.S. total		
1977	21.5	125.3	17.2	3
1978	24.4	137.0	17.8	2
1979	22.9	136.3	16.9	2
1980	19.8	111.8	17.7	2
1981	22.7	120.8	18.9	2
1982	16.5	74.6	22.6	1

In 1982, Indiana became the leading steel producing State in the Nation, having displaced Pennsylvania, which dropped from first place to third behind Ohio. Raw steel production dropped 27% to 16.5 million tons compared with that of 1981 and 33% below the record levels of 1978. Indiana's share of U.S. raw steel production has climbed from less than 16% in 1974 to 22.6% in 1982.

During the year, basic steel in Indiana was being restructured and modernized into a smaller and more specialized industry. Integrated producers shed surplus idle capacity, modernized the remaining capacity, and consolidated production in the most efficient facilities. Some of the shrinkage of integrated steelmaking was offset by increases in minimill capacity.

Inland Steel undertook the initial engineering phase and entered into a technical assistance agreement with Nippon Steel Corp. to install continuous casting at the No. 2 basic oxygen furnace at its Indiana Harbor Works in East Chicago. The unit, designed to cast both slabs and blooms, will become Inland Steel's third continuous caster. Construction continued on the company's No. 3 continuous annealing line, which is expected to be completed in November 1983 and will process ultra-high-strength steel sheets. Inland Steel also formed a new process automation department. The department will help the company to improve its competitive position by planning installation of computers, robots, and other sophisticated instrumentation. In 1982, the company also provided hot metal desulfurization and ingot and slab handling, replaced the No. 4 basic oxygen furnace, and installed a coke oven precipitator. New galvanizing facilities and 12-inch bar mill improvements are planned for 1983.

Also in 1982, Inland Steel developed prelubricate sheet and muffler sheet and introduced sheet with zinc paint. The company also established lower prices for bar products produced from scrap in electric furnaces. During the year, to reduce operating costs, Inland Steel shut down for indefinite periods its "C" battery coke ovens, "B" blast furnace, and No. 3 open hearth furnace and blooming mill. Inland Steel became the fifth largest domestic steelmaker in 1982, having moved up from seventh rank in 1981.

United States Steel Corp. merged its Irvin Works near Pittsburgh and its South Works in Chicago into an expanded Gary Works in northwest Indiana. The Gary Works, United States Steel's largest steel plant, produces plate, bars, rail, sheets, template, and galvanized products. In 1982, seamless mill and sinter plant improvements were in progress and continuous slab caster improvements were completed. Water quality facilities at the hot strip and tubing mills are expected to be operational in 1983. The company apparently ended a 4-year battle with the State by agreeing to reduce air pollution at its Gary coke plants. The agreement includes installing an additional system to collect coke plant emissions in lieu of paying a $415,000 civil penalty and replacing worn or damaged equipment on a schedule set by the State. Failure to meet installation deadlines will cost the company $3,000 per day in penalties.

Bethlehem Burns Harbor plant increased its share of production as shutdowns elsewhere brought more business to it. The plant, opened in 1964, is the Nation's newest integrated steel mill. The facility, which occupies about one-half of the 3,300-acre property near Portage, is Porter County's largest employer. It would require well over $4.5 billion to replace. Bethlehem, the Nation's second largest steel producer, had under construction a $59 million continuous heat-treating line and began the $56 million

rehabilitation of leading coke oven battery. The heat-treating line will produce cold-rolled sheet with high strength and good forming and welding qualities primarily for the automotive industry. The renovations of the coke battery will reduce air pollution while increasing productivity and energy efficiency. Both projects were scheduled for operation in 1983. During the year, the company actively investigated alternative ways for financing a second continuous slab caster for the Burns Harbor plant.

Bethlehem's hot strip mill was shut down for 1 week in September because of a slump in steel orders. From Thanksgiving Day through December 11, most of the primary steelmaking operation at Burns Harbor was closed due to lack of business. Facilities affected by the 17-day shutdown include the plant's one operating blast furnace, sinter plant, basic oxygen furnace shop, continuous slab caster, and slabbing mill. The coke ovens, 160-inch plate mill, 80-inch hot-strip mill, and cold-sheet and tin mills continued to operate. The 110-inch plate mill was idled for most of the year, while the 160-inch mill continued to produce plate, which was formed into 36-inch pipe at Steelton, Pa., for use in the 800-mile Trailblazer natural gas pipeline from Wyoming to Nebraska. During the year, one of the two blast furnaces was shut down for a 4-month relining program.

In late December, as part of restructuring operations, Bethlehem announced that its Lackawanna, N.Y., galvanizing line and certain related facilities would be reorganized as an operating unit of the Burns Harbor plant. The Lackawanna galvanizing unit will require 400,000 tons per year of sheet steel from Burns Harbor.

Jones & Laughlin Steel Corp. (J&L), a subsidiary of LTV Corp. and the Nation's third largest steel producer, continued construction of the $165 million slab caster for its Indiana Harbor plant in East Chicago. The facility, consisting of two slab casting machines capable of feeding three strands, was scheduled to start up in October 1983. Two of the plant's operable blast furnaces were running during 1982. The third was undergoing a $5.5 million relining, which was completed in December. J&L also completed the $1 million expansion at its iron foundry, which allows a 40% increase in production of ingot molds and stools. The company eliminated coke production at the plant when it indefinitely idled the remaining coke battery. The other was shut down in October 1981. Coke will be received from other J&L facilities.

The Midwest Steel Div. of National Steel Corp. claimed a $13 million saving in the operation of its Portage plant in the first 8 months of 1982 as a result of its union-management participation program. The program was implemented after a revision in the language of the 1980 basic steel agreement permitted one plant from each steel company to experiment with the concept. Midwest, which coats and rolls stock from other divisions of National Steel, was National's first plant to get the program. On May 10, National Steel shut down its Portage plant for 24 hours for a meeting with employees at a nearby high school to discuss ways to save money and improve operating efficiency. More than 1,700 employees met with top Midwest officials. At a September 1 press conference, the company announced that since the May 10 meeting the employees have come up with 1,400 different ideas that have saved Midwest $8.5 million. In all of 1981, cost improvement amounted to $5 million. Before the meeting, just 1% of the cost-improvement ideas came from hourly workers. After the meeting, 70% came from hourly workers. National Steel is the Nation's fourth leading steelmaker. Its 20-year-old Portage plant is among the most modern rolling plants in America. In September, the plant was operating at 70% capacity, as opposed to 40% industrywide. About 400 of its 1,800 work force were on layoff at that time.

After the bankruptcy of Penn-Dixie Industries Inc., the Penn-Dixie Steel Corp. of Kokomo was reorganized in March as Continental Steel Corp. About $5 million in wage and benefit cuts, effective February 7, had been made by Penn-Dixie Steel in an effort to lift the company back to profitability and its parent firm, out of Chapter 11 bankruptcy status.

Continental Steel, the 600,000-ton-per-year electric furnace steel mill in Kokomo was planning a possible $38 million outlay for new equipment. The facility, which operates two 175-ton electric furnaces, specializes in bar, rod, and wire products. Capable of producing 50,000 tons of nails per year, Continental is one of the top three U.S. nailmakers.

Continental Steel negotiated agreements for purchase and installation of a new two-strand mill at its Kokomo plant, but delayed the signing of a contract until the economy warrants such a move. The $18

million installation project will replace the obsolete 1953 mill. The remaining $20 million elements in the modernization plan will include a continuous caster in Kokomo and improvement at the company's Joliet, Ill., basic mill. The first of two galvanizing lines, rated at 9,000 tons per year, came onstream in December 1981; the second was ready by midyear. These employ fluidized-bed furnaces in which inert heated sand is used to temper the wire. This new technique provides a more consistent annealing process, resulting in a superior galvanized product. The system also eliminates the health hazard associated with molten lead.

Joslyn Stainless Steel Inc., Fort Wayne, adopted an experimental technique developed by the U.S. Bureau of Mines for in-plant recycling of its stainless steel furnace dusts, mill scale, and grinding swarfs. Bureau research had demonstrated that these waste materials could be pelletized and returned to electric arc furnaces so that chromium, nickel, molybdenum, and other scarce and valuable constituents of stainless and other high-temperature alloy steels could be recovered. The process solves problems of storage and disposal of these wastes and improves the economics of furnace operation.

Other Metals.—The Cabot Corp. High Technology Materials Div. in Kokomo began sales of titanium flat-rolled products and a broadened line of nickel-based alloys from its new $58 million mill facility. Cabot also began processing beryllium-copper and other beryllium alloys at its new Indiana rolling mill. This operation will eventually replace all hot rolling done previously at the Reading, Pa., plant. The Reading plant will continue to produce beryllium alloy billet from imported and domestic ores that were converted to beryllium hydroxide. The Kokomo mill has an annual capacity of 60 million pounds of specialty metals. With additional furnaces, that design capacity can be doubled.

In February, ASARCO Incorporated shut down its Federated Metals Corp. metals recycling plant at Whiting. The plant had produced brass and bronze ingot, zinc dust, solders, and other tin-based alloys and alloys from nonferrous scrap. Approximately 90 jobs were lost.

In December, Chromalloy American Corp. announced the sale of its Newman Foundry Div. in Kendallville to Dayton Malleable Inc. Newman Foundry produces primary automotive and compressor castings. Dayton Malleable is the largest independent foundry organization in the Nation.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.
[2]Indiana Business Review. V. 58, January-February 1983.
[3]Work cited in footnote 2.
[4]Work cited in footnote 2.
[5]Based on reports submitted by individual companies.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Natural:			
Hindostan Whetstone Co	Box 432, 2924 South Mitchell Rd. Bedford, IN 47421	Quarry and plant	Orange.
Metallic:			
Jumbo Manufacturing Co	Box 155 Tippecanoe, IN 46570	Plant	Marshall.
Wheelabrator-Frye Inc., Materials Cleaning Systems Div.	400 South Byrkit St. Mishawaka, IN 46544	do	St. Joseph.
Aluminum:			
Aluminum Co. of America	Warrick Operations Box 10 Newburgh, IN 47630	Smelter and fabricating plant.	Warrick.
Cement:			
Lehigh Portland Cement Co.[1]	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.[1 2]	Box 482 Greencastle, IN 46135	Plant (portland-masonry) and quarry.	Putnam.
Louisville Cement Co.[1 2]	Box 659, Highway 25 West Logansport, IN 46947	Plant (portland) and quarry.	Cass.
Do	Speed, IN 47172	Plant (portland-masonry) and quarry.	Clark.
Clays:			
C & F Shale Co	304 South Depot St. Brazil, IN 47834	Pit (underclay)	Parke.
General Shale Products Corp	Box 96 Mooresville, IN 46158	Pits and plant	Morgan.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Clays —Continued			
Hydraulic-Press Brick Co	Brooklyn, IN 46111	Pit and plant (lightweight aggregate).	Morgan.
Log Cabin Coal Co	304 South Depot St. Brazil, IN 47834	Pits (underclay) and plant.	Clay.
Gypsum:			
National Gypsum Co.[3]	Box 250 Shoals, IN 47581	Underground mine and plant.	Martin.
United States Gypsum Co.[3]	Box M Shoals, IN 47581	do	Do.
Do	3501 Canal St. East Chicago, IN 46312	Plant	Lake.
Iron and steel:			
Bethlehem Steel Corp	Box 248, U.S. No. 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:			
Anderson Peat Organic Compost	Route 19 Noblesville, IN 46060	Bog and plant	Hamilton.
Michigan Peat Co	Box 234, Rural Route No. 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	Box 40228 4700 East 96th St. & Gray Rd. District Office Indianapolis, IN 46240 Drawer 160 Garst Ave. at Ave. B Corporate Headquarters 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, R.R. 5 Greenfield, IN 46140	Pits and plants	Fayette, Hamilton, Henry, Madison, Wayne.
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 27622	do	Clark, Hamilton, Howard, Marion, Vermillion, Vigo.
Rogers Group Inc	Box 849, 350 South Adam St. Bloomington, IN 47402	do	Fountain, Gibson, Green, Knox, Morgan, Owen.
Vulcan Materials Co., Midwest Div.	Box 6, 500 West Plainfield Rd. Countryside, IL 60525	do	Hamilton, Madison, La Porte, Parke, Pulaski, St. Joseph, Tippecanoe, White.
Industrial:			
Crisman Sand Co. Inc	6480 Melton Rd. Portage, IN 46368	Pit and plant	Porter.
Martin Marietta Aggregates, Industrial Sand Div.	East Dunes Highway (U.S. 12) Michigan City, IN 46360	Pits and plant	La Porte.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Crushed:			
American Aggregates Corp	Box 40228 4700 East 96th St. & Gray Rd. District Office Indianapolis, IN 46240 Drawer 160 Garst Ave. at Ave. B Corporate Headquarters Greenville, OH 45331	Quarries and plants	Hamilton, Marion, Wayne.
The France Stone Co	Box 1298 Toledo, OH 43603	do	Allen and Putnam.
Irving Bros. Gravel Inc.[4]	RR 13 Muncie, IN 47302	do	Delaware, Grant, Huntington.
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 27622	do	Clark, Howard, Madison, Marion, Putnam, Vigo.
Mulzer Crushed Stone Co	Box 249, 603 6th St. Tell City, IN 47586	Quarries, mine, and plants.	Crawford.
Rogers Group Inc.[2]	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	do	Lawrence.
B. G. Hoadley Co. Inc	Box 1224 Bloomington, IN 47402	Quarry and plants	Do.
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	do	Lawrence.
Woolery Stone Co. Inc	Box 40 Bloomington, IN 47402	Quarry and plant	Monroe.
Sulfur (recovered):			
Amoco Oil Co	Box 710 2815 Indianapolis Blvd. Whiting, IN 46394	Refinery	Lake.

[1]Also crushed stone.
[2]Also clays.
[3]Also expanded perlite.
[4]Also 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 in Iowa during 1982 was valued at $218.6 million, 5% less than that of 1981 and $59 million less than the record high attained in 1979.

Among the 10 nonmetallic mineral commodities produced, gains in output over those of 1981 were recorded in the production of crushed stone and dimension stone, coupled with slight value increases for these two commodities and clays. Accounting for 41% of the State's total, crushed stone was the leading commodity in value, followed by portland cement, 38%; construction sand and gravel, 12%; and gypsum, lime, masonry cement, clays, dimension stone, industrial sand, peat, and gem stones, comprising the remainder.

Iowa was ranked 28th among the States in the value of nonfuel mineral production, accounting for approximately 1% of the U.S. total. The State ranked second in the value of gypsum produced.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	41	$3,227	W	W
Portland do	1,779	92,099	1,622	$82,225
Clays do	476	2,375	437	2,392
Gem stones	NA	1	NA	1
Gypsum thousand short tons	1,383	12,706	1,177	11,345
Peat do	10	453	W	W
Sand and gravel (construction) do	e10,330	e29,080	10,064	25,618
Stone (crushed) do	22,424	82,891	p22,600	p88,800
Combined value of lime, sand (industrial), stone (dimension), and values indicated by symbol W	XX	6,559	XX	8,256
Total	XX	r229,391	XX	218,637

eEstimated. pPreliminary. 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 Iowa, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Adair	W	W	Stone (crushed).
Adams	W	W	Do.
Allamakee	W	$311	Do.
Appanoose	$2,638	W	Stone (crushed), clays.
Audubon	W	(3)	
Benton	W	W	Stone (crushed).
Black Hawk	W	W	Do.
Boone	724	(3)	
Bremer	W	W	Stone (crushed).
Buchanan	W	1,247	Do.
Buena Vista	109	(3)	
Butler	W	520	Stone (crushed).
Calhoun	W	(3)	
Carroll	329	(3)	
Cass	W	W	Stone (crushed).
Cedar	W	W	Do.
Cerro Gordo	65,146	W	Cement, stone (crushed), clays.
Cherokee	856	(3)	
Chickasaw	582	377	Stone (crushed).
Clarke	1,037	466	Do.
Clay	320	(3)	
Clayton	4,509	W	Sand (industrial), stone (crushed).
Clinton	2,002	1,752	Stone (crushed).
Crawford	W	(3)	
Dallas	W	W	Clays.
Davis	W	W	Stone (crushed).
Decatur	809	610	Do.
Delaware	W	1,048	Do.
Des Moines	5,054	W	Gypsum, stone (crushed).
Dickinson	617	(3)	
Dubuque	W	W	Stone (crushed), stone (dimension).
Emmet	381	(3)	
Fayette	2,503	1,223	Stone (crushed).
Floyd	W	W	Do.
Franklin	W	W	Stone (crushed), clays.
Fremont	423	284	Stone (crushed).
Greene	W	(3)	
Grundy	30	(3)	
Guthrie	304	(3)	
Hamilton	677	518	Stone (crushed).
Hancock	W	W	Stone (crushed), peat.
Hardin	6,293	6,527	Stone (crushed).
Harrison	W	1,085	Do.
Henry	W	W	Do.
Howard	524	392	Do.
Humboldt	W	952	Do.
Ida	W	(3)	
Jackson	W	1,016	Stone (crushed).
Jasper	W	322	Do.
Jefferson	W	W	Do.
Johnson	3,076	W	Do.
Jones	2,952	2,171	Stone (crushed), stone (dimension).
Keokuk	W	W	Stone (crushed).
Kossuth	73	(3)	
Lee	W	W	Stone (crushed).
Linn	W	W	Stone (crushed), peat.
Louisa	W	W	Stone (crushed).
Lucas	41	--	
Lyon	W	(3)	
Madison	W	W	Stone (crushed), clays.
Mahaska	W	151	Stone (crushed).
Marion	W	W	Stone (crushed), gypsum.
Marshall	3,138	W	Stone (crushed).
Mills	349	240	Do.
Mitchell	W	W	Do.
Monona	W	(3)	
Monroe	1,383	863	Stone (crushed).
Montgomery	W	1,404	Do.
Muscatine	W	W	Do.
O'Brien	467	(3)	
Osceola	402	(3)	
Page	W	420	Stone (crushed).
Palo Alto	W	(3)	
Plymouth	W	(3)	
Pocahontas	W	W	Stone (crushed).
Polk	W	13,889	Cement, clays, stone (crushed).
Pottawattamie	W	W	Stone (crushed).
Poweshiek	W	W	Do.

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Sac	W	(3)	
Scott	$38,865	$34,715	Cement, lime, stone (crushed), clays.
Shelby	W	(3)	
Sioux	1,521	(3)	
Story	W	W	Stone (crushed), clays.
Tama	W	W	Stone (crushed).
Taylor	181	216	Do.
Union	W	W	Do.
Van Buren	W	1,465	Do.
Wapello	1,105	W	Clays.
Warren	W	—	
Washington	W	W	Stone (crushed).
Webster	12,027	W	Gypsum, stone (crushed).
Winnebago	W	W	Peat.
Winneshiek	1,446	2,150	Stone (crushed).
Woodbury	W	W	Clays.
Worth	W	1,037	Stone (crushed), peat.
Wright	440	(3)	
Undistributed[4]	88,544	122,939	
Sand and gravel (construction)	XX	e29,080	
Total[5]	251,876	229,391	

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

[1]Iowa, Ringgold, and Wayne Counties are not listed because no nonfuel mineral production was reported.

[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 values indicated by symbol W.

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

Table 3.—Indicators of Iowa business activity

	1981	1982p	Change, percent
Employment and labor force, annual average:			
Total civilian labor force, thousands	1,427.0	1,418.0	-0.6
Unemployment, do	99.0	121.0	+22.2
Employment (nonagricultural):			
Mining[1], do	2.0	1.8	-10.0
Manufacturing, do	236.5	207.7	-12.2
Contract construction, do	44.4	35.1	-20.9
Transportation and public utilities, do	55.0	52.2	-5.1
Wholesale and retail trade, do	277.4	263.5	-5.0
Finance, insurance, real estate, do	59.1	58.7	-.7
Services, do	211.1	209.6	-.7
Government, do	203.1	202.0	-.5
Total nonagricultural employment[1], do	1,088.6	1,030.6	-5.3
Personal income:			
Total, millions	$30,373	$30,595	+.7
Per capita	$10,478	$10,478	--
Construction activity:			
Number of private and public residential units authorized	5,799	5,284	-8.9
Value of nonresidential construction, millions	$218.1	$165.5	-24.1
Value of State road contract awards, do	$132.6	$190.0	+43.3
Shipments of portland and masonry cement to and within the State, thousand short tons	1,163	1,170	+.6
Nonfuel mineral production value:			
Total crude mineral value, millions	$229.4	$218.6	-4.7
Value per capita, resident population	$80	$75	-6.2
Value per square mile	$4,127	$3,884	-5.9

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.

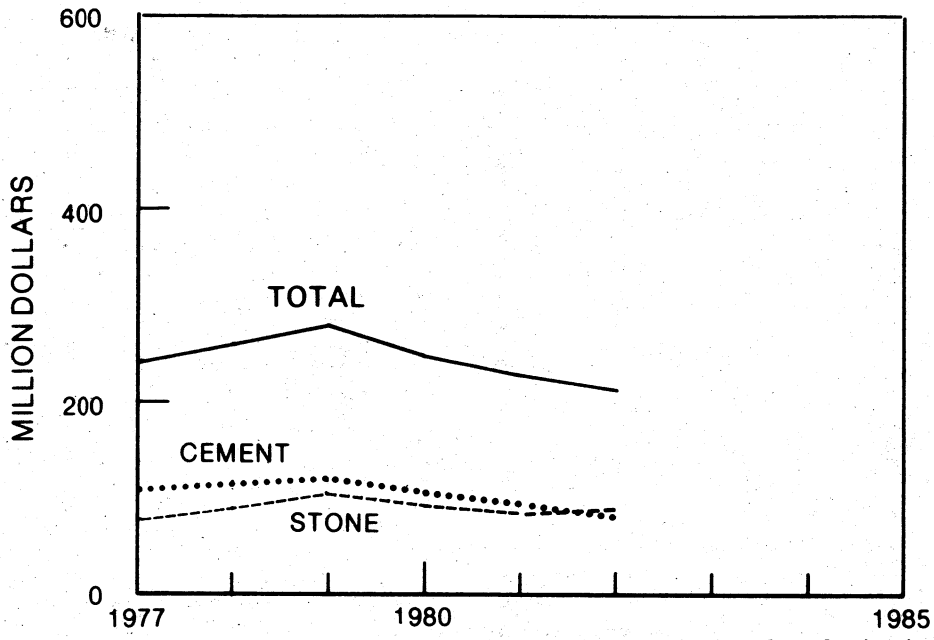

Figure 1.—Value of cement, stone, and total value of nonfuel mineral production in Iowa.

Trends and Developments.—Iowa's industrial expansion dropped significantly during 1982 compared with that of 1981, mirroring the nationwide economic downturn.

According to the Iowa Development Commission, industrial-development investments for new facilities and expansion of existing facilities were about $206 million, a 53% decrease from the previous year's investment level. Mineral-related processing and manufacturing industries included among the 156 new or expanded facilities reported for 1982 totaled 5 within the Standard Industrial Classification (SIC) 32, Stone, Clay, Glass and Concrete Products; and 2 within SIC 33, Primary Metal Industries.

Martin Marietta Corp. began cement production at its new 850,000-ton-per-year plant near Davenport. A unit of the company's Midwest Div., the plant was designed for energy efficiency, consuming 45% less coal and 10% less electricity than the 500,000-ton-per-year, three-kiln plant it replaced. To accommodate production from the new plant, the Midwest Div. enlarged its terminal at Madison, Wis., and added a new terminal at West Des Moines.

Northwestern States Portland Cement Co. of Mason City suspended manufacturing for 2 months in the first half of the year because of expanding inventories and slow sales. The closure was the first in the company's 76-year history of operation.

The underground silica mine and plant Martin Marietta Aggregates operated in Clayton County was closed permanently.

The National Sand & Gravel Association honored several Iowa sand and gravel producers for their safety accomplishments. Special Honor Roll Certificates were awarded to plants that reported accident-free records for the last 5 or more consecutive years, including Martin Marietta Aggregates, Cedar Rapids; Stevens Sand & Gravel Co. Inc., Iowa City; and Van Dusseldorp Sand & Gravel Inc., Colfax.

In 1982, the State issued no permits for metallic-mineral exploration within its borders.

Employment.—According to the Iowa Employment Security Commission, employment in the mining industry at midyear was 1,800 compared with 2,200 at midyear 1981. The average hourly earnings of mining production and related nonsupervisory workers was $8.09 in July 1982, approximately an 8% increase compared with that of the same month in 1981.

Legislation and Government Programs.—The Iowa Geological Survey (IGS)

conducted a variety of applied research projects in geology and water resources during the year. Among the projects conducted within divisions of IGS, were the following:

Water Resources Division.—A program was conducted evaluating alluvial aquifer systems along the interior streams of the State, utilizing seismic techniques to determine alluvial boundaries, thickness, and types of material. A comprehensive inventory of the water supply data of the State's incorporated communities was made, including well locations and construction information, rate of pumping, and water use and quality.

Geological Studies Division.—An assessment was made of the Iowa karst region that covers about 13,400 square miles and contains more than 12,700 sinkholes developed in the Devonian-Silurian aquifer. The study includes an assessment of land use practices in relation to ground water quality, and a model will be developed to evaluate quantitatively what types of land treatment and management may help reduce ground water contamination in karst areas.

Stratigraphy and Economic Geology Division.—A report was prepared on high-calcium limestone in Iowa, including chemical analyses and structure and isopach maps of the various high-calcium units. A list was made of mineral producers in Iowa, organized by county, giving the name, address, and telephone number of each producer and the mineral commodity produced. A series of maps was prepared of the Forest City Basin, including Bouguer gravity anomaly, magnetic anomaly, configuration of the Precambrian surface, and lineament maps.

As part of an ongoing project of investigating the geology of chromite, the U.S. Geological Survey initiated preliminary studies to evaluate the mineral potential of an ultramafic body of Precambrian rocks in the northwestern part of the State.

Personnel from the U.S. Bureau of Mines, Twin Cities Research Center, conducted a testing program to apply hydraulic mining and transportation technology in recovering industrial sand from the St. Peter Sandstone near Clayton. Results of the test[2] indicated that the system was an efficient method for recovering the resource and for overcoming certain burdensome costs associated with room-and-pillar mining methods used in the past.

The Mining and Mineral Resources and Research Institute at the Iowa State University in Ames, which was created under title III of Public Law 95-87, received $150,000 in Fiscal Year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—The value and quantity of cement shipments in 1982 decreased from the previous year's level. During 1982, the fourth consecutive year that shipments dropped below those of the previous year, output fell to its lowest level of the past three decades.

The average unit prices received for 1982 shipments of portland and masonry cement were $50.69 per ton and $82.24 per ton, respectively. Iowa ranked 11th in the Nation in portland cement production and 20th in masonry cement output.

Four companies operated eight kilns at one wet-process and three dry-process plants. Two companies operated plants in Mason City, one in Des Moines, and one near Davenport. Ready-mix companies, the largest users of the State's portland cement production, consumed more than two-thirds of the output, followed by, in descending order of consumption, concrete product manufacturers, highway contractors, building-material dealers, and minor amounts by government agencies and other customers.

Most cement shipments were made in bulk form; minor quantities were marketed in containers. Shipments were principally by truck, although minor amounts traveled by rail.

Approximately 2.6 million tons of mostly State-produced nonfuel minerals was consumed in manufacturing the cement produced in Iowa during 1982.

Clays.—The quantity of common clay and shale produced in the State during 1982 was at its lowest level since the mid-1940's, and 1982 was the sixth consecutive year in which production decreased from the previous year's level. Output for the year was down 9% in quantity but increased less than 1% in total value compared with those of 1981. The average unit price of clay and

shale produced was $5.48 per ton, a $0.49 increase over that of 1981, a record high price.

Production during the year was recorded from nine mines operated by seven companies in seven counties. Three firms produced about two-thirds of the total output. Cerro Gordo and Scott Counties led in clay production and accounted for more than one-half of the State total.

Most of the clay produced in the State in 1982 was used in portland cement manufacturing, consuming about 54% of the output. Other uses of the clay, in descending order of amounts consumed, were in manufacturing building brick, lightweight aggregate for concrete blocks, and structural concrete products.

Gem Stones.—No commercial gem stone mining operations were reported in Iowa during 1982. The value shown in this chapter represents an estimate for material collected by rockhounds, mineral collectors, and other hobbyists.

Gypsum.—Compared with that of 1981, production of crude gypsum in 1982 decreased in quantity and total value. Output, at its lowest level of the past decade, marked the third consecutive year in which production decreased from the previous year's level. The average unit value of gypsum produced during 1982 was $9.64 per ton, a $0.45 increase over that of 1981, a record high price.

Iowa was ranked second among the States in value of crude gypsum produced, exceeded only by Texas.

During 1982, five companies produced gypsum at six mines in three counties. Underground mines were operated by United States Gypsum Co. near Sperry in Des Moines County and by Kaser Corp. near Harvey in Marion County. Surface mine operations were conducted by United States Gypsum, National Gypsum Co., Georgia-Pacific Corp., and Jim Walter Corp. at sites around Fort Dodge in Webster County. All companies, except Kaser, calcined a portion of their output at plants near the minesites.

Adding more than 50 million square feet of annual board capacity, a major expansion was completed at United States Gypsum's Sperry gypsum board plant.

Lime.—Production of lime in 1982 decreased in quantity and value from that of 1981. Linwood Stone Products Co. Inc. in Scott County was the State's sole producer of quicklime and hydrated lime. The output was marketed principally for use in water purification and softening, sewage treatment, steel-furnace operations, and road stabilization.

In 1982, lime consumption in Iowa, obtained from all domestic sources, totaled about 86,000 tons.

Peat.—Four companies harvested peat from bogs in Hancock, Linn, Winnebago, and Worth Counties. Although output remained relatively unchanged from that of 1981, total value declined significantly. The material was marketed mainly in bulk form.

Perlite (Expanded).—Processed perlite, from out-of-State sources, was expanded by National Gypsum and United States Gypsum at their Fort Dodge gypsum calcining plants in Webster County during 1982. Although the quantity of perlite expanded was unchanged from that of 1981, higher unit prices resulted in a gain in total value. The entire output was used for plaster aggregate.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. The 1982 production was at its lowest level since 1951, marking the fourth consecutive year that output decreased from the respective previous year's level. The average value of the material produced was $2.55 per ton, a $0.27 decrease from that marketed in 1981. Production was reported from 201 pits operated by 100 companies and government agencies, at sites throughout 70 of Iowa's 99 counties. Polk County had the largest output, followed by Boone, Plymouth, and Sac Counties, which collectively accounted for about one-fourth of the State's total production. Three companies, operating 33 pits, produced more than 500,000 tons each.

In 1982, approximately 35% of the individual operations produced less than 25,000 tons; 48%, between 25,000 and 100,000 tons; and the remaining 17%, between 100,000 and 500,000 tons.

Most of the construction sand and gravel produced during the year was used for concrete aggregate, accounting for about 44% of the total. Other uses, in descending order of consumption, included asphaltic concrete, road base and coverings, fill, plaster and gunite sands, snow and ice control, concrete products, and other miscellaneous uses.

Table 4.—Iowa: Construction sand and gravel sold or used, in 1982 by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,382	$12,799	$2.92
Plaster and gunite sands	96	374	3.91
Concrete products	56	191	3.42
Asphaltic concrete	2,330	4,564	1.96
Road base and coverings[1]	1,927	4,610	2.39
Fill	997	1,933	1.94
Snow and ice control	78	208	2.67
Other	199	940	4.72
Total[2] or average	10,064	25,618	2.55

[1]Includes road and other stabilization (cement and lime).
[2]Data may not add to totals shown because of independent rounding.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	5,237	$14,579	$2.78
Gravel	NA	NA	NA	3,909	9,556	2.44
Sand and gravel (unprocessed)	NA	NA	NA	917	1,483	1.62
Total or average	e10,330	e$29,080	e$2.82	[1]10,064	25,618	2.55
Industrial sand	W	W	11.86	W	W	11.86
Grand total or average	W	W	2.72	W	W	2.59

[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.

Table 6.—Iowa: Construction sand and gravel sold or used by producers, by county

County	1980			1982		
	Number of mines	Quantity (thousand short tons)	Value (thousands)	Number of mines	Quantity (thousand short tons)	Value (thousands)
Allamakee	2	22	W	1	36	$76
Benton	1	16	$47	3	W	W
Black Hawk	5	377	820	5	301	964
Boone	6	277	724	3	672	1,644
Buena Vista	3	61	109	3	W	W
Calhoun	2	W	W	1	50	70
Carroll	5	153	329	4	173	397
Cherokee	6	395	856	7	207	398
Clay	5	159	320	14	247	342
Clayton	5	W	W	2	57	138
Clinton	4	105	274	2	W	W
Dallas	5	292	876	5	296	957
Des Moines	1	W	278	1	W	W
Dickinson	6	244	617	6	192	382
Emmet	4	174	381	7	W	W
Fayette	5	34	101	1	W	W
Floyd	3	W	W	1	51	81
Franklin	4	145	259	3	91	172
Greene	4	W	W	11	235	524
Grundy	1	8	30	--	--	--
Guthrie	3	127	304	3	92	210
Hamilton	4	75	103	2	W	W
Hancock	5	170	361	4	82	184
Hardin	6	204	467	2	W	W
Howard	2	12	59	3	15	45
Jones	4	251	815	3	234	465

See footnotes at end of table.

Table 6.—Iowa: Construction sand and gravel sold or used by producers, by county —Continued

County	1980			1982		
	Number of mines	Quantity (thousand short tons)	Value (thousands)	Number of mines	Quantity (thousand short tons)	Value (thousands)
Kossuth	3	61	$73	3	79	$97
Lee	1	125	293	1	85	175
Linn	2	W	W	5	308	937
Lyon	2	W	W	8	130	290
Marion	5	446	1,322	3	228	734
Marshall	3	W	W	3	229	557
Muscatine	4	578	1,177	3	150	479
O'Brien	4	204	467	1	W	W
Osceola	3	196	402	4	159	304
Plymouth	2	W	W	4	557	1,350
Polk	8	1,376	3,838	4	698	2,002
Sac	3	W	W	4	521	1,196
Scott	3	190	498	--	--	--
Sioux	6	489	1,521	5	222	667
Van Buren	1	65	W	1	W	W
Webster	5	198	559	4	90	219
Winnebago	1	52	58	--	--	--
Winneshiek	1	50	165	1	48	174
Woodbury	2	W	W	3	126	255
Worth	3	138	332	5	288	612
Wright	3	176	440	5	W	W
Undistributed[1]	r42	5,037	13,447	37	3,117	8,522
Total[2]	208	12,683	32,722	201	10,064	25,618

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]Includes Appanoose, Audubon, Bremer (1980), Buchanan, Butler, Cass (1982), Cedar, Cerro Gordo, Crawford (1980), Delaware, Dubuque (1980), Harrison (1980), Humboldt, Ida, Iowa (1982), Jackson, Jasper, Johnson, Keokuk (1982), Louisa, Mitchell, Monona, Montgomery (1980), Page, Palo Alto, Pottawattamie, Shelby, Story, Tama, Wapello, and Washington (1982) Counties and data indicated by symbol W.

[2]Data may not add to totals shown because of independent rounding.

Industrial.—Martin Marietta Aggregates, Central Div., produced industrial sand from an underground mine in Clayton County. Output during 1982 was marketed principally for use by the foundry industry. A decline in production from that of 1981 was reported, owing in part to the permanent closure of the operation in August.

Stone.—To reduce reporting burdens and costs, the Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Limestone is the only type of stone being produced in the State.

Crushed.—The estimated quantity of crushed limestone produced during the year was slightly more than that of 1981 but was 30% below the record level set in 1979.

During the year, Martin Marietta Aggregates acquired the assets of E. I. Sargent Quarries Inc., Des Moines.

Dimension.—The estimated output of dimension limestone increased in quantity and value compared with that of 1981.

[1]State Liaison Officer, Bureau of Mines, Minneapolis, Minn.

[2]Savanick, G. A. Hydraulic Mining Experiments in an Underground Mine in the St. Peter Sandstone, Clayton, Iowa. Paper in Proceedings of the Second U.S. National Conference on Water Jet Cutting (Rolla, Mo., May 20-25, 1983). Univ. Mo.—Rolla, September 1983, 23 pp.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Lehigh Portland Cement Co	Box 1882 Allentown, PA 18105	Plant	Cerro Gordo.
Martin Marietta Corp., Cement Div.	Box 4288 Davenport, IA 52808	do	Polk and Scott.
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:			
Martin Marietta Corp., Cement Div.	Box 4288 Davenport, IA 52808	Pit and plant	Scott.
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 Div., Jim Walter Corp	1500 North Dale Mabry Tampa, FL 33607	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.
Lime:			
Linwood Stone Products Co. Inc.	Route 2 Davenport, IA 52804	Plant	Scott.
Peat:			
C-IT-GRO	Route 2 Garner, IA 50438	Bog and plant	Hancock.
Eli Colby Co	Box 248 Lake Mills, IA 50450	do	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):			
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 76622	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.
Sand (industrial):			
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 76622	Underground mine and plant.	Clayton.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone (limestone, 1981):			
Crushed:			
Alpha Crushed Stone Inc	Box 267 Marion, IA 52302	Quarries and plants	Cedar, Clinton, Jones, Linn.
B. L. Anderson Inc	327 Guaranty Bldg. Cedar Rapids, IA 52401	do	Benton, Jackson, Jones, Linn, Tama.
Kaser Corp	7200 Hickman Rd. Des Moines, IA 50322	Underground mines, quarries, plants.	Des Moines, Fremont, Jasper, Keokuk, Marion, Mills, Monroe, Montgomery, Poweshiek, Washington.
McCarthy Improvement Co., Linwood Stone Products Co. Inc.	Route 2 Davenport, IA 52804	Underground mine and plant.	Scott.
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 76622	Underground mines, quarries, plants.	Black Hawk, Bremer, Chickasaw, Hancock, Johnson, Keokuk, Linn, Madison, Marshall, Polk, Scott, Worth.
Northwestern States Portland Cement Co.	Box 1008 Mason City, IA 50401	Quarry and plant	Cerro Gordo.
River Products Co	220 Savings & Loan Bldg. Iowa City, IA 52240	Quarries and plants	Johnson, Louisa, Washington.
Schildberg Construction Co. Inc.	Box 358 Greenfield, IA 50849	do	Adair, Adams, Cass, Madison, Pottawattamie, Union.
Weaver Construction Co	Box 817 Iowa Falls, IA 50126	Underground mine, quarries, plants.	Cerro Gordo, Franklin, Hamilton, Hardin, Humboldt.
Welp & McCarten Inc	Box W Fort Dodge, IA 50501	Quarries and plants	Black Hawk, Howard, Humboldt, Webster, Worth.
Dimension:			
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 Jane P. Ohl[1] and David A. Grisafe[2]

The value of nonfuel minerals produced in Kansas was $256 million in 1982, a 2.8% increase over that of 1981. The increase was due mainly to a 19.4% increase in the total value of salt, which offset the decline in the use of housing and highway construction materials during the continuing nationwide recession. Every important mineral commodity produced in Kansas declined from the 1981 output except industrial sand and gravel, salt, and crushed and dimension stone. Total values, however, of Grade-A helium, salt (excluding salt in brines), and industrial sand and gravel increased over those of 1981. In 1972 constant dollars, the value of nonfuel minerals in Kansas declined more than 7% in the 1972-82 decade.

Kansas Department of Human Resources reported an increase in employment toward yearend in the nonfuel mining and quarrying industries. The year's lowest employment was 988 persons in February; the peak employment was in July and August when 1,255 were employed, a 21.3% increase.[3]

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	51	$2,835	46	$2,628
Portland	do.	1,641	81,792	1,549	79,558
Clays	do.	915	4,756	664	3,656
Gem stones		NA	1	NA	1
Helium (Grade-A)	million cubic feet	W	W	790	26,860
Salt[2]	thousand short tons	1,410	60,148	1,588	71,826
Sand and gravel:					
Construction	do.	e10,500	e21,000	9,720	20,612
Industrial	do.	W	W	331	3,635
Stone:					
Crushed	do.	14,143	45,738	p14,400	p41,100
Dimension	do.	14	605	p11	p395
Combined value of gypsum, helium (crude, 1981), lime, pumice, salt (brine), and values indicated by symbol W		XX	32,185	XX	5,745
Total		XX	249,060	XX	256,016

eEstimated. pPreliminary. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Allen	W	W	Cement, stone (crushed), clays.
Anderson	$419	$374	Stone (crushed).
Atchison	W	974	Do.
Barber	W	W	Gypsum.
Barton	W	87	Clays.
Bourbon	W	725	Stone (crushed).
Brown	9	(3)	
Butler	3,519	1,537	Stone (crushed).
Chase	231	W	Stone (dimension), stone (crushed).
Chautauqua	29	190	Stone (crushed).
Cherokee	W	W	Clays, stone (crushed).
Cheyenne	W	(3)	
Clark	30	(3)	
Clay	W	W	Stone (crushed).
Cloud	W	136	Clays.
Coffey	W	225	Stone (crushed).
Comanche	5	(3)	
Cowley	3,051	1,550	Stone (crushed), stone (dimension).
Crawford	W	W	Stone (crushed), clays.
Decatur	100	(3)	
Dickinson	W	1,738	Stone (crushed).
Doniphan	W	W	Do.
Douglas	W	645	Do.
Edwards	W	(3)	
Elk	W	W	Stone (crushed).
Ellis	W	9	Do.
Ellsworth	W	W	Helium, salt, clays.
Finney	W	195	Stone (crushed).
Ford	741	(3)	
Franklin	W	W	Stone (crushed), clays.
Geary	W	W	Stone (crushed).
Graham	W	130	Do.
Grant	W	W	Helium.
Gray	W	(3)	
Greeley	17	(3)	
Greenwood	148	230	Stone (crushed).
Hamilton	W	(3)	
Harper	48	(3)	
Harvey	W	(3)	
Haskell	W	(3)	
Hodgeman	42	(3)	
Jackson	73	--	
Jefferson	1,887	1,609	Stone (crushed).
Jewell	W	W	Do.
Johnson	W	W	Stone (crushed), sand and gravel (industrial).
Kearny	W	(3)	
Kiowa	W	(3)	
Labette	1,098	1,138	Stone (crushed).
Leavenworth	1,690	1,231	Do.
Lincoln	W	W	Stone (crushed).
Linn	564	710	Do.
Lyon	W	281	Do.
McPherson	W	W	Clays.
Marion	W	W	Stone (crushed).
Marshall	W	W	Gypsum, stone (crushed).
Meade	W	(3)	
Miami	960	895	Stone (crushed).
Montgomery	W	W	Cement, stone (crushed), clays.
Morris	2	128	Stone (crushed).
Morton	W	W	Helium.
Nemaha	55	164	Stone (crushed).
Neosho	W	W	Cement, stone (crushed), clays.
Ness	227	(3)	
Norton	W	W	Pumice, stone (crushed).
Osage	148	347	Stone (crushed).
Ottawa	85	(3)	
Pawnee	166	(3)	
Phillips	50	(3)	
Pottawatomie	W	411	Stone (crushed), stone (dimension).
Pratt	W	(3)	
Rawlins	33	(3)	
Reno	46,961	43,086	Salt.
Republic	W	W	Stone (crushed).
Rice	W	W	Salt, stone (crushed).
Riley	W	970	Stone (crushed), stone (dimension).
Rooks	13	(3)	
Rush	W	W	Helium.
Russell	53	(3)	
Saline	W	(3)	
Sedgwick	W	W	Salt.

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Seward	$242	(3)	
Shawnee	W	W	Stone (crushed).
Sheridan	W	(3)	
Sherman	W	W	Lime.
Smith	W	W	Stone (crushed).
Stafford	W	(3)	
Stevens	46	(3)	
Sumner	W	(3)	
Thomas	W	(3)	
Trego	140	$23	Stone (crushed).
Wabaunsee	W	135	Do.
Wallace	11	(3)	
Washington	W	W	Stone (crushed).
Wilson	W	W	Cement, stone (crushed), clays.
Woodson	31	102	Stone (crushed).
Wyandotte	W	W	Cement, stone (crushed), sand and gravel (industrial).
Undistributed[4]	198,677	168,088	
Sand and gravel (construction)	XX	e21,000	
Total[5]	261,593	249,060	

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

[1]Gove, Kingman, Lane, Logan, Mitchell, Osborne, Scott, Stanton, and Wichita Counties are not listed because no nonfuel mineral production was reported.

[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 that cannot be assigned to specific counties and values indicated by symbol W.

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

Table 3.—Indicators of Kansas business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,191.0	1,185.0	-0.5
Unemployment	do	50.0	74.0	+48.0
Employment (nonagricultural):				
Mining[1]	do	19.8	18.7	-5.6
Manufacturing	do	188.6	166.2	-11.9
Contract construction	do	42.7	37.5	-12.2
Transportation and public utilities	do	62.7	61.7	-1.6
Wholesale and retail trade	do	228.6	226.8	-.8
Finance, insurance, real estate	do	48.2	48.8	+1.2
Services	do	173.2	173.1	-.1
Government	do	185.9	186.4	+.3
Total nonagricultural employment[1]	do	949.7	919.2	-3.2
Personal income:				
Total	millions	$25,790	$27,564	+6.9
Per capita		$10,824	$11,448	+5.8
Construction activity:				
Number of private and public residential units authorized		8,430	8,977	+6.5
Value of nonresidential construction	millions	$250.6	$233.7	-6.7
Value of State road contract awards	do	$105.7	$73.7	-30.3
Shipments of portland and masonry cement to and within the State	thousand short tons	1,108	974	-12.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$249.1	$256.0	+2.8
Value per capita, resident population		$105	$106	+1.0
Value per square mile		$3,028	$3,112	+2.8

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.

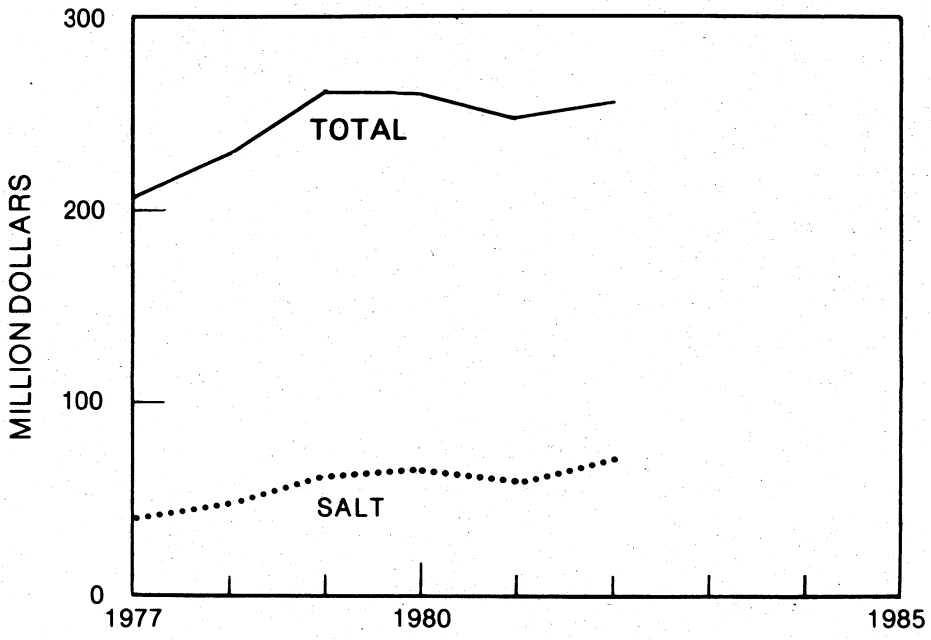

Figure 1.—Value of salt and total value of nonfuel mineral production in Kansas.

Trends and Developments.—Members of the Kansas Highway Coalition—a group of 16 agricultural, professional, and business firms—proposed several possible remedies for inadequate highway funding: (1) the passage of a 3-cent-per-gallon increase in motor fuel taxes, (2) the elimination of sales tax on highway construction materials, (3) a slight increase in vehicle registration fees or the placement of a surcharge on motor vehicles and parts, and (4) funding the Kansas Highway Patrol from the State general fund. The organizations making up the coalition, including Kansas Aggregate Producers Association and Kansas Asphalt Pavers Association, asserted that the continuing failure to maintain and upgrade the Kansas transportation system was seriously impeding the future industrial and economic growth of the State. They claimed that inadequate highways, roads, and streets tend to increase production and distribution costs for Kansas-produced items, and thus make Kansas less commercially competitive with other States.[4]

Sponsored by the Kansas Technical Institute and the Asphalt Institute, a 1-day workshop on the use of asphalt cold mixes and emulsions was held in January at the Kansas Technical Institute Conference Center in Salina.

Road base aggregates stabilized with lime and fly ash incurred structural failure at two extensive road projects in Kansas City. Officials planned to investigate the failures, characterized by buckling of pavements in frigid weather, to learn whether the lime-fly ash mixture was at fault.[5]

Exploration activities in western Clark and eastern Meade Counties discovered small amounts of uranium, but probably not enough to be mined profitably.[6]

Cominco Ltd. bought exploration rights on land near Randolph in Riley County, where kimberlite, a common source of diamonds, is known to exist.[7]

In spite of an explosion in a kiln at Chanute on September 13, Ash Grove Cement Co. did not shut down the kiln during an estimated $200,000 worth of required repairs because to do so would have resulted in a 50% loss of the firm's output during an important period of fall sales. Kansas Department of Health and Environment officials decided to let the company continue operations because of the economic situation and because the electrostatic precipitator was performing at about the same level it did in 1971 before there were air emission controls. Dust, approximately 85% limestone, was being released in more than usual amounts, owing to damage the precip-

itator sustained during the explosion.

Ash Grove Cement celebrated its 100th anniversary on February 7, 1982. It had been incorporated under the name Ash Grove White Lime Association in Ash Grove, Mo.; the name was changed to Ash Grove Lime & Portland Cement Co. in 1907 when the firm reorganized and built the cement manufacturing plant at Chanute. Upon relocation of the general offices in 1968, the name was shortened to its present form.[8]

Quarries and underground mines continued to be brought into new use. The Elks Club leased the old Lehigh quarry and grounds near Parsons for camping, fishing, and picnicking; in the future, shelter houses and a lighted trap-shooting range will be built.[9]

Creative architects and engineers have proposed that the caverns remaining under Kansas City after limestone mining should be converted to residential communities; vast underground storage facilities are already in use in similar mined-out space.[10]

Legislation and Government Programs.—On January 1, 1982, because of limited funding imposed by the U.S. Congress, a temporary restraint of the Mine Safety and Health Administration's (MSHA) enforcement of safety rules in surface mining of stone and sand and gravel operations went into effect. This temporary restraint was lifted on July 15, 1982, and MSHA's inspectors resumed enforcing the safety rules, but under new guidelines that reduced the number of violations to those that were significant and substantial.

The Surface Transportation Assistance Act (Public Law 97-424), passed by Congress on January 6, 1982, initiated a 5-cent-per-gallon user fee and other fees highway users were to pay, effective April 1, 1983. States are expected to provide matching funds for interstate highway work, and some projects are to start in the first half of 1983. Public Law 97-424 extended the Federal Highway Trust Fund to September 30, 1988. The levels of funding established in the act are the highest ever for highways and mass transportation, and the highest in constant dollars since the early seventies. The passage of this act was called a very important step toward achieving a strong recovery in the general U.S. economy, and, in particular, was expected to increase crushed stone demand significantly.

A curb on the once fairly widespread practice of spreading saltwater brine on road surfaces occurred when the Kansas Legislature passed a law prohibiting brine from an oil well going anywhere except back into underground formations through a saltwater disposal well. Controls were enacted because of a fear that the unregulated spreading of brine might lead to a level of use that would result in leaching and killing vegetation along drainage channels. Salt can draw and retain moisture, which action creates adhesion among fine particles of dirt, and thereby creates surface stability and prevents erosion from traffic use. The new law appeared to conflict with a long-standing State Highway Commission practice of using brine on high shoulders and roadbeds. The contradiction between the State law and the highway practice emerged when a tank service company from Rice County was charged in Pratt County with illegally spreading brine on a county road. Subsequently, the law was changed to allow the supervised use of brine on roadbeds in certain situations, provided the Kansas Highway Commission issues a permit.[11]

Hazardous Waste.—State officials were concerned about speculation that the Carey salt mine at Lyons would be used as a low-level waste dump site, averring "it could be converted to a high-level (radioactive) waste dump." House Bill 2935 was introduced to prohibit storing high-level nuclear waste in the bedded salt deposits of Kansas. By Federal law, however, the States must agree on some way to dispose of, or store, waste; Kansas and nine other Midwestern States were drafting a multi-State compact to submit to Congress for approval of an agreed-upon, low-level radioactive waste storage site within the multi-State compact area.[12]

The U.S. Bureau of Mines and the Kansas Geological Survey (KGS) began studying the cave-ins that had been occurring in southeastern Kansas in the old Tri-State lead-zinc mining district. The State's study was to be completed in January 1983; the Bureau completed its study and began installing structural concrete plugs in selected shafts.

Under a Federal program called the Superfund, Kansas was to receive between $250,000 and $300,000 to study reclamation of lands and waters in the 40-square-mile Tar Creek lead and zinc mining area that had been mined before 1977 and abandoned. Since abandonment, many shafts and near-surface mines have collapsed, resulting, sometimes, in fatalities; contamination of

ground and surface water by mine drainage is a major part of the problem. According to a KGS estimate, 46,000 acres of such lands are in Kansas; in combination with Tar Creek lands in Oklahoma, these lands constituted the largest environmental hazard in the Nation.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Kansas ranked 11th in value out of 40 portland cement-producing States, and 20th out of 38 masonry cement-producing States. Compared with portland cement production in 1972 when five plants were operating, only 66% of capacity was used in 1982, and output was 19% less from the same number of plants. Compared with production of masonry cement a decade ago, 1982 production was 20% less.

Four plants, owned by Ash Grove Cement, General Portland Inc., Lehigh Portland Cement Co., and The Monarch Cement Co., were operated in Neosho, Wilson, Montgomery, and Allen Counties in southeastern Kansas, and one plant owned by Lone Star Industries Inc. was operated in Wyandotte County at Kansas City in 1982.

Finished portland cements are classified as white or gray. Only the gray was produced in Kansas to make types I and II (general use and moderate heat portland cement); type III (high-early-strength); type V (very high sulfate resistance), and an oil well type.

In decreasing order of quantity used, finished portland cements were distributed as follows: 72.5% to ready-mix companies, 10.7% to other contractors, 6.1% to concrete product manufacturers, 3.9% to building materials dealers, 3.6% to miscellaneous customers, 3% to highway contractors—over 1-1/2 times that of 1981—and about 1% to Federal, State, and other governmental agencies.

About 75% of finished portland cement was shipped to consumers by truck, approximately 25% by rail, and the remainder by other means.

During the year, the industry operated 15 kilns having a total production capacity of 7,538 tons of cement per 24 hours. Ash Grove, General Portland, and Lone Star all used the wet process; Monarch Cement and Lehigh Portland used the dry process.

The industry consumed 2.4 million short tons of cement rock and limestone, 255,400 tons of clay and shale, about 334,000 tons of sand and sandstone, and more than 71,000 tons of ferriferous materials and gypsum. Also consumed were small amounts of various acids, resins, and other materials.

Energy requirements for the industry in 1982 were about equal to those of 1981. Natural gas consumption was 1.18 billion cubic feet, 15.7% more than in 1981; fuel oil, petroleum coke, and bituminous coal use also increased, but petroleum consumption declined, and the electricity energy total was down 14%.

The average value of all types of portland cement rose to $51.37 per short ton, a 3% increase over that of 1981. The average value of prepared masonry cement was $56.65 per short ton, $0.87 higher than that of 1981.

In late summer, O'Brien Rock Co., of St. Paul (Neosho County), completed constructing a small ready-mix concrete plant at the north edge of the Parson city limits (Labette County). The plant employed five workers and produces about 40,000 cubic yards of concrete per year.[13]

Red Cloud Concrete Co., a Nebraska-based firm, opened a ready-mix batch plant at Osborne, Osborne County, in early summer.

Table 4.—Kansas: Portland cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	5	5
Production	1,842,861	1,607,974
Shipments from mills:		
Quantity	1,640,572	1,548,714
Value	$81,791,554	$79,558,045
Stocks at mills, Dec. 31	293,953	258,852

Table 5.—Kansas: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	5	5
Production	71,691	43,405
Shipments from mills:		
Quantity	50,831	46,390
Value	$2,835,185	$2,628,120
Stocks at mills, Dec. 31	32,691	24,620

Clays.—Common clay and shale and a comparatively small amount of swelling bentonitic clay were mined in 1982. Com-

mon clay and shale output decreased 27%, and the quantity of bentonitic clay decreased 44% from that of 1981. The average price for all clays was $5.51, a $0.31 increase from that of 1981. Twelve companies extracted common clay and shale from more than 20 mines in 11 counties: Barton, Cloud, Ellsworth, and McPherson in central Kansas; and Allen, Cherokee, Crawford, Franklin, Montgomery, Neosho, and Wilson in eastern Kansas. One company extracted a mica-bearing bentonitic clay from a mine in Woodson County. In addition, Ideal Basic Industries Inc., located in Superior, Nebr., mined clay in northern Kansas (Jewell County) for cement production.

Micro-Lite Inc., headquartered at Chanute in Neosho County, constructed approximately 10,000 square feet of new plant space at Buffalo, Wilson County, close to the source of its mined materials. The space housed Micro-Lite's blending and bagging operations for the micaceous bentonitic clays mined in Woodson County, north of Buffalo. The company manufactured feed and fertilizer supplements from the micaceous clay mixture; the supplements were sold in a 17-State area and in Central America. Annual capacity at the plant increased from 15,000 to 45,000 tons. Micro-Lite employed about 12 people at its office, plant, and mine.[14]

More than 41% of the common clay was used in manufacturing portland cement; about one-third was used to fabricate lightweight aggregate for concrete blocks and structural concrete products; and about 20% was used for common and face brick. Clay also was used in ceramic floor, wall, and roof tiles; drain tiles; sewer pipes; and highway surfacing.

Gypsum.—A low number of housing starts in the State in 1982 reduced activity in the gypsum industry for the third straight year. Crude and calcined gypsum production and values declined slightly from those of 1981. In 1982, Georgia-Pacific Corp., Gypsum Div., mined and processed gypsum at Blue Rapids, Marshall County, and National Gypsum Co. operated its integrated facilities near Medicine Lodge and Sun City, Barber County.

Helium.—Kansas ranked first in the Nation among the three Grade-A-helium-producing States. Grade-A helium plants were in Ellsworth, Grant, Morton, and Rush Counties. The plants extracted helium from natural gas using cryogenic extraction processes. Plants that produced and liquefied Grade-A helium were Cities Service Cryogenics, near Ulysses; Kansas Refined Helium Co., near Otis; Helium Sales Inc., near Elkhart (the facility was purchased from Phillips Petroleum Co. on September 30, 1982); and Union Carbide Corp., Linde Div., near Bushton.

Crude helium plants were operated by Cities Service Cryogenics near Scott City, whose output was piped to the company's plant near Ulysses for purification; by Cities Service Helex Inc., at its Ulysses plant; and by Northern Helex Co., at its plant near Bushton.

In early January, InterNorth Inc. terminated production of helium at its Northern Helex extraction facility east of Bushton. Automobile manufacturers, homebuilding suppliers, and plastics makers use InterNorth natural gas byproducts. As those segments of the economy were down, so was the demand for ethane, and the byproduct plant was shut down. Inasmuch as helium is recovered from an off-gas stream of the byproducts plant, much needed crude helium production was also shut down.

The major domestic end uses of helium in 1982 were cryogenics, pressurizing and purging, and welding. The U.S. Bureau of Mines price, f.o.b. plant, for Grade-A helium was increased from $35 to $37.50 per thousand cubic feet, effective October 1, 1982, the first helium price increase in more than 20 years.

Lime.—Lime production declined 31%; value, however, increased 38% from that of 1981. During the first 2 and last 3 months of the year, Great Western Sugar Co. produced quicklime for use in manufacturing and refining sugar at its beet sugar plant near Goodland, Sherman County. From March to the end of September, the plant normally is in a maintenance phase.

Perlite (Expanded).—Lite-Weight Products Inc. expanded perlite obtained from out-of-State sources at its plant in Wyandotte County. The product was sold for filter aids and other uses.

Pumice (Volcanic Ash).—One of only eight pumice (volcanic ash) producing States, Kansas produced an estimated 50% more volcanic ash in 1982 than in 1981, and the value increased more than 68%.

Calvert Mines Inc. owned mineral rights under 250 acres in Norton County, northwestern Kansas, where volcanic ash has been mined for many years. The volcanic ash material from Calvert's surface mine was processed at the nearby mill and sold

for use as abrasives and absorbents. The company's chemical analysis data sheet lists apparent bulk density, 2.35; silica, 72%; alumina, 11.5%; potassium oxide, 4.7%; and smaller amounts of sodium, iron, and calcium oxides.

Quartz.—Electro Dynamics Corp. and Thermo Dynamics Corp., both in Shawnee-Mission, produced cultured quartz crystal for use in the quartz-cutting industry.

Salt.—Salt sales decreased early in 1982 because smaller cattle herds required less block salt and less salt for feed and because of a reduced demand for rock salt used in deicing highways during the mild winter weather. By yearend, however, the quantity and value of rock salt Kansas producers sold or used had increased over 1981 figures by 12.6% and 19.4%, respectively. Evaporated salt sold or used in Kansas increased 1.4% in quantity but 19.6% in value. The use of salt pellets to recharge water softeners in areas of hard water did not constitute a large percentage of total consumption despite some market growth; American Salt Co., Carey Salt Co., and Independent Salt Co. increased production.

Salt recovered by evaporation methods averaged $70.99 per ton, mined rock salt averaged $10.33, and salt in brine averaged $8.40.

Morton Salt Div. of Morton-Norwich Products Inc. sold 35% of its salt to agriculture and pelletized a smaller portion for use as water conditioners; Morton employed about 190 workers. Carey Salt sold three-fourths of its salt to the agricultural industry. In early 1982, the company employed 235 workers, a decrease from earlier months, mainly through attrition. Cargill Inc., Salt Div., sold 50% to 60% of its salt to agriculture; Cargill employed about 120 workers. Independent Salt's market was divided equally among deicing salt, agriculture, and the packing industry. Independent Salt employed 60, its fewest number of employees in more than 20 years.[15]

Vulcan Materials Co., Chemical Div., extracted sodium chloride brines and electrolytically separated chlorine, hydrogen, and sodium hydroxide at its operation at Wichita, Sedgwick County.

Sand and Gravel.—During 1982, in decreasing order of the combined output of construction sand and gravel and industrial sand, the five top-ranking counties were Sedgwick, Wyandotte, Johnson, Reno, and Cherokee. When ranked by value, the five top producing counties were Wyandotte, Sedgwick, Johnson, Reno, and Barton.

Construction.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Quantity and value of construction sand and gravel decreased 8% and nearly 2%, respectively, from estimated output and value for 1981. Of 157 construction sand and gravel operations, 68 produced less than 25,000 tons each and 10 produced more than 200,000 tons each. About 120 companies and government agencies produced construction sand and gravel from 229 pits in 71 of 105 Kansas counties. Averaging $2.12 per ton, construction sand and gravel was used, in decreasing order of quantity, for concrete aggregate, road base, fill, asphaltic concrete aggregate, concrete products, railroad ballast, snow and ice control, and plaster and gunite sands.

More than 90% of construction sand and gravel was transported by truck; the remainder traveled by railroad and unspecified methods of transportation or was used on the site.

Industrial.—Six companies at nine localities produced industrial sand in Dickinson, Douglas, Johnson, Republic, and Wyandotte Counties. Only two operations produced more than 50,000 tons. Output and value of industrial sand in 1982 more than doubled the 1981 figures. Industrial sand averaged $10.99 per ton and, in decreasing order of quantity, was used in fiberglass, for engine traction, blasting abrasives, foundry molding and core, scouring cleansers, roofing granules, and filtration materials.

After removal of iron from industrial sand mined in the Kansas City area, the material was used by such fiberglass producers as CertainTeed Corp., Insulation Group; Owens-Corning Fiberglas Corp.; and Manville Products Corp.

The Manville fiberglass insulation plant at McPherson, McPherson County, shut down for 2 weeks, idling about 250 workers. The temporary shutdown, March 14 through 28, was the result of a lagging housing market and excessive inventories. To reduce the inventory of insulation materials, a small crew remained in the warehouse to continue shipping. The plant has

been running at 50% to 60% capacity for 6 to 8 months; the shutdown was expected to take the plant through the usual winter lull into spring and summer, when construction work and the expected demand for insulation would again increase.

Table 6.—Kansas: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	5,330	$11,772	$2.21
Gravel	NA	NA	NA	2,790	6,446	2.31
Sand and gravel (unprocessed)	NA	NA	NA	1,600	2,393	1.50
Total or average	e10,500	e$21,000	e$2.00	9,720	[1]20,612	2.12
Industrial sand	W	W	9.95	331	3,635	10.99
Grand total or average	W	W	e2.11	10,051	24,247	2.41

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

Table 7.—Kansas: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,493	$8,105	$2.32
Plaster and gunite sands	W	W	2.87
Concrete products	323	843	2.61
Asphaltic concrete	1,393	3,066	2.20
Road base and coverings	2,223	4,527	2.04
Fill	1,666	2,668	1.60
Snow and ice control	125	412	3.31
Railroad ballast	W	W	1.50
Other	498	991	1.99
Total or average	[1]9,720	20,612	2.12

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Data do not add to total shown because of independent rounding.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and completed the following year.

Crushed.—Kansas ranked 20th in the Nation in crushed stone production. About 14.4 million tons of crushed limestone and sandstone valued at $41.1 million was produced mainly in eastern counties. The largest producers were Monarch Cement's Humboldt quarry in Allen County, Martin Marietta Aggregates's Moline quarry in Elk County, and Ash Grove Cement's Chanute quarry in Neosho County. All were limestone producers.

Dimension.—Kansas dimension stone declined 23% in quantity and 35% in value from those of 1981.

A new publication, "Petrographic Characteristics of Kansas Building Limestone,"[16] described several types of Kansas limestones used as building materials. Rock samples were taken at local quarries in eastern Kansas from the Cottonwood Member of the Beattie Limestone, Chase County; the Fort Riley Member of the Barneston Limestone and the Cresswell Member of the Winfield Limestone, Cowley County; the Five Point Limestone Member of the Janesville Shale and the Funston Limestone, Pottawatomie County; and the Neva Member of the Grenola Limestone, Riley County.

Stone processing plants are in Cowley, Pottawatomie, Riley, Sedgwick, and Shawnee Counties.

Sulfur (Recovered).—Recovered sulfur was produced or sold from stocks by Farmland Industries Inc., Getty Refining & Marketing Co., and Phillips Petroleum, in Montgomery, Butler, and Wyandotte Counties.

Vermiculite (Exfoliated).—No exfoliated vermiculite was produced during 1982. The plant facilities once owned by Shelter Shield Products Inc. were disassembled and shipped to Toronto, Canada, after the company closed down.

[1]State Liaison Officer, Bureau of Mines, Denver, Colo.
[2]Associate scientist, Mineral Information, Kansas Geological Survey, Lawrence, Kans.

[3]Kansas Department of Human Resources, Division of Employment. 1 p.
[4]Topeka Capital-Journal. Jan. 11, 1982.
[5]Rock Products. Lime-Fly Ash Mixture Re-examined in K.C. V. 85, No. 5, May 1982, p. 26.
[6]Berendsen, P., and L. R. Hathaway. Uranium in Unconsolidated Aquifers in Western Kansas. Kans. Geol. Survey Miner. Res. Series 9, 1981, 43 pp.
[7]St. Marys (Kansas) Star. Aug. 21, 1982.
[8]Chanute (Kansas) Tribune. Ash Grove to Mark 100th Year. Jan. 29, 1982.
[9]Parsons (Iola, Kansas) Sun. July 5, 1982.
[10]Kansas City Star. Think Deep. Dec. 31, 1981.
[11]Lyons (Kansas) Daily News. Aug. 24, 1982.
[12]———. Carlin Expresses Mine Use Reluctance; High-level Fear. Jan. 9, 1982.
[13]Parsons (Iola, Kansas) Sun. Aug. 12, 1982.
[14]Chanute (Kansas) Tribune. Micro-Lite Expanding Plant Capacity. Aug. 19, 1982.
[15]Enoch, M. Ag Downturn Hurts Salt Sales. Hutchinson News, Jan. 24, 1982.
[16]Aber, S. W., and D. A. Grisafe. Petrographic Characteristics of Kansas Building Limestone. Kans. Geol. Survey Bull. 224, 1982, 37 pp.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co.[1 2]	8900 Indian Creek Pkwy. Suite 600 Overland Park, KS 66225	Plant and quarry	Neosho.
General Portland Inc., Victor Div.[1 2]	7701 East Kellogg St. Wichita, KS 67207	do	Wilson.
Lehigh Portland Cement Co	Box 428 Independence, KS 67301	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, mine, mill, plant	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	Mines and mill	Barton.
Lehigh Portland Cement Co	718 Hamilton Mall Allentown, PA 18105	Mine	Montgomery.
Micro-Lite Inc	1100 South Katy St. Chanute, KS 66720	do	Woodson.
Gypsum:			
Gypsum Div. of Georgia-Pacific Corp	133 Peachtree St., NE. Atlanta, GA 30303	Mine and plant	Marshall.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	do	Barber.
Helium:			
Alamo Chemical Co	Richfield, KS 67953	Plant	Morton.
Kansas Refined Helium Co	Otis, KS 67565	do	Rush.
Northern Helex Co	Bushton, KS 67427	do	Ellsworth and Rice.
Union Carbide Corp., Linde Div	do	do	Do.
Lime:			
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 (volcanic ash):			
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	1800 Carey Blvd. Hutchinson, KS 67501	Underground mine	Reno.
Cargill Inc., Salt Div	Box 1403 Hutchinson, KS 67501	Mine	Do.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Salt —Continued			
Independent Salt Co	Box 36 Kanopolis, KS 67454	Underground mine	Ellsworth.
Morton Salt Div. of Morton-Norwich Products Inc.	Box 1547 Hutchinson, KS 67501	Evaporation pond	Do.
Vulcan Materials Co., Chemical Div	Box 7689 Birmingham, AL 35223	Wells	Sedgwick.
Sand and gravel:			
Construction:			
Bingham Sand & Gravel Co	Box 728 Baxter Spring, KS 66713	Pit and plant	Cherokee.
Builders Sand Co	4150 Kansas Ave. Kansas City, KS 66106	Dredge and plant	Johnson and Wyandotte.
Ritchie Paving Inc	6500 West 21st St. Wichita, KS 67204	Dredge	Sedgwick.
Industrial:			
HUB Materials Inc	Box 11126 Kansas City, KS 66111	Plant	Wyandotte.
Holliday Sand & Gravel Co, a division of List & Clark Construction Co.[3]	6811 West 63d St. Overland Park, KS 66202	Plants and dredges	Johnson and Wyandotte.
Stone:			
N. R. Hamm Quarry Inc	Box 17 Perry, KS 66073	Quarries and plants	Various (12 counties).
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 27622	do	Various (10 counties).
McAdam Limestone Products Inc	Moran, KS 66755	do	Anderson and Cowley.
Midwest Minerals Inc	Box 412 Pittsburg, KS 66762	do	Cherokee, Crawford, Labette, Montgomery, Neosho, Wilson.
Sulfur (byproduct):			
CRA Inc	North Linden St. Coffeyville, KS 67337	Secondary recovery plant.	Montgomery.
Getty Refining & Marketing Co	Box 1121 El Dorado, KS 67042	do	Butler.
Phillips Petroleum Co	Bartlesville, OK 74004	do	Wyandotte.

[1]Also clays.
[2]Also stone.
[3]Also construction sand and gravel.

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] and Preston McGrain[2]

The value of Kentucky's nonfuel mineral production in 1982 was $206.9 million, $1.6 million less than that of 1981. Crushed stone continued to be the leading nonfuel mineral produced, accounting for more than 50% of the total value. The State was one of the Nation's leading producers of ball clay, lime, and primary aluminum. Other commodities produced included cement, common and fire clays, sand and gravel, and zinc. Commodities processed or manufactured in the State included alumina, ferroalloys, perlite, vermiculite, synthetic graphite, pig iron, regenerator iron oxides, and synthetic mullite. Nationally, Kentucky ranked 30th in value of total nonfuel mineral output. The State ranked second in the Nation in ball clay production and third in primary aluminum and lime output.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2]	thousand short tons	490	$2,395	579	$2,039
Gem stones		NA	1	NA	1
Sand and gravel:					
Construction	thousand short tons	e6,939	e16,070	6,499	15,936
Industrial	do.	W	247	7	116
Stone (crushed)	do.	32,433	108,257	p29,500	p104,300
Combined value of cement, clays (ball clay), lime, and zinc		XX	81,559	XX	84,555
Total		XX	r208,529	XX	206,947

eEstimated. pPreliminary. 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 ball clay; value included with "Combined value" figure.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Adair	W	$493	Stone (crushed).
Allen	W	W	Do.
Anderson	W	W	Do.
Barren	$765	W	Do.
Bell	W	(3)	
Boone	3,229	(3)	
Bourbon	W	W	Stone (crushed).
Boyle	W	W	Do.
Breckinridge	W	W	Do.
Bullitt	W	W	Stone (crushed), clays.
Caldwell	W	W	Stone (crushed).
Calloway	W	242	Sand and gravel (industrial).
Carlisle	W	W	Clays.
Carroll	1,640	(3)	
Carter	W	W	Stone (crushed), clays.
Casey	342	360	Stone (crushed).
Christian	3,338	3,177	Do.
Clark	--	W	Do.
Clinton	W	749	Do.
Crittenden	W	W	Do.
Cumberland	W	150	Do.
Daviess	2,125	(3)	
Edmonson	W	W	Stone (crushed).
Estill	552	407	Do.
Fayette	W	W	Do.
Fleming	W	W	Do.
Floyd	W	1,400	Do.
Franklin	W	1,677	Do.
Gallatin	W	(3)	
Garrard	382	628	Stone (crushed).
Graves	W	2,795	Clays.
Grayson	W	W	Stone (crushed).
Green	W	W	Do.
Hancock	223	182	Clays.
Hardin	3,397	W	Stone (crushed).
Harlan	645	2,333	Do.
Harrison	W	W	Do.
Hart	W	W	Do.
Henderson	W	(3)	
Henry	W	W	Stone (crushed).
Hickman	W	(3)	
Jackson	437	590	Stone (crushed).
Jefferson	30,159	22,130	Cement, stone (crushed), clays.
Jessamine	2,003	W	Stone (crushed), zinc.
Knott	W	1,450	Stone (crushed).
Laurel	247	267	Do.
Lee	W	W	Do.
Letcher	2,879	1,363	Do.
Lewis	W	5	Sand and gravel (industrial).
Livingston	W	W	Stone (crushed).
Logan	W	W	Do.
McCracken	W	(3)	
Madison	W	W	Stone (crushed).
Marion	293	651	Do.
Martin	W	(3)	
Mason	W	W	Lime, stone (crushed).
Meade	3,925	3,312	Stone (crushed).
Menifee	W	1,573	Do.
Mercer	W	W	Do.
Metcalfe	341	282	Do.
Monroe	W	W	Do.
Montgomery	W	817	Do.
Morgan	1,252	W	Do.
Muhlenberg	1,955	1,464	Do.
Nelson	W	W	Do.
Nicholas	138	220	Do.
Ohio	W	W	Do.
Oldham	3,144	1,824	Do.
Pendleton	W	W	Lime, stone (crushed).
Pike	W	W	Stone (crushed).
Powell	1,989	1,909	Stone (crushed), clays.
Pulaski	2,398	2,949	Stone (crushed).
Rockcastle	W	W	Do.
Scott	W	W	Do.
Simpson	W	W	Do.
Taylor	W	W	Do.
Todd	W	W	Do.
Trigg	W	W	Do.

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Union	W	(3)	
Warren	W	W	Stone (crushed).
Washington	W	W	Do.
Wayne	$600	W	Do.
Whitley	W	W	Clays.
Wolfe	475	$427	Do.
Undistributed[4]	135,426	136,584	
Sand and gravel (construction)	XX	e16,070	
Total[5]	204,300	208,529	

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, Boyd, 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, Spencer, Trimble, Webster, and Woodford.

[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 values indicated by symbol W.

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

Table 3.—Indicators of Kentucky business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,665.0	1,675.0	+0.6
Unemployment	do	140.0	178.0	+27.1
Employment (nonagricultural):				
Mining[1]	do	53.3	54.1	+1.5
Manufacturing	do	270.2	246.8	-8.7
Contract construction	do	52.9	49.5	-6.4
Transportation and public utilities	do	67.6	65.8	-2.7
Wholesale and retail trade	do	260.4	259.7	-.3
Finance, insurance, real estate	do	52.3	51.7	-1.2
Services	do	215.0	215.8	+.4
Government	do	224.3	221.0	-1.5
Total nonagricultural employment[1]	do	1,196.0	[2]1,164.0	-2.7
Personal income:				
Total	millions	$30,824	$32,494	+5.4
Per capita		$8,416	$8,861	+5.3
Construction activity:				
Number of private and public residential units authorized		8,067	7,397	-8.3
Value of nonresidential construction	millions	$341.8	$197.3	-42.3
Value of State road contract awards	do	$102.2	$225.5	+121.1
Shipments of portland and masonry cement to and within the State	thousand short tons	990	954	-3.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$208.5	$206.9	-.8
Value per capita, resident population		$57	$56	-1.8
Value per square mile		$5,143	$5,123	-.4

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.

Trends and Developments.—The persistent weakness in the economy continued to affect the State's construction mineral producers. The number of private and public residential units authorized declined in 1982, as well as the value of nonresidential construction. As a result, output of most construction mineral commodities (stone, sand and gravel, and cement) was lower in 1982.

The stone industry was especially hard hit by the continuing recession. According to the Kentucky Crushed Stone Association (KCSA), stockpiles were full at yearend and had been that way all summer. High interest rates especially hurt the stone industry, not only by causing delayed purchases, but by postponing construction of new homes, farm roads, and outbuildings. Although these construction postponements may not

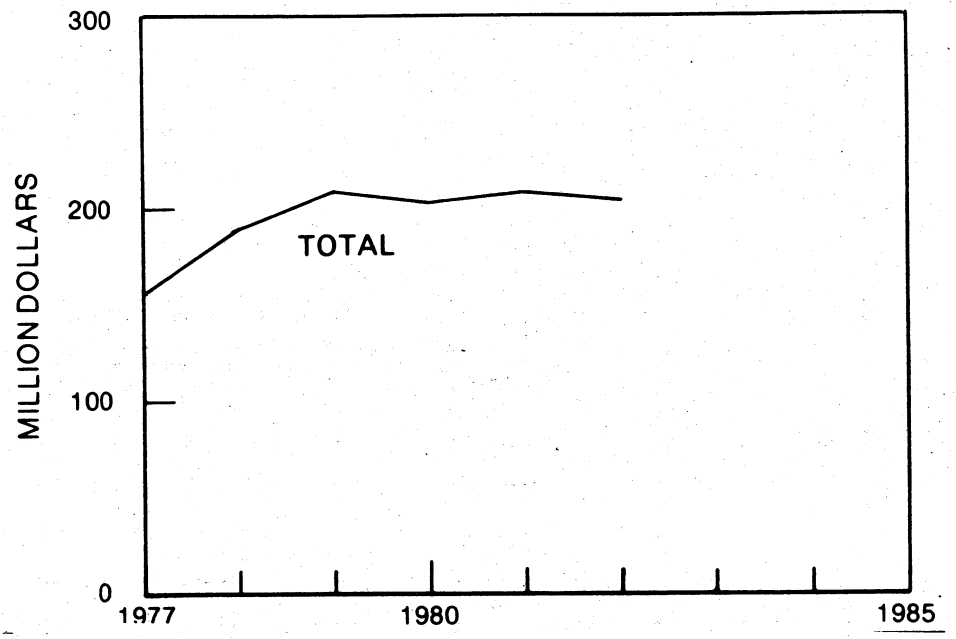

Figure 1.—Total value of nonfuel mineral production in Kentucky.

have required large quantities of stone, the KCSA noted that they had a strong impact on smaller producers for whom this kind of business was their "bread and butter." Stone sales were also affected by reduced road construction and maintenance. The bulk of the Kentucky highway program was in resurfacing with only large highway construction projects undertaken at Louisville, Lexington, and eastern Kentucky areas. These projects benefited only a limited number of producers located in the vicinity of the projects.

Like their counterparts in other States, Kentucky stone producers managed to cope with the recession by working shorter hours with smaller crews. Frequently, staff personnel doubled up on work assignments to help reduce the work force need.[3]

The State's metal sector was also affected by the downturn in the economy. Early in the year, Armco Inc. indefinitely postponed a $290 million seamless tubular expansion at Ashland because of the decline in drilling activity and overcapacity in the domestic tubular market. However, the company continued construction on a $90 million continuous caster at the site. Also during the year, Armco purchased the Allied Corp. coke plant in Ashland. The plant, which will supply coke to the company's steel mill in Ashland, also produces various chemical byproducts.

Weak demand from the automotive and construction industries forced most aluminum producers to curtail production during the year. Both of Kentucky's primary aluminum producers reduced plant output in 1982. Near yearend, National-Southwire Aluminum Co. idled about 54,000 tons of its 180,000-ton-per-year aluminum reduction plant at Hawesville. Likewise, Arco Metals Co. (formerly Anaconda Aluminum Co.) idled about 64,800 tons at the company's 180,000-ton-per-year Sebree smelter.

The State continued to lead the Nation in the apparent consumption of industrial explosives and blasting agents in 1982. More than 772 million pounds (nearly 20% of the U.S. total) was sold during the year. Although the principal consuming industry was the coal mining sector, the State ranked fourth in the Nation in sales for quarrying and nonmetal mining (28.3 million pounds) and second in sales (40.7 million pounds) for use in construction work.

Exploration Activities.—Mineral exploration in Kentucky during 1982 continued

to focus principally on fuel resources. In addition, special interest was given to western Kentucky's surface and shallow tar sand deposits.

Exploration for fluorspar and related minerals continued on a limited scale in the western Kentucky fluorspar district. Kentucky Geological Survey's (KGS) 1982 report on barite deposits generated some interest in the central Kentucky mineral district.

During recent years, various energy companies have drilled an estimated 250 core holes in Late Mississippian and Early Pennsylvanian tar sands in northern Logan, southern Butler, northern Warren, central Edmonson, and southern Grayson Counties. Depths ranged from 50 to 600 feet with an aggregate of 100,000 feet drilled and cored. Unofficial estimates of measured and inferred bitumen and heavy-oil resources in place are about 4 billion barrels. About 250,000 to 300,000 acres are currently under lease in these five counties.[4]

Legislation and Government Programs.—Several legislative acts were passed during the year affecting the State's nonfuel mineral industry.

H.B. 722 created the Mining and Minerals Trust Fund. The bill authorized a bond issue to raise money needed to build a $14 million mines and minerals research school at the University of Kentucky. The bill appropriates 5% of the license, permit, and acreage fees collected by the Department of Mines and Minerals and the Department for Natural Resources and Environmental Protection during the next 2 fiscal years for debt service, and 20% of the fees thereafter. H.B. 722 also authorizes mining programs at three University of Kentucky community colleges.

H.B. 398 allows a circuit court to establish a trust and appoint a trustee for the benefit of unknown or missing owners of severed mineral interests. The trustee is allowed to sell a lease covering these severed mineral interests, but only after several attempts have been made to locate the unknown or missing owners, and the court has determined that the development of the severed mineral interests will be advantageous to the unknown or missing owners. The trustee is required to hold and invest the proceeds from the sale of the lease for the use and benefit of the unknown or missing owners.

The unknown or missing owner is allowed 7 years after the date of first commercial production of the severed mineral interest under the lease to produce proof of ownership and to receive from the trustee the proceeds of the lease of the mineral interest and also to receive a recordable instrument documenting title to the mineral interest. If this does not occur, the unknown or missing owner may not recover title to the severed mineral interest. Instead, the fee simple owner of the surface estate becomes the owner of the severed mineral interest by order of the court and also receives any accumulated proceeds from the lease.

S.B. 144, sections 10 through 18, relate to road hauling permits for motor carriers transporting natural resources. This legislation will impact those motor carriers that transport coal and other natural resources. The intent of this new law is to allow the transportation of these materials in excess of the established weight limits for a fee of 0.4% of the gross value or average value of the commodity, whichever is less. This law exempts a producer holding a natural resource permit from the 2.85 cent per mile truck tax imposed under H.B. 810, also passed during the year.

S.R. 83, a resolution adopted during the year, requests the Legislative Research Commission to study the feasibility and effects of the taxation of unmined minerals.

Major research projects of the KGS were focused on coal, tar sands, oil and gas, limestone, sand and gravel, and water resources. Characterization studies of limestone resources continued with emphasis on applications for coal consuming and producing industries. Work also continued on a detailed surface and subsurface study in the western Kentucky fluorspar district.

During 1982, 18 new reports and maps were published by the KGS. Several of the publications pertaining to nonfuel mineral resources included reports on Kentucky's barite deposits, sand and gravel resources, and a study of the kimberlite deposits in Elliott County.[5] A detailed discussion of the economic geology of Rowan County was also issued.[6] Undeveloped resources in the county include building stone, limestone, oil and gas, oil shale, refractory clay, and miscellaneous clays and shales. Other reports concerning the geology of construction materials and trends in the industrial mineral industry were also published.[7]

Late in 1981, the State of Kentucky signed a cooperative agreement with the U.S. Mine Safety and Health Administration (MSHA) for the inspection and monitoring

of State-maintained mine rescue stations. Under MSHA's mine-rescue-team rules, which became effective on July 11, 1981, the operator of each underground mine must either establish mine rescue teams or enter into an agreement for mine rescue services. Underground mine operators are responsible for establishing two mine rescue teams, each comprised of five members and one alternate, or arranging for these services to be available in an emergency.

The State has agreed to allow MSHA to inspect the station, examine the equipment and storage conditions, and check the records of team members' training and equipment maintenance. MSHA then reports its findings to State officials so that unsafe conditions or practices can be remedied promptly. State mine rescue stations are inspected by MSHA representatives when they are first opened and then once every 6 months thereafter.

In fiscal year 1982, the U.S. Bureau of Mines had 20 active contracts and grants in the State totaling $701,754. A total of 18 of these were with the University of Kentucky and 2 were with private firms. Most of the monies were awarded for research grants, allotments, and studies pertaining to various aspects of the mineral industry.

The Mining and Mineral Resources and Research Institute at the University of Kentucky in Lexington, which was created under title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

Several reports on the mineral resources of Beaver Creek Wilderness and Troublesome Roadless Area, both in McCreary County, were published. The reports, the results of mineral surveys conducted jointly by the U.S. Bureau of Mines and U.S. Geological Survey (USGS) were published by the USGS as Miscellaneous Field Studies Map Series.[8]

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Kosmos Cement Co. Inc., a subsidiary of Moore McCormack Cement Inc., continued to operate the only cement plant in the State. The plant, located near Louisville, produced both portland and masonry cement using the dry process.

In 1982, combined shipments of portland and masonry cement declined 3% compared with that of 1981 because of fewer housing starts and the continuing slowdown in the construction industry. Main users of the cement were ready-mix concrete companies, concrete product manufacturers, highway contractors, and building material dealers.

Clays.—During the year, 13 companies operated 18 pits and produced common clay and shale, fire clay, and ball clay.

Common clay and shale were produced by 9 companies at 11 pits in Boyd, Bullitt, Hancock, Jefferson, Powell, and Whitley Counties. Principal uses were for the manufacture of common and face brick, quarry tile, lightweight aggregate, and portland cement.

Fire clay was mined by two companies in Carter and Graves Counties. The majority of the production was from the Olive Hill district in Carter County. This district has been one of the State's major producers of refractory clay for the past 60 years. Most of the production is from the Olive Hill clay bed, which occurs in the Pennsylvanian Lee Formation near the unconformity with the underlying Mississippian rocks. The clay, which often has as much as 80 to 100 feet of overburden, is strip mined.[9]

Because brick made from fire clay is generally able to withstand temperatures of 1,500° C or higher, most of it is used for firebrick and refractories. However, because of economic conditions and technological advances, production of these clays has steadily declined over the past 30 years. The steel industry, the chief consumer of firebrick, has seen its need decline because of improvements in the quality of refractories and technological improvements within the steel industry itself. Other economic considerations include the development of deposits in other States located closer to consumers and the use of competitive nonclay materials such as dolomite, silica, and water-cooled sidewall and roof panels.[10]

Ball clay, primarily used for bonding in ceramic ware, was produced by two companies with five operations in Carlisle and Graves Counties. The ball clays of the western Kentucky-Tennessee region occur in late Eocene beds, lenticular units in which the clay is interstratified with sand, silt, and lignite. Individual clay beds are variable in aerial extent, and thicknesses of the clay units normally range from less than 3 feet to more than 15 feet.[11]

Principal ball clay markets are ceramics (mainly dinnerware), pottery, wall tile, and sanitary ware. Production decreased during the year primarily because the domestic ceramic industry is in a recession.

Sipple Div. of U.S. Brick Co. began manufacturing a new line of utility-size brick (3-5/8 by 3-5/8 by 11-5/8 inches) to be used in institutions, office buildings, warehouses, and other commercial structures. Also, Corbin Brick Co. signed a contract for the design of a solid fuel system for its plant near Corbin.

Fluorspar.—Exploration for fluorspar and related minerals continued on a limited scale in the western Kentucky fluorspar district. Depressed economic conditions, especially in the Nation's steel industry, and competition from cheaper imported sources continued to affect the domestic fluorspar industry. No production has been reported for Kentucky since 1978.

Pennwalt Corp. was planning to modernize and expand its Isotron gaseous-chlorofluorocarbon plant at Calvert City. Products of this plant are used primarily as refrigerants, blowing agents for foamed plastics, and as precursors in the production of plastics and elastomers. The company was also expanding its capacity at Calvert City to produce Isotron polyvinylidene-fluoride resins.

Gem Stones.—Barite, calcite, fluorite, galena, pyrite, and sphalerite were some of the minerals collected by hobbyists. The State is also well known for its Halls Gap millerite and honessite, agate, and coal fossils.

Graphite (Synthetic).—Two companies produced synthetic graphite in the State. 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 West Germany, continued to produce graphite at a plant in Hickman, Fulton County. The graphite was primarily used to make electrodes. During the year, Sigri Carbon completed a $27 million expansion at the plant that was begun in 1981.

Lime.—Nationally, Kentucky ranked third in lime production, moving up from fourth place in 1981. Two companies operated underground mines to produce feed for calcining facilities in Mason and Pendleton Counties. These lime facilities were the second and fourth leading individual lime plants in the Nation.

Dravo Lime Co., a subsidiary of Dravo Corp., produced sulfur-absorbing Thiosorbic lime from a 1-million-ton-per-year-capacity plant near Maysville, Mason County, on the Ohio River. Thiosorbic lime is used by coal-fired electric utilities as a scrubber reagent to remove SO_2 from stack gases. The product is supplied to eight powerplants in the Ohio River Valley region, which extends through portions of Kentucky, Indiana, Ohio, West Virginia, and Pennsylvania. The plant ships approximately 1 million tons of lime and a comparable amount of limestone fines each year. The lime is principally shipped by river barge; other modes include covered rail cars, covered dump trucks, and pneumatic trucks.[12]

The Black River Lime Co. operated an underground mine and calcining facility at Carntown, Pendleton County. The plant, located on the Ohio River, is one of the largest producers and suppliers of lime for industrial and chemical use in the Midwest and upper South.

Mullite (Synthetic).—Didier-Taylor Refractories Corp. produced high-temperature sintered synthetic mullite at a plant in Greenup County. The material was primarily used in refractory products.

Perlite (Expanded).—Two companies expanded perlite shipped from other States. Grefco Inc. operated a plant at Florence in Boone County, and W. R. Grace & Co., at Wilder, Campbell County. Total State production dropped nearly 4% compared with 1981 levels. The expanded perlite was used in the manufacture of roofing materials, for horticultural purposes, and as lightweight construction aggregate.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Output of construction sand and gravel decreased nearly 16% in 1982 compared with 1980 levels, primarily because of the slowdown in construction activity in the State. Construction sand and gravel was produced by 21 companies operating 27 pits and floating dredge operations in 16 counties. Leading counties in descending order of tonnage were Daviess, Livingston, Jefferson, Boone, and Carroll. Main uses were for concrete aggregate, asphaltic concrete, con-

crete products, and road base and coverings.

Ingram Materials Co., a supplier of sand and gravel for the construction industry, moved its Kentucky office and storage area from Lake City to a riverfront site in Paducah. The new facility is closer to the current dredging site on the Ohio River, closer to most of its customers, and permits bulk cargo offloading and storage.[13] Also during the year, Green River Sand & Gravel Inc. sold its operations in Hart County to Tri-County Sand & Gravel Inc., Rockfield.

Industrial.—Two companies produced industrial sand and gravel in the State. Murray Silica Sand Co. operated a pit in Calloway County, and Industrial Supply House produced industrial sand from an operation in Lewis County. Principal uses were for mold and core and sandblasting.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	4,374	$9,941	$2.27
Gravel	NA	NA	NA	1,648	5,057	3.07
Sand and gravel (unprocessed)	NA	NA	NA	478	937	1.96
Total[1] or average	e6,939	e$16,070	e$2.32	6,499	15,936	2.45
Industrial sand and gravel	W	247	W	7	116	15.73
Grand total or average	W	e16,317	e2.35	6,506	16,052	2.47

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Data may not add to totals shown because of independent rounding.

Table 5.—Kentucky: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,812	$9,270	$2.43
Plaster and gunite sands	30	79	2.66
Concrete products	380	723	1.90
Asphaltic concrete	1,712	4,669	2.73
Road base and coverings	280	607	2.17
Fill	253	499	1.98
Snow and ice control	W	W	1.85
Railroad ballast	8	18	2.30
Other	25	69	2.82
Total[1] or average	6,499	15,936	2.45

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Data may not add to totals shown because of independent rounding.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Based on these preliminary estimates, crushed stone production declined nearly 9% in 1982. Principal uses of crushed stone were for road base, road base aggregate, and rip rap.

Tennessee Valley Authority (TVA) dedicated a new, $68 million pilot plant in Paducah, McCracken County, designed to test a clean and economical way to burn coal. The complex process, which burns coal on a special limestone bed, is designed to reduce sulfur dioxide emissions at an electric generating facility.[14]

During the year, two companies began producing rock dust. In early 1982, Camp Nelson Stone Co. started producing rock dust at a plant in northern Garrand County. The plant, located at the company's

limestone mine, sold rock dust to coal companies in eastern Kentucky.

In October, Speedco Inc. began producing rock dust at a plant in Boonesboro for use in underground coal mines and as agricultural lime. The plant, adjacent to the Boonesboro quarry, is designed to produce 170,000 tons of rock dust per year.[15] The material is primarily shipped by truck to markets in eastern Kentucky and West Virginia.[6]

Cen-Ken Stone Co. Inc., which operated limestone quarries in Hardin and Meade Counties, was purchased by Vulcan Materials Co., a Birmingham, Ala.-based company.

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 (Primary).—Kentucky ranked third, behind Washington and New York, in the production of primary aluminum. Production in the State dropped nearly 20% in 1982, compared with that of 1981, as most primary metal producers were affected by weak markets and prices. Declines in demand were evident in the building, transportation, and electrical industries. Near yearend, almost 40% of the capacity of the U.S. primary aluminum smelting industry was idle.

Two companies operated 180,000-ton-per-year smelters in the State: National-Southwire Aluminum in Hawesville, Hancock County, and Arco Metals in Sebree, Webster County. However, because of weak demand, both smelters curtailed production during the year. National-Southwire idled one-third (54,000 tons) of its smelter capacity near yearend. Also, Arco Metals shut down about 64,800 tons of its capacity at its Sebree plant. However, the company continued construction of the new $400 million aluminum rolling mill complex near Russellville. The plant will employ 400 to 500 workers when it becomes operational in 1983. Also during the year, Arco Metals announced it was moving its headquarters out of Louisville, after nearly 25 years in that city, to Rolling Meadows, Ill.

Ferroalloys.—SKW Alloys Inc. continued to produce ferroalloys (ferrosilicon, magnesium-ferrosilicon, silicomanganese, and medium-carbon ferromanganese) at its plant in Calvert City. However, production fluctuated during the year as the plant's eight furnaces were intermittently shut down. Weak demand and competitive imports necessitated the temporary shutdowns.

Iron and Steel.—Armco continued to produce both pig iron and regenerator iron oxides at its Ashland plant in Boyd County. Early in the year, the company postponed a $290 million seamless tubular expansion at the Ashland Works. The postponement was prompted by uncertainty regarding the timing of economic recovery, continuation of high interest rates and volatile financial markets, and uncertainty as to the direction of Government action on budget and tax issues.[16] However, work continued on the company's $90 million continuous caster at its plant in Ashland. The project, under construction since mid-1981, was expected to be completed in 1983. The new caster will eliminate a step in the steelmaking process by allowing molten steel to be shaped into billets or slabs without first cooling the material. Also during the year, the company purchased the Allied coke plant in Ashland. The plant, which will supply coke to the company's steel mill in Ashland, also produces various chemical byproducts.

Newport Steel Corp., which purchased the closed Interlake Inc. plants in Wilder and Newport, was undertaking a $28 million pipe mill expansion at its Newport plant. The mill, planned for completion in 1983, is designed to produce 400,000 tons of steel pipe up to 16 inches in diameter and employ at least 120 additional employees. Newport primarily produces steel pipe that is used in oil and gas drilling and for transmission of natural gas.[17]

Ohio River Steel Corp., a subsidiary of Intercontinental Metals Corp., began construction of a $77 million rolling minimill in Calvert City. Completion of the mill is scheduled for autumn 1983 with an expected annual output of 400,000 tons of angles, flats, channels, and I-beams. The rolling mill is the first of a three-stage development with annual capacity of 750,000 tons upon completion of the third stage. The minimill is being constructed by an international consortium, including partners from the United States, Saudi Arabia, and the Federal Republic of Germany with funding from Banco de Brazil and unnamed U.S. and West German financial institutions.[18]

Green River Steel Co. completed a capital project at its Owensboro plant that has

increased its ability to directly ship larger bar sizes and improve ladle refining. The program included the installation of two straighteners, a two-roll rotary unit for rounds, and a horizontal press for squares and flat bars.

Zinc.—Lexington Quarry Co. (Catnip Hill operation) continued to recover and concentrate zinc ore as a byproduct of underground limestone mining. The concentrate was shipped to an out-of-State smelter. The company was also expanding its small zinc separation mill to be able to concentrate barite and lead ores. Some of the vein-zinc deposit in the underground operation is being selectively mined for sale to mineral collectors.

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[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.
[2]Assistant State geologist, Kentucky Geological Survey.
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[9]Minerals in the Refractories Industry. A supplement to Industrial Miner., April 1983, pp. 74-75.

[10]Pages 2-3 of second work cited in footnote 7.

[11]Murray, H. H. Clay Resources of the Midwest States. Min. Eng., v. 34. No. 1, January 1982, pp. 68-71.

[12]Bingham, K. P. Maysville: Total Transportation. Min. Eng., v. 34, No. 10, October 1982, p. 1465.

[13]The Paducah Sun. Apr. 16, 1982.

[14]Mining Engineering. October 1982, p. 1411.

[15]Kentucky Coal Journal. March 1982.

[16]Skillings Mining Review. Mar. 20, 1982, p. 10.

[17]Louisville (Ky.) Courier-Journal. Apr. 11, 1982, pp. E1, E3.

[18]American Metal Market. May 12, 1982.

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]	Dixie Highway Kosmosdale, KY 40272	Plant	Jefferson.
Clays:			
Ball clay:			
Kentucky-Tennesse Clay Co	Box 77 Mayfield, KY 42066	Mines and plant	Carlisle and Graves.
Old Hickory Clay Co	Route No. 2, Box 303 Mayfield, KY 42066	do	Graves.
Common:			
General Shale Products Co	Box 3567 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.
Ford Burchett Clay Co	Route 1, Box 270 Olive Hill, KY 41164	do	Do.
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	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:			
Evansville Materials Inc	Box 248 Tell City, IN 47586	Dredge	Daviess.
Ingram Materials Co	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	Box 2137 Louisville, KY 47130	do	Trumble.
Stone (1981):			
Kentucky Stone Co	400 Sherburn Lane Louisville, KY 40207	Underground mines, quarries, plants.	Various.
Medusa Aggregates Co	175 Moore Dr. Lexington, KY 40502	do	Do.
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 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 Albert E. Ward[1]

Total value of nonfuel minerals produced in Louisiana declined by about 26% in 1982, to $418 million from $566 million in 1981. The State led the Nation in salt output with almost one-third of the total. Ranked second in Frasch sulfur mined, Louisiana also produced a substantial quantity of recovered elemental sulfur from oil processing. The combined value of salt and sulfur comprised about 70% of the State's total nonfuel minerals value in 1982. Slack demand from the in-State chemical industry effected a significant decline in salt production and a precipitous fall in sulfur recovery.

Other important minerals produced were clays, gypsum, lime, sand and gravel, and stone—mostly for the construction industry. Output declined considerably from that of 1981 as the State experienced its second consecutive year of a sluggish economy, owing to the nationwide recession and the sharp decline in Louisiana oil and gas industry activity.

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

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
Clays thousand short tons	[2]380	[2]$6,338	326	[2]$6,216
Gem stones	NA	1	NA	1
Salt thousand short tons	12,565	[r]114,476	12,172	117,569
Sand and gravel:				
Construction do.	[e]17,240	[e]53,550	16,558	50,966
Industrial do.	293	4,026	378	4,590
Sulfur (Frasch) thousand metric tons	2,235	W	1,239	W
Combined value of cement, clays (bentonite), gypsum, lime, stone (crushed), and values indicated by symbol W	XX	[r]388,005	XX	238,325
Total	XX	[r]566,396	XX	417,667

[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.

Table 2.—Value of nonfuel mineral production in Louisiana, by parish[1]

(Thousands)

Parish	1980	1981[2]	Minerals produced in 1981 in order of value
Allen	W	(3)	
Ascension	W	W	Salt.
Assumption	W	W	Do.
Beauregard	W	(3)	
Bienville	W	$81	Clays.
Caddo	W	W	Do.
Calcasieu	W	W	Salt.
Catahoula	$492	(3)	
Claiborne	--	W	Clays.
East Baton Rouge	7,863	W	Sand and gravel (industrial).
East Feliciana	2,632	(3)	
Grant	1,897	(3)	
Iberia	72,986	56,593	Salt.
Iberville	W	W	Do.
Jefferson	W	W	Sulfur, salt.
Jefferson Davis	W	(3)	
Lafayette	725	(3)	
La Salle	2,706	(3)	
Livingston	674	(3)	
Morehouse	W	(3)	
Natchitoches	W	24	Clays.
Orleans	W	W	Cement, stone (crushed), lime.
Ouachita	1,903	(3)	
Plaquemines	W	W	Sulfur, salt.
Pointe Coupee	W	W	Clays.
Rapides	6,378	(3)	
Red River	438	W	Sand and gravel (industrial).
Sabine	17	(3)	
St. Bernard	W	(3)	
St. Helena	W	W	Clays.
St. James	W	W	Salt.
St. Martin	W	W	Do.
St. Mary	W	38,403	Salt, lime, stone (crushed).
St. Tammany	W	W	Clays.
Tangipahoa	3,608	(3)	
Terrebonne	W	W	Sulfur, salt.
Vermilion	252	(3)	
Vernon	1,317	(3)	
Washington	4,540	(3)	
Webster	7,322	W	Sand and gravel (industrial).
West Feliciana	1,307	(3)	
Winn	W	W	Stone (crushed), gypsum.
Undistributed[4]	466,712	417,746	
Sand and gravel (construction)	XX	e53,550	
Total[5]	583,766	566,396	

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, Cameron, Concordia, De Soto, East Carroll, Evangeline, Franklin, Jackson, Lafourche, Lincoln, Madison, Richland, St. Charles, St. John the Baptist, St. Landry, Tensas, Union, West Baton Rouge, and West Carroll Parishes.

[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 that cannot be assigned to specific counties and values indicated by symbol W.

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

Table 3.—Indicators of Louisiana business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,854.0	1,855.0	+0.1
Unemployment	do	156.0	192.0	+23.1
Employment (nonagricultural):				
Mining[1]	do	99.3	98.9	-.4
Manufacturing	do	222.1	205.7	-7.4
Contract construction	do	138.2	123.7	-10.5
Transportation and public utilities	do	132.7	129.5	-2.4
Wholesale and retail trade	do	366.7	367.8	+.3
Finance, insurance, real estate	do	77.6	79.3	+2.2
Services	do	290.1	302.3	+4.2
Government	do	303.8	306.9	+1.0
Total nonagricultural employment[1]	do	1,630.5	[2]1,614.0	-1.0
Personal income:				
Total	millions	$40,995	$43,985	+7.3
Per capita		$9,517	$10,083	+5.9
Construction activity:				
Number of private and public residential units authorized		19,627	20,030	+2.1
Value of nonresidential construction	millions	$732.2	$808.0	+10.4
Value of State road contract awards	do	$219.0	$473.0	+116.0
Shipments of portland and masonry cement to and within the State	thousand short tons	2,667	2,520	-5.5
Nonfuel mineral production value:				
Total crude mineral value	millions	$566.4	$417.7	-26.2
Value per capita, resident population		$137	$96	-29.9
Value per square mile		$11,828	$8,608	-27.2

[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.

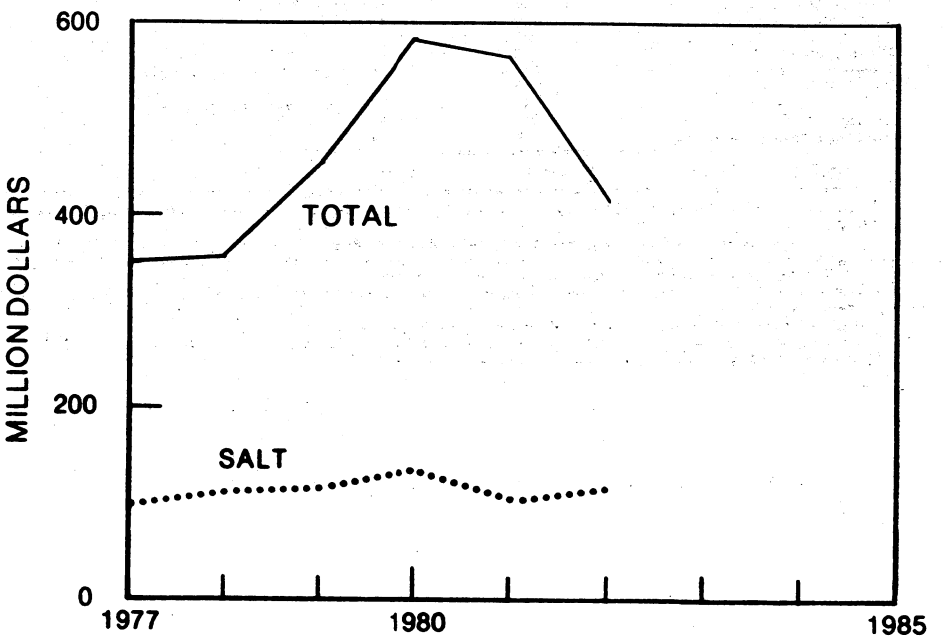

Figure 1.—Value of salt and total value of nonfuel mineral production in Louisiana.

Trends and Developments.—In a yearend address to a group of business people, an official of the State Department of Natural Resources stressed that the environment had become the primary political issue in Louisiana. Cleaning up the Mississippi River, hazardous-waste sites, and environmental discharges is high on the public agenda in the State.

Chemical, petrochemical, and mineral-processing plants that line the Mississippi River from Baton Rouge downstream past New Orleans have become the initial targets for environmental improvements. Kaiser Aluminum & Chemical Corp. and others have made major investments to alleviate environment-related problems at their facilities along the Mississippi. About 60% of Louisiana's salt and a substantial share of its sulfur output are consumed at in-State chemical plants. Handling these and other minerals and disposal of mineral wastes are primary environmental concerns. Reports of increasing pollution problems in Lakes Pontchartrain and Maurepas near New Orleans, although a complex problem, usually highlight the presence of toxic metals. Saltwater encroachment, natural and resulting from human activities, in these and other freshwater lakes and waterways is also a public concern. Mineral producers and processors in Louisiana—particularly in the southern one-third tier of parishes—seem certain to be confronted with the need for additional costly investments in the 1980's to help lessen environmental problems.

Efforts continued to deepen the Mississippi River channel between Baton Rouge and the Gulf of Mexico, opening the waterway to deep-draught vessels. State funds were sought because Federal money was unavailable in 1982; however, State finances were also tight, owing to the sharp decline in oil and gas revenues and the recession. Proponents of the 55-foot-deep channel foresee an opportunity to increase coal and grain exports from loading facilities in the area.

Louisiana Offshore Oil Port (LOOP), the Nation's first supertanker terminal, completed its first full year of operations in 1982. Capable of handling 1.4 million barrels per day, the system was operated at about one-quarter capacity for much of the year. LOOP, privately owned by a consortium of oil companies, is 18 miles offshore from Port Fourchon and 60 miles due south of New Orleans. Oil piped to the St. James terminal, on the Mississippi River, 30 miles southeast of Baton Rouge, is then piped to the salt dome storage at Weeks Island. Oil also is stored in the Choctaw salt dome in northwestern Iberville Parish, about 25 miles west of Baton Rouge. When completed, the U.S. Strategic Petroleum Reserve (SPR) will have stored crude oil in five salt domes in Louisiana and one in east Texas. Established by Congress in 1975 to reduce the U.S. vulnerability to severe interruptions of imported oil supplies, the SPR eventually will store up to 1 billion barrels of crude oil.

One Gram Inc. opened a pilot plant in Westwego to extract strategic and precious metals from waste materials. The $300,000 plant will handle up to 800 pounds of wastes per day. Initial efforts will recover chromium, germanium, palladium, platinum, silver, and other metals from electrolytic copper and zinc plating materials, used catalytic converters, photographic processing refuse, and base metal mine tailings. A full-scale producing facility, estimated to cost up to $18 million, would use a series of chemical and metallurgical processes to separate 28 metals from wastes.

Exploration Activities.—Diamond Crystal Salt Co. continued investigating selected salt dome deposits in southern Louisiana parishes. The company lost its Jefferson Island Mine to flooding in 1980 and has been buying salt in the open market since then.

Legislation and Government Programs.—Legislation enacted by the Louisiana Legislature in 1982 that affected minerals included the following:

Act No. 98, approved July 11, 1982, set fees to be collected by the Office of Conservation for the purpose of plugging abandoned mineral wells and to create a Natural Resources Conservation Fund.

Act No. 139, approved July 12, 1982, regulated offsite waste treatment, storage, and disposal facilities.

Act No. 237, approved July 15, 1982, affirmed the validity of operating agreements, joint exploration, development, and mineral production agreements.

Act No. 249, approved July 17, 1982, provided remedies and procedures for obtaining payment by a royalty owner other than the mineral lessor.

Act No. 289, approved July 18, 1982, required that any lease executed on behalf of a school board shall provide for minimum royalties of one-sixth on all oil and gas, sulfur, potash, and other minerals produced, and 5% on lignite and salt.

Act No. 794, approved August 4, 1982, prohibited tests to determine the suitability of salt domes and other geologic structures for disposal of radioactive wastes without written approval of the appropriate local and State authorities, except by the Federal Government.

The Louisiana Geological Survey (LGS) conducted geological research programs to produce information useful in developing the State's natural resources and protecting the environment. LGS emphasized water programs. The comprehensive flood-control program the legislature passed in 1982 gave LGS the major role in providing the flood-data base and one of three positions on the project evaluation committee. A 100-map, flood-information atlas showing flood plains, flood-prone areas, and other such data is to be published in September 1983. The legislature also funded new personnel positions for LGS's coastal research program, which will permit expansion of coastal process studies. Pilot coastal erosion control projects will emphasize barrier island shoreline stabilization and freshwater diversions.

LGS continued developing geologic mapping in parishes east of the Mississippi River. A 1:500,000-scale State geologic map was completed and was to be distributed in 1983. LGS personnel arranged field trips for the 1982 annual meeting of the Geological Society of America in New Orleans. LGS geologists conducted three of the trips, and the LGS published guidebooks for four trips.

In ground water studies, LGS continued to provide technical assistance and detailed assessments of geology and hydrology to administering agencies in hazardous waste areas and saltwater injection wells. LGS completed a preliminary assessment of ground water availability for supplemental or emergency supply for New Orleans. Scheduled for completion in 1983, a compilation of waste disposal practices and infiltration rates in the Baton Rouge ground water recharge area continued in 1982.

To forecast rates of coastal and land loss, LGS planned to launch a major study of subsidence rates and mechanisms in southern Louisiana in 1983. Plans are to cover the roles of sediment compaction, tectonic influences, fluid withdrawal, and other factors.

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 1982 for operations and research.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—The surge in construction of barite grinding plants in 1980 and 1981 to serve the oil- and gas-drilling industry ceased in early 1982. Custom grinding plants and drilling-fluid operators cut back output sharply as the petroleum industry curtailed drilling because of oil and gas surpluses in late 1981. The Baroid Div., NL Industries Inc., completed its new grinding plant in Lake Charles. Halliburton Co., Imco Services Div., and Chromalloy-American Corp. completed capital improvements at their Houma facilities.

Cement.—Across-the-board weakness in the State's economy resulted in a one-third decline in portland cement output and sales at the New Orleans plant of Lone Star Industries Inc. In 1981, output fell by about one-quarter. Surprisingly, oil well cement sales were off less than 30%; construction industry demands for cement were down almost 40%. Ready-mix companies increased their take of cement to almost 50% of output from 47% in 1981; whereas building material dealers, concrete product manufacturers, and highway and other contractors slightly lowered their demands. Declining interest rates near yearend and legislation aimed at highway and bridge construction and repair helped support cement sales and foreshadowed an upturn in cement output following the apparent cyclic trough in mid-1982. Price of portland cement was up about $2 per short ton over the 1981 price.

Lone Star also produced a small quantity of masonry cement. Output was about one-tenth lower following the near 50% plunge in output in 1981. Masonry cement rose $2 per ton during 1982.

Lone Star's two wet-process cement kilns continued operating almost 20% below capacity. Fuel and energy purchases reflected the reduced operations and efforts to cut costs; costly natural gas purchases were down about 75%, whereas coal and electricity consumption declined about one-fourth. As cement demands firmed toward yearend,

inventories increased moderately in anticipation of an improvement in near-term sales.

Clays.—Output of common clay was down by about one-fifth in 1982 as cement, brick, and general construction industry demands all remained weak during most of the year. Some firming in cement demand and an upturn in housing construction in some areas at yearend may prove to be the trough in the 4-year ebbing of clay mining in Louisiana. Declining interest rates in the last half of 1982 and legislation that earmarked a gasoline tax for highway and bridge construction and repair also suggested that the yearend firmness in clay demand may foretell the turnaround in demand for this basic construction-industry material. Average price of common clay was strong in 1982—at $20.12 per ton, up about 20% from $16.68 in 1981. Six companies produced common clay at eight mines in the State during 1982.

Filtrol Corp., a subsidiary of Kaiser, operated a bentonite mine in Claiborne Parish. The output was chiefly used in clarifying mineral and vegetable oils.

Table 4.—Louisiana: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1978	517	4,786
1979	416	6,073
1980	380	5,841
1981[1]	380	6,338
1982	326	[1]6,216

[1]Excludes bentonite.

Gypsum.—Output of gypsum and anhydrite at the Winn Rock Inc. quarry near Winnfield, Winn Parish, fell about 40% in 1982 as construction markets weakened sharply. Price per ton rose about 10%. National Gypsum Co. in Jefferson Parish and United States Gypsum Co. in Orleans Parish continued producing calcined gypsum from gypsum shipped into the State. Both producers moderately increased output that helped maintain total income as unit price for the calcined gypsum continued its moderate decline.

Lime.—Production of lime fell by more than one-third as construction and industrial markets were weak during most of the year. Hydrated lime output was off almost 20% and quicklime production was cut 50%. Average price for all lime produced held firm, however, rising about 2%. United States Gypsum continued to produce lime from clamshells at its New Orleans facility. The plant has operated safely for more than 400,000 employee-hours, worked since 1974, without a single lost-time accident.

Perlite (Expanded).—Filter Media Co. of Louisiana increased expanded perlite output from ores shipped to its plant in Reserve, St. John the Baptist Parish. Although markets for perlite remained soft, Filter Media produced and shipped about one-third more product in 1982 than in 1981.

Salt.—As in 1981, Louisiana retained its leading position among 16 salt-producing States in 1982 with 32% of the Nation's output. Most markets for Louisiana salt remained weak in 1982, a continuation of the soft demand that developed in 1981 following two strong marketing years. Output declined about 3% in 1982, compared with the 1% downturn in 1981. Price, however, was firm, rising about 3%. Fourteen companies recovered salt at 17 operations in 11 parishes.

Lawsuits and countersuits related to the November 20, 1980, flooding of the Diamond Crystal Salt Mine at Jefferson Island now appear likely to be tried in 1983. Because of the number of litigants, several years may be required to resolve all of the complex lawsuits.

Sand and Gravel.—Sand and gravel production eased down about 3% in 1982 as oil- and gas-industry activity remained depressed and the effect of the economic recession spread to most business sectors in the State.

Construction.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Construction sand and gravel again ranked first on the 1982 list of construction minerals produced in Louisiana and second only to salt in value. In recent years, output peaked in 1978, fell sharply in 1979 and 1980, and declined slightly in 1981 and 1982. Some State and national economic data at yearend indicated construction activity may have reached a low ebb in 1982. At $3.03 per ton, price also appeared to have reached a trough in 1982, down slightly from that of

1981 and off about one-seventh from the 1980 peak.

In 1982, construction sand and gravel was mined at 80 operations from 92 pits. The top 5 producers accounted for 40% of the tonnage; the top 10 produced 61%. One operation yielded more than 1 million tons and seven mined in excess of 500,000 tons. Output was recovered from 24 of Louisiana's 64 parishes. Parishes yielding in excess of 1 million tons in 1982, in order of tonnage, were St. Helena, St. Tammany, East Baton Rouge, Webster, and Washington. St. Helena Parish produced about 21% of the State's total output, and the 5-million-ton-plus parishes yielded 61%. Although construction sand and gravel production varies with the business cycle and is influenced by other external factors, the percentage of output from million-ton parishes has remained essentially unchanged in recent years.

The 17-million-ton construction sand and gravel output of 1981-82 is down from the 20- to 22-million-ton level during 1976-79. If the firming demand in late 1982 proves to be the trough of sand and gravel demand, then the loss of output between cyclic peak and low would be about 20%. As in all recent years, concrete aggregate took the lion's share of output—60% in 1982.

Industrial.—Three companies produced industrial sand in four parishes in 1982. Although output was up by almost one-third, average price fell from $13.74 per ton in 1981 to $12.14 in 1982. East Baton Rouge was the leading parish, followed by Webster, Allen, and Red River.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	6,762	$17,635	$2.61
Gravel	NA	NA	NA	8,570	31,261	3.65
Sand and gravel (unprocessed)	NA	NA	NA	1,225	2,070	1.69
Total or average	e17,240	e$53,550	e$3.11	[1]16,558	50,966	3.08
Industrial sand	293	4,026	13.74	378	4,590	12.14
Grand total or average	e17,533	e57,576	e3.28	16,936	55,556	3.28

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

Table 6.—Louisiana: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	10,027	$30,759	$3.07
Plaster and gunite sands	13	53	4.06
Concrete products	1,042	3,375	3.24
Asphaltic concrete	1,740	8,513	4.89
Road base and coverings[1]	1,997	5,264	2.64
Fill	1,668	2,835	1.70
Snow and ice control	70	167	2.40
Total or average	[2]16,558	50,966	3.08

[1]Includes road and other stabilization (cement).
[2]Data do not add to total shown because of independent rounding.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and completed the following year.

Markets for crushed stone turned weak in 1982 as the State's oil and gas industry

experienced a full year of sluggish activity; this weakness followed the 1981 downturn as the effect of the national recession spread to most other sectors of the Louisiana economy. Estimated crushed stone output was off about one-third, and the average price was down about 7%.

The long-simmering conflict between shell dredgers and environmental groups edged toward the boiling point in 1982. In the precariously balanced ecology of coastal and wetland Louisiana, pollution of the Mississippi River and lakes, saltwater encroachment, and flooding have received increased attention in recent years.

Lake Pontchartrain, Louisiana's largest lake (612 square miles, 112 shoreline miles, 18-foot maximum depth, and elevation at sea level), and source of two-thirds of the State's shell output, continued its long-term deterioration as saltwater pushed into the lake through the Inner Harbor Navigation Canal built in 1923. Salinity has increased from 6 to 8 parts per thousand during the past three decades (freshwater has less than 1 part; the Gulf of Mexico has 35 parts per thousand). Since 1950, the lake has lost about one-half of its wetlands to housing and commercial developments. Urban runoff, toxic chemicals (including cadmium, lead, mercury, and zinc), and raw or partly treated sewage continue to be the main causes of the lake's complex pollution problems. Owing to pollution, swimming was prohibited along much of the south shore (New Orleans) in 1982, and oyster harvesting was not permitted in some areas.

State-permitted shell dredging, begun in the lake during the 1930's, alters the characteristics of bottom sediments by making them fluffy, soft, and fluid. Storms easily disturb soft sediments and carry toxic materials upward on clay particles. Shell dredging also kills bottom organisms that are food for commerical fish. Shell from the lake largely is marketed in the New Orleans-Baton Rouge area. Much of the metals, chemical, and petrochemical industry along this strip of the Mississippi River have been forced to make costly pollution-control and energy-saving investments during the past decade. If shell dredging has to be phased out to help save Lake Ponchartrain, alternate shell supplies may be found along the gulf coast; however, the 100- to 300-mile barge-transport of about 5 million tons of shell and lime would be another cost burden for this industrial area.

Sulfur.—Louisiana again ranked second nationally in Frasch sulfur output; and fifth, up from sixth in 1981, in recovered elemental sulfur production. The State produced about one-fifth of the national sulfur output, down from one-fourth in 1981. Frasch sulfur production was off 45%, whereas recovered elemental sulfur output inched down 3%, from 239,000 to 232,000 metric tons. Reported Frasch sulfur price rose about 8%, whereas elemental sulfur price eased down 2%.

Markets for sulfur, weakened in 1981 because of the onset of the recession at midyear, remained weak through 1982. Frasch sulfur producers bore the burden of cutbacks in sulfur demand as their output slumped to the lowest level since 1946. Frasch sulfur stocks rose moderately at yearend, whereas elemental sulfur stocks were essentially unchanged. Freeport Sulfur Co., a division of Freeport Minerals Co. and Freeport McMoran Inc., mined Frasch sulfur in Jefferson, Plaquemines, and Terrebonne Parishes; and eight oil companies recovered elemental sulfur from eight operations in seven parishes—unchanged from that in 1981. Freeport completed its second year of operations at its new Frasch sulfur mine at Caillou Island in Timbalier Bay, Terrebonne Parish, about 35 miles south of Houma; however, as in 1981, slack demand forced the company to operate the facility at less than its 300,000-ton capacity.

Table 7.—Louisiana: Sulfur produced and shipped from Frasch mines

(Thousand metric tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1978	1,928	1,984	W
1979	2,460	2,858	W
1980	2,309	2,590	W
1981	2,440	2,235	W
1982	1,312	1,239	W

W Withheld to avoid disclosing company proprietary data.

Vermiculite (Exfoliated).—W. R. Grace & Co. decreased production of exfoliated vermiculite but increased sales by lowering inventories at its New Orleans plant during 1982. Sales were up more than one-quarter from those of 1981, and average price rose by about one-eighth. End uses in concrete and plaster aggregates and for horticulture were up, whereas demands for loose fill and block insulation declined.

METALS

Aluminum.—Among the 17 States producing primary aluminum, Louisiana ranked 10th in 1982, a drop from its 6th place ranking in 1981. Whereas national output fell 27.1%, Louisiana production declined 50%. Widespread weakness in the industry was a continuation of the slack demand in 1981. The container and packaging market was firm, but all other markets were characterized by soft to very poor demand. Total national inventories were reduced by about 9% through yearend. Spot price moved down from 51 cents per pound in January to 43 cents in June, then fluctuated between 44 cents and 47 cents through yearend.

By late summer, Kaiser had curtailed operations at its Chalmette primary refinery to 22% of capacity. Three of five potlines were down, and employment had been slashed to 880 employees from the 2,740 at full production. The Chalmette refinery was built during the Korean war in St. Bernard Parish in an area underlain by abundant, low-cost natural gas. Contracts signed in the late 1950's called for long-term delivery of gas at up to 34 cents per thousand cubic feet; in 1982, gas contracts set the price at between $3 and $4 per thousand cubic feet. Kaiser generated about 60% of its electrical energy needs and purchased the other 40% from Louisiana Power & Light (LP&L). LP&L remained heavily committed to gas for generating electricity. Construction of LP&L's Waterford 3 nuclear powerplant at Taft, 30 miles west of Chalmette and up the Mississippi River, was begun in 1970 at an estimated cost of $230 million. Nearing completion at a newly estimated cost of $2.1 billion (up more than 800%), the plant will not be a future source of low-cost electricity as formerly expected.

Kaiser has made several major investments in its Louisiana operations to counter the rising energy cost during the past decade. An ongoing $154 million modernization of Kaiser's Baton Rouge plant, intended to improve energy efficiency by about 25%, is to be completed late in 1983. Another $97 million project to update the calcination section of the Baton Rouge plant was begun in 1981. This project will include modernizing the plant's powerhouse controls and upgrading the electrical system. Preengineering and evaluation work continued through yearend on developing a coal-fired energy source for the Gramercy alumina plant. Primary objectives are the near-term replacement of natural gas with coal—a more secure energy source—and the reduction of energy costs.

Kaiser's large investments to achieve energy efficiencies at its operations reflect currently available, limited alternatives. Recently developed surface-minable lignite reserves in De Soto and Red River Parishes in northwest Louisiana represent an alternative source of energy for the aluminum, other metal, chemical, and petrochemical industries that line the Mississippi River in southeast Louisiana. Initial investigations of deep-basin lignite resources in the same general area suggest that these deep coal seams are more attractive than first thought and that they are promising for future in situ gasification. However, the 200- to 300-mile distance between the lignite reserves in the northwest and the Baton Rouge-New Orleans market for low British thermal unit (Btu) lignite remained an added cost for industry in southeast Louisiana. Since gas from lignite typically generates about 125-Btu-per-cubic-foot, only one-eighth the value of natural gas, this is a questionable alternative energy source.

Aluminum Co. of America planned to build a $16.5 million alumina chemicals plant in Vidalia. To be completed in 1983, the plant will have a capacity of 20 million pounds of specialty chemicals, mostly to satisfy needs of the regional petrochemical and oil and gas refining industries. Products will consist of activated alumina and catalyst-support chemicals. The market for these specialty chemicals is expected to grow as lower quality oils make up an increasing share of the world's crude oil output.

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[1]State Liaison Officer, Bureau of Mines, Denver, Colo.

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 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 Kenwood, LA 70444	do	St. Helena.
Gypsum:			
Winn Rock Inc	Box 790 Winnfield, LA 71483	Quarry and plant	Winn.
Lime:			
S. I. Lime Co	Pelican State Lime Div. Suite 204, Three Riverchase 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	9950 West Lawrence Suite 400 Shiller Park, IL 60276	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	do	Calcasieu.
Sand and gravel:			
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	Washington.
Texas Industries Inc	Box 5472 Alexandria, LA 71301	Dredges, pits, plants.	Beauregard, Grant, La Salle, Ouachita, Rapides, St. Tammany, Washington.
Stone:			
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.
Sulfur (native):			
Freeport Minerals Co	200 Park Ave. New York, NY 10166	Frasch process	Jefferson, Plaquemines, Terrebonne.
Sulfur (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 1982 was $35.4 million, nearly $8 million below that of 1981 and the lowest value reported in the State since 1973. Of the mineral commodities produced in Maine, output of garnet and peat increased; output of cement, clays, sand and gravel, and stone decreased.

The State enacted a severance tax law relating to the mining of metallic minerals. The legislation was prompted by the discovery of a massive sulfide deposit in northern Maine in the late 1970's.

Martin Marietta Corp. announced plans to permanently close its Thomaston cement plant in March 1983. The Thomaston plant is the only cement manufacturing facility in New England. At yearend, Cianbro Corp. announced intentions to purchase the operation.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	57	$166	37	$76
Sand and gravel (construction) do.	e7,500	e19,400	6,701	15,118
Stone (crushed) do.	1,375	5,532	p1,200	p4,000
Combined value of other nonmetals	XX	18,271	XX	16,245
Total	XX	r43,369	XX	35,439

eEstimated. pPreliminary. rRevised. 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

(Thousands)

County	1980	1981[1]	Minerals produced in 1981 in order of value
Androscoggin	W	W	Clays.
Aroostook	$1,574	$706	Stone (crushed).
Cumberland	W	W	Stone (crushed), clays.
Franklin	W	W	Garnet.
Hancock	818	(2)	
Kennebec	W	(2)	
Knox	W	W	Cement, stone (crushed), clays.
Lincoln	398	(2)	
Oxford	W	(2)	
Penobscot	2,352	(2)	
Piscataquis	369	(2)	
Sagadahoc	11	(2)	
Somerset	395	(2)	
Waldo	W	W	Peat.
Washington	W	W	Peat, stone (crushed).
York	1,648	(2)	
Undistributed[3]	29,402	23,263	
Sand and gravel (construction)	XX	e19,400	
Total	36,967	43,369	

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

[1]County distribution for construction sand and gravel is not available; total State value shown separately under "Sand and gravel (construction)."

[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

	1981	1982p	Change, percent
Employment and labor force, annual average:			
Total civilian labor force thousands	509.0	515.0	+1.2
Unemployment do	37.0	44.0	+18.9
Employment (nonagricultural):			
Mining do	(1)	(1)	
Manufacturing do	113.5	107.4	-5.4
Contract construction do	17.5	16.5	-5.7
Transportation and public utilities do	18.7	18.4	-1.6
Wholesale and retail trade do	89.4	87.8	-1.8
Finance, insurance, real estate do	17.0	17.6	+3.5
Services[2] do	80.5	81.0	+.6
Government do	82.6	81.9	-.9
Total nonagricultural employment do	419.2	410.6	-2.0
Personal income:			
Total millions	$9,663	$10,238	+6.0
Per capita	$8,530	$9,033	+5.9
Construction activity:			
Number of private and public residential units authorized	2,603	2,843	+9.2
Value of nonresidential construction millions	$100.5	$100.2	-.3
Value of State road contract awards do	$54.5	$38.1	-30.1
Shipments of portland and masonry cement to and within the State thousand short tons	236	206	-12.7
Nonfuel mineral production value:			
Total crude mineral value millions	$43.4	$35.4	-18.4
Value per capita, resident population	$34	$31	-8.8
Value per square mile	$1,155	$1,067	-7.6

pPreliminary.

[1]Included with "Services."

[2]Includes mining.

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

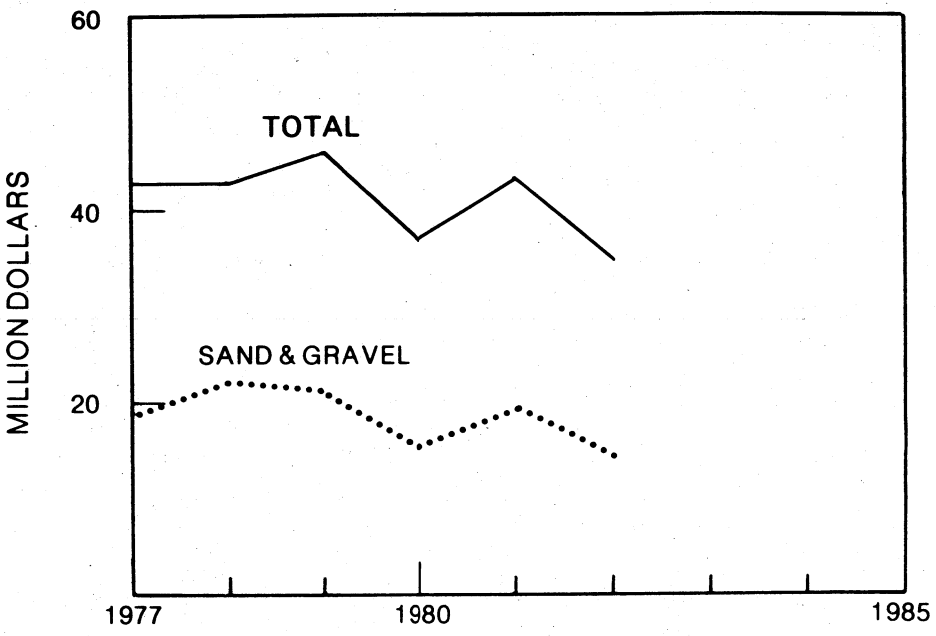

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Maine.

Trends and Developments.—In the late 1970's, a 36-million-ton copper-zinc deposit was discovered and plans for mine development were underway. About 20 companies were conducting exploration programs in the State enhancing the possibility of Maine's mining industry expanding. Also in the late 1970's, demand for mineral commodities peaked with the value of production reaching a record of nearly $46 million.

However, by late 1981 and in 1982, plans for mine development had been postponed and exploration activity had declined considerably. In addition, output of nonmetallic minerals declined, and the value of production dropped to a 9-year low of $35.4 million; about $10.6 million below the record 1979 figure.

Although the prospect of development of a metal mine diminished and demand for construction mineral commodities declined in the early 1980's, there were some encouraging developments during the year. On December 23, 1982, Cianbro, Pittsfield, announced intentions to purchase the Martin Marietta operation, but final agreement was pending at yearend. Cianbro, a leading construction company in Maine, also is one of the State's top five sand and gravel producers.

In May, the State passed a severance tax bill on the mining of metallic minerals. The legislation was expected to encourage metal mining and exploration in the sense that enactment of the law allows mining interests to predetermine the effect of such a tax on profitability of proposed mining operations. The lack of tax legislation was considered an impediment to metal mining in Maine, particularly because some type of tax was expected if mining began.

Even though the severance tax legislation was enacted, Superior Mining Co., which discovered a 36-million-ton copper-zinc deposit, announced that plans to file environmental applications for the proposed copper-zinc mining operation in Aroostook County were indefinitely suspended. The

company's original timetable called for completion of the applications in 1982. The weakened demand for metals from the automobile, electrical, and housing industries, and resulting decline in metal prices, forced the delay. The deposit is 200 miles northeast of Augusta near Ashland. According to the company, relatively close-spaced drilling has indicated reserves of about 25 million tons containing 1.54% copper and approximately 11 million tons containing 2.50% zinc. If the site is developed, company officials expect site preparations and construction to take 2 years with mine life estimated at 20 years.

In other developments, expansion of the peat mining industry in Maine appeared imminent as two companies announced plans to mine peat in 1983. The State, according to a study conducted by the University of Maine at Orono, has the Nation's eighth largest reserve of peat. Peatlands extend across the State with significant reserves in Aroostook, Hancock, Penobscot, and Washington Counties.

Late in the year, United States Peat Co. announced plans to mine peat near Saco in York County. The firm was expected to receive a $180,000 low-interest loan as part of a $1.29 million grant from the U.S. Department of Housing and Urban Development to the city of Saco. The company planned to begin mining the Saco Heath in May 1983 and process the peat for horticultural use. Wheelabrator-Frye Inc. was considering a $90 million peat processing plant for Maine. The firm intends to seek loan guarantees from the Federal Synthetic Fuel Corp. after the potential environmental impact is investigated by the State Department of Environmental Protection. The project would employ 300 during construction and 100 on a permanent basis. Bogs in Penobscot, Hancock, and Washington Counties would be mined at the rate of approximately 150 to 200 acres of peat per year. The plant would have the capacity to produce the equivalent of approximately 1 million barrels of oil per year.

Exploration Activities.—A moderate number of investigations were underway despite the weakened demand for most metallic minerals. Noranda Exploration Inc. (a subsidiary of Noranda Exploration Co. Ltd.), Bangor, signed a 10-year agreement with Scott Paper Co. for exploration rights on 130,000 acres in the northwestern part of the State. Getty Mining Co. (a division of the Getty Oil Co.) opened an office in Hermon. For the past 3 years, Getty has conducted exploratory drilling in northern and central Maine.

Billiton Exploration U.S.A. Inc. detected a regional anomaly in the Vassalboro area, Kennebec County, during a reconnaissance exploration program. Toward yearend, Billiton was attempting to obtain lease agreements from landowners with soil sampling planned for 1983 if agreements are reached.[4] Chevron Oil Co. and Houston International Mining Co. sought permission from the Penobscot Indians to conduct an exploration program on 40,000 acres in northern and western Maine.[5]

Scintilore Explorations Ltd. and North American Exploration Inc. continued investigations near Pembroke, Washington County. Exploratory drilling for lead, zinc, copper, and silver has been conducted sporadically in the area by a number of firms over the past 20 years.

Several firms continued reconnaissance programs in Maine including Appalachian Resources Inc., F. M. Beck Inc., FMC Corp., GCO Minerals Co., Newmont Exploration Ltd., Phillips Petroleum Co., and Santa Fe Mining Inc.

Legislation and Government Programs.—In May, the State's 110th Legislature enacted Legislative Document No. 2155: "An Act to Create an Excise Tax on Mining Companies and Regulate Mining Activities."

The amount of the mining excise tax is the greater of a 5-mill tax on the value of facilities and equipment of a mine (defined as all mining property, excluding land and mineral property), or a tax on gross proceeds, which is determined by the following formula: Tax rate of gross proceeds equals 4.5 minus gross proceeds divided by net proceeds divided by 100. The tax on gross proceeds has a minimum rate of 0.9%. The formula was designed to result in a higher tax rate in the years of a mining company's greatest profitability.

Revenues from the excise tax are first distributed to municipalities if a mining company received a tax exemption on land in their jurisdiction. The remaining tax revenues are allocated according to the following schedule, in percent:

Fund	Year					
	1	2	3	4	5	6 plus
General	20	15	20	25	25	30
Mining Excise Tax Trust	--	10	15	25	30	60
Mining Impact Assistance	80	75	65	50	45	10

The General Fund is the State Treasury. The Mining Excise Tax Trust Fund is used to purchase and develop parks, recreational facilities, marine and wildlife habitats, unique natural areas, and to restore the quality of marine waters, lakes, rivers, and streams. The Mining Impact Assistance Fund is used to provide assistance to areas in which a minesite is located. Funding is based on the need for new or additional public facilities and services, severity of the impact of mining development, extent of local effort to meet anticipated needs, and availability of increased local revenues from other sources including municipal reimbursement.

During 1982, the Maine Geological Survey (MGS) continued a number of mapping and mineral resource-related programs. Bedrock and surficial mapping of 1:62,500 quadrangles in various parts of the State 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 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 are scheduled to be published in 1983. In a related project dealing with potential low-level waste disposal sites, the MGS completed a 1:250,000 map series showing the distribution of glacial-marine clay deposits in Maine. The Hydrogeology Div. of the MGS, in cooperation with the U.S. Geological Survey (USGS), completed the second year of a planned 5-year assessment of the geometry, yield, and water quality of sand and gravel aquifers.

Also in 1982, bedrock quadrangle mapping was continued in the Lewiston and Sherbrooke 1:250,000 quadrangles for the USGS Conterminous United States Mineral Appraisal Program. This program has generated bedrock maps and geochemical data for mineral resource assessment in western Maine.

The MGS completed the 4th year of the Maine Peat Resource Evaluation Program funded by DOE. A total of 51 deposits in Washington and southern Aroostook Counties were surveyed to determine extent and estimated resources and to collect samples for laboratory analysis. The results of the program, which also included investigations of accumulation rates, surface vegetation, and hydrology and geochemistry of selected peat deposits, were to be published in the fall of 1983.

The MGS and the Bureau of Public Lands have administrative jurisdiction over exploration and mineral development on those lands owned or held in trust by the State that are open for mineral exploration. The Survey issues prospectors' permits, records claims, and with the consent of the Director of the Bureau of Public Lands, issues permits to mine. In 1982, 291 claims, 24 prospectors' permits, 2 mining leases, and 1 license to mine on State lands were active.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—On December 3, 1982, Martin Marietta announced plans to permanently close the Thomaston cement plant in March 1983. On December 23, Cianbro, Pittsfield, signed an option and letter of intent to purchase the plant, but final agreement remained pending at yearend. Competition from imported cement and rising fuel and labor costs were cited by Martin Marietta among the reasons for shutting down the operation.

At the Thomaston facility, both portland and masonry cement were produced. Shipments declined about 13% in 1982 compared with that of 1981. Raw materials used in the manufacturing process included limestone, clays, sand, iron-bearing material, and gypsum. The cement was sold primarily to ready-mix companies, concrete product manufacturers, and building material dealers in Maine and Massachusetts.

Clays.—Production dropped for the 4th consecutive year, and output was the lowest reported in 23 years. Three companies, two in Cumberland County and one in Androscoggin County, mined common clay in southern Maine.

Garnet.—Nationally, Maine ranked third in garnet production. Industrial Garnet Extractives Inc. (IGE), the State's only producer, doubled output in 1982 compared with that of 1981. The company has increased production each year since operations began in 1979.

Garnet was mined at an open pit near Rangeley, Franklin County, and crushed onsite. The material was trucked about 65

miles to the IGE mill in West Paris, Oxford County, for further crushing, screening, and bagging.

The garnet was sold for abrasive, filtration, heavy media, nonskid, wear-resistant, and surface coating applications. A garnet-based, utility-grade material was sold for use in sandblasting, as filtration sand, and nonskid aggregate.

Gem Stones.—Nationally, Maine ranked third in the value of gem stones and mineral specimens collected and sold on the open market in 1982. Areas in Androscoggin and Oxford Counties continued to attract rockhounds and mineral specimen collectors. Among the semiprecious and gem-quality specimens collected were amethyst, aquamarine, citrine, topaz, and tourmaline.

Peat.—Sales of peat tripled in 1982 compared with that of 1981. Maine ranked 10th among the 20 States that mined peat in 1982. The tonnage produced in Maine is small in comparison with the leading States; Michigan's and Florida's combined output of about 360,000 tons accounted for about one-half of the domestic production. However, during 1982, two firms, United States Peat and Wheelabrator-Frye, announced plans to open new operations that would add substantially to the State's output. In 1982, three companies, one in Waldo County and two in Washington County, mined peat.

Perlite (Expanded).—Crude perlite, shipped by rail from New Mexico, was expanded by Chemrock Corp., the State's only producer, in Rockland, Knox County. Most of the company's sales were for use as a filter agent. Maine and Massachusetts were the only two New England States with expanded perlite operations.

Sand and Gravel (Construction).—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981 collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Production declined 800,000 tons in 1982 to 6.7 million tons compared with that of 1981. However, Maine continued to rank second in output of sand and gravel in the six-State New England region. Construction sand and gravel was mined in all 16 of the State's counties. Leading counties in terms of output were York, Penobscot, and Cumberland.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.
[2]State geologist and Director, Maine Geological Survey, Augusta, Maine.
[3]Geologist, Maine Geological Survey, Augusta, Maine.
[4]Kennebec (Maine) Journal. Feb. 15, 1983, p. 4.
[5]USA Today. Mar. 10, 1983, p. A6.

Table 4.—Maine: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,007	$3,107	$3.09
Concrete products	102	298	2.91
Asphaltic concrete	1,694	4,553	2.69
Road base and coverings	1,825	3,318	1.82
Fill	1,017	1,967	1.93
Snow and ice control	732	966	1.32
Railroad ballast	22	93	4.27
Other	303	818	2.70
Total[1] or average	6,701	15,118	2.26

[1]Data may not add to totals shown because of independent rounding.

Table 5.—Maine: Construction sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	NA	NA	NA	2,762	$6,360	$2.30
Gravel	NA	NA	NA	2,498	6,524	2.61
Sand and gravel (unprocessed)	NA	NA	NA	1,442	2,234	1.55
Total or average	[e]7,500	[e]$19,400	[e]$2.59	[1]6,701	15,118	2.26

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

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Martin Marietta Corp.[1]	6801 Rockledge Dr. Bethesda, MD 20817	Quarry and plant	Knox.
Clays:			
LaChance Brick Co., a division of Morin Brick Co.	Mosher Rd. Gorham, ME 04038	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.
Perlite (expanded):			
Chemrock Corp	End of Osage St. Nashville, TN 37208	Plant	Knox.
Sand and gravel:			
Cianbro Corp	Box D Pittsfield, ME 04967	Pits and mills	Androscoggin, Franklin, Hancock, Oxford, Penobscot, Somerset.
Harry C. Crooker & Sons Inc	R.F.D. 4, Old Bath Rd. Brunswick, ME 04011	Pits and plants	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	Penobscot, Somerset, York.
Stone:			
Blue Rock Industries	58 Main St. Westbrook, ME 04092	Quarries and mill	Cumberland and Kennebec.
Lane Construction Corp	Box 627 Presque Isle, ME 04769	Quarry	Aroostook.
Lime Products Corp	Box 357 Union, ME 04862	2 quarries and mill	Knox.

[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 $171.5 million in 1982, a $4 million decrease from that of 1981 and $21.5 million below the 1979 record of $193 million. Mineral commodities produced included crushed stone, construction sand and gravel, common clay, dimension stone, and lime. Also produced were cement, ball clay, 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. Nationally, Maryland ranked 33d in value of nonfuel mineral production.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] thousand short tons	597	$1,984	405	$1,346
Gem stones	NA	2	NA	2
Lime thousand short tons	9	441	7	396
Peat do.	W	W	--	--
Sand and gravel (construction) do.	e9,500	e31,800	9,720	32,386
Stone:				
Crushed do.	16,485	74,289	p15,100	p73,500
Dimension do.	34	1,002	p32	p1,001
Combined value of cement, clays (ball clay), and value indicated by symbol W	XX	65,937	XX	62,826
Total	XX	r175,455	XX	171,457

eEstimated. pPreliminary. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Allegany	W	W	Stone (crushed).
Anne Arundel	$4,739	(3)	
Baltimore[4]	W	W	Stone (crushed), clays, stone (dimension).
Caroline	31	(3)	
Carroll	W	W	Cement, stone (crushed), clays.
Cecil	12,039	W	Stone (crushed).
Charles	4,436	(3)	
Dorchester	W	(3)	
Frederick	W	W	Cement, stone (crushed), clays, lime.
Garrett	W	W	Stone (crushed), peat.
Harford	W	W	Stone (crushed).
Howard	W	W	Stone (dimension).
Kent	56	$27	Clays.
Montgomery	W	10,469	Stone (crushed), stone (dimension).
Prince Georges	10,568	196	Clays.
Queen Annes	W	W	Stone (crushed).
St. Marys	W	(3)	
Washington	W	W	Cement, stone (crushed), clays.
Wicomico	W	(3)	
Worcester	1,963	(3)	
Undistributed[5]	152,300	132,963	
Sand and gravel (construction)	XX	e31,800	
Total	e186,135	175,455	

eEstimated. 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.

[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 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

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,163.0	2,161.0	-0.1
Unemployment	do	157.0	183.0	+16.6
Employment (nonagricultural):				
Mining[1]	do	(2)	(2)	--
Manufacturing	do	231.7	212.2	-8.4
Contract construction	do	99.7	87.4	-12.3
Transportation and public utilities	do	88.3	86.9	-1.6
Wholesale and retail trade	do	409.3	406.1	-.8
Finance, insurance, real estate	do	93.6	95.1	+1.6
Services[3]	do	377.3	388.7	+3.0
Government	do	415.9	393.3	-5.4
Total nonagricultural employment[1]	do	1,715.8	1,669.7	-2.7
Personal income:				
Total	millions	$48,822	$52,011	+6.5
Per capita		$11,452	$12,194	+6.5
Construction activity:				
Number of private and public residential units authorized		17,132	20,361	+18.8
Value of nonresidential construction	millions	$790.6	$855.7	+8.2
Value of State road contract awards	do	$90.2	$219.9	+143.8
Shipments of portland and masonry cement to and within the State	thousand short tons	1,262	1,158	-8.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$175.5	$171.5	-2.3
Value per capita, resident population		$42	$40	-4.8
Value per square mile		$16,891	$16,210	-4.0

pPreliminary.

[1]Includes bituminous coal and gas extraction.

[2]Included with "Services."

[3]Includes "Mining."

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.—Based on production and sales, Maryland's extractive industries throughout 1982 remained well entrenched in the broad and deep trough of the 1981-82 recession, which officially bottomed out in December. However, preliminary figures for all indicators of Maryland's construction activity, with the notable exception of cement shipments, demonstrate a new upward trend. Up until July 1982, the number of building permits issued in Maryland began to exceed those given out during the same months of 1981. This was also true of the Nation as a whole. During the second half of 1982, the number of housing units authorized grew about twice as fast in Maryland as in the United States. Maryland building permits issued in 1982 were 20,361, up 19% from those of 1981 but still at only 38% of the 1972 peak level of 54,114 units. The 8.4% average annual unemployment rate in Maryland compared favorably with the national average of 9.7% in 1982, but Baltimore City at 11.4% did not fare as well.

The State's nonfuel mineral production, which essentially consists of crushed stone, construction sand and gravel, and common clay, is dependent on construction activity.

Although several of Maryland's aggregate producers reported an average or better-than-average year, most again reported declining sales. Fortunately, the continued demand in the Baltimore area for construction aggregate, sand and gravel, cement, riprap, and dimension stone saved several of Maryland's mineral producers from an otherwise more somber year. During the second quarter of 1982, the Arundel Corp. aggregate and concrete operations in Baltimore reflected record levels of revenues and earnings derived from two extraordinarily large supply contracts: Stone, barged from the company's Havre de Grace quarry on the Susquehanna River for the Hart and Miller Island Project; and concrete, produced for the Fort McHenry Tunnel Project.

In addition to reduced sales, the construction aggregate producers continued to experience strong and broad-based opposition to the expansion of existing operations and the development of new minesites because much of the near-market sand and gravel and stone resources are located in populated areas. Several mining plans faced strong citizen opposition during the year.

Plans of Arundel, an excavator of quarry stone near Reisterstown, were opposed by nearby residents seeking to limit the extent of controlled blasting. The company, which supplies crushed serpentine rock to the county and State for use as road base material, had applied for an extension to its special exception.

The City of Gaithersburg and upper Montgomery County legislators joined residents of the Germantown and Boyds areas to oppose a Boyds master plan amendment that would allow operation of a stone quarry on 500 of the 1,800 acres that Rockville Crushed Stone Inc. owns adjacent to Boyds.

The Maryland Board of Public Works approved the payment of $1.3 million to Joppa Sand & Gravel Corp. to acquire that company's 140-acre property for the expansion of Gunpowder Falls State Park. Breakdown of the payment is $515,000 for the property and $800,000 for relocation, reportedly to Kent County.

A circuit court judge upheld a county council's decision, which had denied the Silver Hills Sand & Gravel Co. request to mine sand and gravel on its 64-acre tract in the Temple Hills-Marlow Heights neighborhood of Upper Marlboro. The proposed minesite is surrounded on three sides by single-family houses and zoned for 1/2-acre residential lots.

In October 1981, Silver Hills requested a special exception to mine a 203-acre tract along Piscataway Road in Upper Marlboro. Residents of the surrounding neighborhood, objecting more to the truck traffic than to the minesite, organized and hired a lawyer to help fight the mine. Silver Hills has two other mining operations in the area. In May 1982, the hearing examiner ruled in favor of the Silver Hills request. The citizen's group appealed the decision to the district council, and the legal battle continued through 1982.

On appeal by the Prince Georges County Council, the court of special appeals reversed the decision by the circuit court whereby a sand and gravel company would construct a wet-process plant in Zekiah Swamp in the Cedarville area. The appeal was urged by local residents and area environmentalists who feared that damage might be done to the ecology of Maryland's largest natural hardwood area. This decision apparently ended the 4-year legal battle.

However, some noteworthy support for the State's extractive industries was evidenced in 1982. The Prince Georges County Council agreed to sell $3.25 million in indus-

trial revenue bonds to finance construction of a wet-processing plant on an 85-acre site in the heart of the Brandywine community to Brandywine Sand & Gravel Co. The council also agreed to underwrite an additional $3.25 million in bonds for the company for the purchase of 25 truck tractors and 35 trailers. County council members pointed out that the sand and gravel industry deserves county support, the wash plant would create additional jobs, and the operation would increase county revenues.

Weak demand for steel, copper, and aluminum had a continuing adverse affect on Maryland's metal producers and fabricators. Because of decreased demand and to reduce inventories, production was cut drastically in 1982, especially during the latter half of the year. Most metal-finishing and affiliated raw materials operations also were temporarily idled or sharply curtailed.

Primary and fabricated metals were among the manufacturing industries that bore the brunt of the employment losses in Maryland, as well as the Nation. In 1982, the State's work force in the primary metals sector declined 14.5% from that of 1981; about 4,200 employees were idled. Employment in the fabricated metals sector dropped 11.9% for the same period, with 1,500 workers losing jobs.

Typical of basic industry's response to poor conditions in the worldwide economy was Bethlehem Steel Corp.'s strategy to cut operating losses at its Sparrows Point plant while modernizing to regain profitability. Operating losses, in large part, were cut by reducing the work force. At yearend, 6,500 employees had been laid off and an additional 1,300 workers had been placed on a 4-day, 32-hour workweek. Prior to 1982 developments, Bethlehem had been Maryland's largest industrial employer, with a peak production work force of 17,000. Modernization of the steel plant continued with the completion of the $165 million "A" coke oven battery. Most of the coke produced by the A battery is to be used in the "L" blast furnace, the largest in working volume in the Nation, which was completed in February 1979 at a cost of more than $200 million. Another battery similar to the A battery is planned, and Bethlehem also was investigating ways to finance a continuous slab caster for the Sparrows Point plant.

Solarex Corp. dedicated its new solar cell facility near Frederick on October 24. The $20 million plant produces silicon material for photovoltaic devices. An array of more than 200,000 crystalline-silicon solar cells on the plant's southern roof converts sunlight directly into electricity, and a bank of special lead batteries stores power. The plant is totally independent from any electric utility company and is a model for future plants in remote areas where power is not readily available.

The $91 million Atlantic Cement Co. slag cement project that began in March 1981 was completed at midyear. It included slag granulation facilities adjacent to Bethlehem's new giant L blast furnace, a grinding plant, storage facilities, a deepwater dock facility, and a 19,000-ton barge to supplement Atlantic Cement's marine fleet.

The Port of Baltimore in 1982 fared better than most global ports during the worldwide economic slump. The Maryland Port Authority reported cargo volume to be down by 3.6 million tons, a 10% decline from 34.3 million tons in 1981 to 30.7 million tons in 1982. Ore and oil shipments were down because of depressed industrial activity; coal exports were down owing to the recession in Europe. Ore imports declined from 6.5 to 4.2 million tons, a 35.4% drop.

Legislation and Government Programs.—In fiscal year 1982, expenditures of the Maryland Geological Survey totaled $1.8 million. Of this total, 75% was State general funds and special funds, 17% was Federal funds, and 8% was reimbursable funds. Of particular interest to the State's mineral producers and processors was the hydrogeology study of the Baltimore industrial area and two completed studies relative to lands for potential mineral resource development—one in the Baltimore-Washington, D.C., area and the other in western Maryland. Of further value to mining was the Survey's mapping program. Topographic map revisions progressed in Frederick and Baltimore Counties, while geologic mapping was completed in three quadrangles and was underway in two others. Since 1971, 26 quadrangles have been geologically mapped and 12 have been published.

The Maryland General Assembly appropriated $2.4 million for construction of renovated quarters for the Maryland Geological Survey. A building on the National Register of Historic Places is to be used as the new home of the Survey.

Significant studies conducted at the U.S. Bureau of Mines Avondale Research Center during fiscal year 1982 included the identification and characterization of fibrous mineral particulates, corrosion behavior, rapid

identification of scrap metals, and metal recovery from secondary copper smelter flue dusts. The center's major areas of technical competence include urban refuse recycling, secondary metals, corrosion, flotation, and materials characterization. The test facility is unique in having ion-implantation equipment and two pilot plants for treating raw or incinerated refuse.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Calcite.—The Genstar Stone Products Co. plant, located north of Baltimore, in Texas, Md., produced calcium carbonate for use as paper coating and whiting substitute for paint, rubber, and plastic. The 93%-pure calcite deposit was mined by surface and underground methods. Mill production in 1982 totaled 144,000 tons, down 18% from that of 1981.

Cement.—Alpha Portland Cement Co., Lime Kiln; Lehigh Portland Cement Co., Union Bridge; and Marquette Co., Hagerstown, produced portland cement. Lehigh Portland and Marquette also produced masonry cement. Genstar, Frederick County, operated a grinding plant and produced masonry cement. Sales of finished portland cement and prepared masonry cement fell for the third consecutive year. From 1981 to 1982, portland cement shipments decreased 6% while the average value decreased 4%. Concurrently, masonry cement shipments decreased only 2% while the average value fell 19%.

The $77 million Atlantic Cement "Newcem" plant at Sparrows Point began operation at midyear. The water-granulated blast furnace slag is conveyed from storage silos to dockside loading facilities for deep-water barge transport to Atlantic Cement's network of tidewater distribution terminals, which span a 16-State market area from New England to Florida. The cementitious material is blended with types I and II portland cement in proportions from 40% to 65% with excellent mortar strengths.

The Alpha Portland plant in Lime Kiln was sold in September to Coplay Cement Co. for $12 million. The Frederick County facility employs 100 people and has a 1.5-million-ton-per-year capacity. The associated mineral rights on the 1,000-acre site are being leased to Coplay by Alpha Portland.

Marquette, a subsidiary of Lone Star Industries Inc., ended a 5-week production shutdown at midyear. The Washington County plant, located just east of Hagerstown, started production in 1908. It has a rated capacity of 500,000 tons per year. This former subsidiary of Gulf + Western Industries Inc. was acquired by Lone Star in early 1982. To date, about 50 million tons of limestone has been mined from the site. The other raw materials necessary for production—sand, shale, iron ore, and gypsum—are trucked to the plant. The kiln is heated with pulverized coal. Portland cement and masonry cement, sold under the name of Blue Bond, are shipped in bulk and in packages to the company's major market areas of Baltimore and Washington, D.C.

Clays.—Common clay was produced by six companies operating eight pits in Carroll, Frederick, Kent, Prince Georges, and Washington Counties. Production totaled 405,000 tons, down 32% from 1981 levels. Common clay was used in the manufacture of portland cement clinker, common brick, and face brick.

Ball clay was produced in Baltimore County by Cyprus Industrial Minerals Co., Maryland's sole producer. Production decreased by about one-third from 1981 levels. Major end uses of the Cyprus ball clay were in the manufacture of floor and wall tiles, ceramics, and sanitary ware. Ball clay is a plastic, white-firing clay used principally for bonding in ceramic ware. The clays are of sedimentary origin and consist mainly of kaolinite and sericite micas.

The status of the Boehm-Joy clay mining operation in Crownsville continued to be uncertain. The "black" clay was to be used to construct and close out hazardous waste landfills. The plan requires removal of 300,000 cubic yards of clay from the 7.5-acre portion of the 198-acre tract. The initial 1-acre-sized pit is 300 feet from an onsite, 10-year-old industrial waste pit and 50 feet above the Magothy Aquifer, which supplies water to the entire Annapolis water system.

Gem Stones.—An estimated $2,000 in gem stones and mineral specimens were collected by mineralogists and rock hounds in 1982.

Gypsum.—National Gypsum Co. and United States Gypsum Co. calcined gypsum at company facilities in Baltimore for use in the manufacture of wallboard. The import-

ed crude gypsum was mined in Nova Scotia and New Brunswick, Canada. Production increased 6% over 1981 levels.

Believed to be the first time in the Nation, byproduct gypsum was mixed with natural gypsum and commercially used in the manufacture of wallboard. The United States Gypsum wallboard plant in Baltimore, the eighth leading plant in the United States, blended substantial amounts of byproduct gypsum with its gypsum rock raw material. The byproduct gypsum was obtained from the SCM Corp. Glidden Pigments Group plant in Baltimore, and although it presented some problems in handling, satisfactory wallboard was produced.

Iron Slag.—Although output by Bethlehem at Sparrows Point fell for the third consecutive year, Maryland continued to rank seventh nationally in iron slag production. Expanded slag, comprising 90% of the iron blast furnace slag produced as a byproduct of steelmaking, was sold to Atlantic Cement for the manufacture of cement. The remainder, as air-cooled slag, was used as construction aggregate.

At the new Atlantic Cement 800,000-ton-per-year, water-granulated slag cement plant, slag is received directly from Bethlehem's giant L blast furnace. The molten material is immediately impacted with a high volume of water and quickly cooled. The water-granulated slag is then ground to a fineness similar to that of portland cement. This product, called Atlantic Newcem, can be substituted for portland cement and is blended with portland by the user to meet particular job requirements.

The Arundel Corp., Baltimore, reported an unfavorable impact on the operating profits of its aggregate operation owing to the reduced availability of slag materials from the Bethlehem Sparrows Point plant.

Lime.—S. W. Barrick & Sons Inc., Frederick County, produced about 7,000 tons of agricultural lime in 1982. Limestone was calcined in a continuous operation in some of the few remaining vertical, mixed-feed kilns still in existence. Anthracite trucked from eastern Pennsylvania fuels the kilns, and minus 6-inch plus 1-inch crushed limestone is supplied from a nearby 210-foot-deep quarry. The major part of the firm's lime product is sold in bulk to customers in six States. The remainder is packaged for sale in 50-pound bags, and a small amount is sold for soil stabilization. Barrick & Sons is the State's only producer of lime.

Peat.—Garrett County Processing & Packing Corp. has been mining reed-sedge peat for almost 20 years from a 30-acre bog in the western corner of Maryland. The company, which markets peat as a soil conditioner under the trade name of Free State Peat, reported 8 to 10 years of reserves at the current rate of extraction. It is the State's sole producer of peat. Garrett County Processing has worked with the Maryland Nature Conservancy to protect two of the conservancy's bogs.

Sand and Gravel.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

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

	1981[e]			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	NA	NA	NA	5,517	$18,977	$3.44
Gravel	NA	NA	NA	3,224	11,330	3.51
Sand and gravel (unprocessed)	NA	NA	NA	979	2,079	2.12
Total or average	9,500	$31,800	$3.35	9,720	32,386	3.33

[e]Estimated. NA Not available.

Table 5.—Maryland: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,766	$17,204	$3.61
Concrete products	1,018	3,266	3.21
Asphaltic concrete	1,730	5,200	3.01
Road base and coverings	881	2,530	2.87
Fill	841	2,232	2.65
Snow and ice control	2	6	2.41
Other	481	1,948	4.05
Total or average	[1]9,720	32,386	3.33

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

In 1982, 35 companies operated 48 pits and 28 processing plants in 13 of Maryland's 23 counties to produce 9.7 million tons of sand and gravel valued at $32.4 million. In 1982, production and value increased 220,000 tons and $586,000, respectively, over 1981 figures. The average value per ton was $3.33.

Eighty-six percent of the material was transported by truck, while 6.5% was shipped by rail or barge, and 7.5% was consumed at the site of the operation. Shipments from Baltimore, Cecil, and Dorchester Counties were by truck and rail, whereas sand and gravel from Worcester County was transported by barge as well as truck. All production from Frederick County was consumed within the county.

Major uses of construction sand and gravel were for concrete aggregate (49%), asphaltic concrete (18%), and various concrete products (10%). Other uses included road base and coverings and fill.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Crushed.—Based on preliminary data, the production and sales of crushed stone fell for the third consecutive year as economic conditions, particularly high interest rates, continued to depress construction activity. Production, estimated at 15.1 million tons, was down 8.4% from that of 1981, while total value dropped 1.1% to $73.5 million.

In early 1982, Genstar announced a $13 million expansion and modernization of its Frederick facilities. The remodeled plant was expected to increase crushed stone output by more than 80%. A major feature of the project is a new primary crusher to be located within the quarry. Secondary and tertiary crushing facilities were also being upgraded.

Genstar began purchasing oyster shells from C. J. Langenfelder & Sons Inc., which dredges the shells from Chesapeake Bay under Government contract. The shells are crushed and screened at the Genstar White Marsh plant and shipped either as bagged product or in trailers. The product, fed to hens as grit, sold for an average price of $50 per ton.

Dimension.—Based on preliminary data, dimension stone production in Maryland amounted to 32,000 tons, down 6% from that of 1981, while total value remained essentially unchanged at $1 million.

Vermiculite (Exfoliated).—W. R. Grace & Co. at Muirkirk, Prince Georges County, exfoliated South Carolina-mined vermiculite. Sales decreased 31% from those of 1981. The vermiculite was used primarily for high temperature block and loose fill insulation and for concrete aggregates. A small amount was used for horticultural purposes as a soil conditioner, and for plaster aggregates.

METALS

Aluminum.—Eastalco Aluminum Co., owned by Howmet Aluminum Corp. and Alumax Inc., produced primary aluminum for local, national, and worldwide markets from its reduction plant in Frederick. Alumina imported for Kwinama, Australia, under long-term contract was shipped to the special Eastalco dock facilities at Hawkins Point, Port of Baltimore. The alumina and other raw materials for the aluminum-reduction process (cryolite, aluminum fluoride, pitch, and coke) were shipped to the plant by rail. Eastalco, the operating company, produced extrusion billets, rolling

ingots, and remelt T-ingots from two 240-electrolytic-cell potlines. The plant, which operated at 90% of its 176,000-ton-per-year capacity during the first 4 months of 1982, completed the year at 75% of capacity. About 70% of production was used by the owner's fabricating facilities, with the remainder sold on the open market. Facility modernization, at a cost of $3 million in 1982, included automation in potlines and energy-saving improvements in the casthouses.

Copper.—Kennecott Refining Corp., one of four primary copper refineries in the Eastern United States, operated at less than 50% of its 23,000-ton-per-month capacity in 1982. Copper anode from Utah, Arizona, New Mexico, and Nevada was refined at Curtis Bay for worldwide markets.

Iron and Steel.—Bethlehem, the second largest steel producer in the Nation, produced iron, raw steel, and finished and semifinished steel products at Sparrows Point from ore imported from Nova Scotia and Liberia. Because of decreased customer demand and to reduce inventories, Bethlehem's steel production was cut back drastically in 1982, especially during the latter half of the year. The plant operated well below the 47% average utilization of production capability for the domestic steel industry. The $165 million coke oven battery, begun in 1979, was completed in 1982. The partially computerized battery consists of eighty 6-meter-high ovens capable of producing 850,000 tons per year of 3/4-inch or larger coke. The first "push" of coke from the new battery occurred in August.

Armco Inc., at its East Baltimore specialty steel plant, produced stainless steel ingots, billets, bars, rods, and wire products. During 1982, output was cut to 40% of normal capacity, and one-third of the work force, or more than 200 employees, was furloughed. Completed in 1982 as part of a modernization program were a new electric arc furnace, an argon-oxygen decarbonization vessel, and bar-turning and annealing facilities. A new rotary forge machine and horizontal continuous caster were expected to go into production by late 1983.

Titanium Dioxide.—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.

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[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:			
Masonry:			
Genstar Stone Products Co	Box 696, South St. Frederick, MD 21701	Plant	Do.
Portland:			
Alpha Portland Cement Co.[1]	4120 Buckeystown Pike Lime Kiln, Box D Frederick, MD 21701	Plant and quarry.	Do.
Portland and masonry:			
Lehigh Portland Cement Co.[1 2]	Box L Union Bridge, MD 21791	do	Carroll.
Marquette Co.[1]	Box 650 Hagerstown, MD 21740	do	Washington.
Slag cement:			
Atlantic Cement Co	Box 6687 Sparrows Point, MD 21219	do	Baltimore.
Clays:			
Ball clay:			
Cyprus Industrial Minerals Co., Cyprus Mines Corp.	9420 Pulaski Highway Baltimore, MD 21220 Box 188 White Marsh, MD 21162	Pit	Do.
Common clay:			
Victor Cushwa & Sons Inc	Clearspring Rd. & Route 68N Box 160 Williamsport, MD 21795	Pits	Washington.
Lehigh Portland Cement Co	Box L Union Bridge, MD 21791	do	Carroll and Frederick.
Copper:			
Kennecott Refining Corp	Kenbo Rd. Curtis Bay, MD 21226 Box 3407 Baltimore, MD 21226	Refinery	Anne Arundel.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
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	5500 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):			
Charles County Sand & Gravel Co. Inc.	Waldorf Industrial Center Box 548 Waldorf, MD 20601	Pits and plants	Anne Arundel, Charles, St. Marys.
Contee Sand & Gravel Co. Inc	Box 1000 Laurel, MD 20810	do	Anne Arundel, Howard, Prince Georges.
Genstar Stone Products Co.[3]	Executive Plaza 4 11350 McCormick Rd. Hunt Valley, MD 21031	do	Anne Arundel and Baltimore.
J. E. Owens, III	5893 Upper Pindell Rd. Lothian, MD 20820	Pit (bankrun)	Anne Arundel.
York Building Products Co. Inc., Mason Dixon Div.	Box 1708 Loucks Mill Rd. York, PA 17405	Pits and plants	Cecil.
Stone:			
Crushed:			
Arundel Corp	110 West Rd. Baltimore, MD 21204	Quarries and plants.	Baltimore and 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:			
Stoneyhurst Quarries	Box 34463 8101 River Rd. Potomac, MD 20817	do	Do.
Tri-State Stone Co. Inc	8200 Seven Locks Rd. Bethesda, MD 20034	do	Do.
The Weaver Stone Co	Box 96 Reisterstown, MD 21136	do	Baltimore.
Vermiculite (exfoliated):			
W. R. Grace & Co	12340 Conway Rd. Beltsville, MD 20705	Plant	Prince Georges.

[1]Also crushed stone.
[2]Also clays.
[3]Also calcite.

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, Jr.,[1] and Joseph A. Sinnott[2]

The value of nonfuel mineral production in Massachusetts in 1982 was $89.3 million, a decline of $5.4 million from that of 1981. The State ranked 39th nationally in value of mineral production but 1st among the six New England States, accounting for about one-third of the region's total value. Massachusetts led the region in production of clays, lime, industrial sand, construction sand and gravel, and crushed stone.

Gypsum, perlite, and vermiculite were processed in the State and synthetic graphite was manufactured. Combined output of these four commodities accounted for about $6.7 million in sales.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	259	$1,322	210	$1,115
Lime	do.	170	10,793	135	9,414
Sand and gravel:					
Construction	do.	e12,500	e31,300	12,003	34,438
Industrial	do.	87	W	140	1,615
Stone:					
Crushed	do.	7,997	41,037	p6,900	p33,500
Dimension	do.	50	8,616	p51	p9,158
Combined value of gem stones, peat, and value indicated by symbol W		XX	1,669	XX	62
Total		XX	r94,737	XX	89,302

eEstimated. pPreliminary. 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 Massachusetts, by county

(Thousands)

County	1980	1981[1]	Minerals produced in 1981 in order of value
Barnstable	$1,484	(2)	
Berkshire	W	$22,363	Stone, lime.
Bristol	5,924	W	Stone.
Dukes	109	(2)	
Essex	4,925	3,953	Stone.
Franklin	W	1,499	Do.
Hampden	W	W	Do.
Hampshire	W	W	Do.
Middlesex	19,546	W	Stone, sand and gravel.
Nantucket	W	(2)	
Norfolk	W	W	Stone, clays.
Plymouth	W	1,284	Sand and gravel (industrial), clays, stone.
Suffolk	797	1,600	Stone.
Worcester	W	W	Stone, peat.
Undistributed[3]	58,428	32,738	
Sand and gravel (construction)	XX	e31,300	
Total	[4]91,211	94,737	

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

[1]County distribution for construction sand and gravel is not available; total State value is shown separately under "Sand and gravel (construction)."

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

[3]Includes gem stones and values indicated by symbol W.

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

Table 3.—Indicators of Massachusetts business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,963.0	3,016.0	+1.8
Unemployment	do	188.0	239.0	+27.1
Employment (nonagricultural):				
Mining	do	(1)	(1)	--
Manufacturing	do	669.4	636.9	-4.9
Contract construction	do	79.6	78.2	-1.8
Transportation and public utilities	do	120.1	118.8	-1.1
Wholesale and retail trade	do	579.1	570.1	-1.6
Finance, insurance, real estate	do	164.8	168.2	+2.1
Services[2]	do	664.2	682.5	+2.8
Government	do	391.1	367.3	-6.1
Total nonagricultural employment	do	2,668.3	2,622.0	-1.7
Personal income:				
Total	millions	$64,244	$68,913	+7.3
Per capita		$11,127	$11,921	+7.1
Construction activity:				
Number of private and public residential units authorized		16,794	16,882	+.2
Value of nonresidential construction	millions	$1,201.9	$874.6	-27.2
Value of State road contract awards	do	$119.0	$307.0	+158.0
Shipments of portland and masonry cement to and within the State	thousand short tons	1,033	1,023	-1.0
Nonfuel mineral production value:				
Total crude mineral value	millions	$94.7	$89.3	-5.7
Value per capita, resident population		$17	$15	-11.8
Value per square mile		$11,752	$10,815	-8.0

pPreliminary.

[1]Included with "Services."

[2]Includes "Mining."

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, in addition to leading the New England region in nonfuel mineral production, was also foremost in manufacturing. During the year, a number of metalworking firms announced expansions.

Wyman-Gordon Co., one of the Nation's principal producers of titanium forgings, purchased the federally owned (U.S. Air Force) forging facilities at Grafton, Mass., for $34.45 million. The Grafton plant and the bulk of the facility's equipment, including 18,000-, 35,000-, and 50,000-ton hydraulic forging presses, had been leased from the Government by Wyman-Gordon since 1946. Wyman-Gordon also purchased a 42.5% interest in International Titanium Inc.'s (ITI) new Moses Lake, Wash., titanium sponge manufacturing facility.

Construction continued on Wyman-Gordon's $11 million titanium melting facility at Millbury, Mass., which was expected to be supplied with sponge from the ITI operation upon its completion in 1983. In addition, the firm began construction of a $13 million facility at the Grafton plant, which will have the capability of producing billets from the ingots produced at the Millbury operation.

NRC Inc., Newton, continued as a leading U.S. producer of tantalum powder for the electronics industry and tantalum metal for the aerospace industry. In 1982, NRC completed a $5 million expansion program, installed an 800-megawatt electron beam furnace (considered to be the second largest of its type in the world), added a new rolling mill, and announced plans to start manufacturing columbium products in 1983.

Nuclear Metals Inc., Concord, a manufacturer of uranium metal billets, completed construction of a new facility in Barnwell County, S.C. The new operation, Carolina Metals Inc., doubled Nuclear Metal's production capacity to 650,000 pounds of billets per month. Carolina Metals refined uranium fluoride into uranium metal billets for shipment to the Concord facility for extruding, recasting, and machining. After processing, the billets were sold for use in high-density shields against radioactivity, in counterweights for aircraft, and in ordnance projectiles.

American Solar King Corp., a manufacturer of solar energy collectors, increased capacity at its Burlington plant to 100,000 copper absorber plates per year. The expansion doubled the firm's capacity and was expected to increase Solar King's consumption of copper products from 1 to 3 million pounds per year. American Solar King, which markets the plates for residential use, also operated a manufacturing facility at Waco, Tex. Another copper plate producer, Terra-Light Inc., a division of Butler Manufacturing Co., completed construction of a $4 million copper absorber plate plant at Danvers. The firm also operates a production facility at Billerica. Both plants manufacture medium-temperature copper plates used primarily in water heaters.

Exploration Activity.—Generally, in New England, previously mined or investigated mineral properties are often reexamined by large mining concerns as part of a reconnaissance program or by local interests seeking financial investment for development of a small operation. Activity in Massachusetts in 1982 followed this general pattern.

St. Joe Minerals Corp., a subsidiary of Fluor Corp., leased mineral rights in the area of the old Davis Mine in Rowe, Franklin County. The Davis Mine was worked from 1882 to 1915 producing iron pyrite used in the manufacture of sulfuric acid. Zinc, copper, and lead mineralization were also associated with the deposit. Activity by St. Joe in 1982 consisted primarily of soil testing and geological reconnaissance.

Two other mineral properties in the State were under investigation by private concerns. Exploration activity was reported in the Newbury-Newburyport area in Essex County where the old Chipman Mine was worked for silver and lead from 1874 to 1926. A beryl pegmatite property in Royalston, Worcester County, which was periodically examined between 1915 and the late 1940's, was also under investigation.

Legislation and Government Programs.—The Massachusetts Department of Environmental Quality Engineering, through the office of the State geologist, continued as the primary source of information on the mineral resources and geology of the State.

During the year, the Massachusetts Executive Office of Energy Resources completed a report on the first phase of a peat resources program with the U.S. Department of Energy. The study identified 180 peatlands in the State containing an estimated 260.5 million tons of peat.[3]

In 1982, the U.S. Bureau of Mines was involved in 68 contracts and grants with Massachusetts research firms and universities. The majority of work involved mining

equipment and health and safety technology. Funding for the work totaled $4.6 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 $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—Norton Co., Worcester, was one of five firms in the United States that produced nonmetallic crude artificial abrasive material in 1982. The company manufactures bonded and coated abrasive products primarily used in foundries, steel mills, and stone cutting and construction industries. Production dropped sharply during the year reflecting the worldwide economic decline, particularly in the industrial sector. Late in the year, Norton reduced the work force at its Worcester facilities by 120. Despite the weakened demand for abrasive products in 1982, Norton introduced a new line of coated abrasives using proprietary abrasive grains and a laser-welded diamond saw blade for cutting masonry construction materials.[4]

Clays.—Massachusetts again ranked 1st among the four States that mine clay in New England, although ranked 25th nationally. Production decreased in 1982 after increasing in each of the previous 6 years. Output of clay used in brick manufacture remained about the same in 1982 compared with that of 1981. However, clay used in the manufacture of concrete block and structural concrete declined. Three companies mined clay—two in southeastern Massachusetts in Plymouth County, and one in the east-central part of the State in Norfolk County.

Graphite (Manufactured).—Massachusetts was 1 of 14 States that manufactured synthetic graphite in 1982. Two companies, both in Middlesex County—Avco Corp. and Stackpole Fibers Co.—manufactured graphite fibers used primarily by the aerospace industry.

Gypsum (Calcined).—United States Gypsum Co. imported crude gypsum from company-owned mines in Canada for wallboard manufacture. The facility, in Suffolk County near Boston, was one of two gypsum calcining operations in New England; the other was in New Hampshire. The wallboard was shipped throughout New England primarily for use in residential construction.

Lime.—Output declined for the first time since 1980 because of reduced demand from the agricultural, chemical, and construction industries. Two companies continued to manufacture lime in Berkshire County in western Massachusetts from locally quarried limestone.

Lee Lime Corp., in Lee, primarily produced hydrated lime and, secondarily, quicklime. About three-fourths of the company's output was used for agricultural purposes, and the remainder, in construction. The lime was marketed in western New York and New England with 98% of the shipments transported by truck and 2% by rail. During the year, Lee completed a kiln-fuel conversion project switching from oil to coal.

The State's other lime producer, Pfizer Inc., Minerals Pigments & Metals Div. in Adams, produced quicklime mainly for chemical uses. Pfizer also operated the only other lime manufacturing facility in New England at Canaan, Conn. During the year, Pfizer also began production of ultrafine, precipitated calcium carbonates at the Adams plant. The ultrafine calcium carbonates are used as extenders, impact modifiers, reinforcement agents for plastics and rubber products, and in printing inks and sealants. Sales are to U.S. and Canadian markets and for export in the Western Hemisphere. Previously, the specialty-grade calcium carbonate was available primarily from producers in Europe and Japan.[5]

Peat.—Reed sedge peat was produced by Sterling Peat Co., Worcester County, in north-central Massachusetts. The peat was used predominently for agricultural applications.

Perlite (Expanded).—Whittemore Products Inc. expanded perlite mined in New Mexico at its facility in Essex County. Expanded perlite was used in lightweight aggregate and as a horticultural medium.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production infor-

mation for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. Massachusetts ranked 1st in New England and 17th nationally in sand and gravel production in 1982. Leading counties in terms of production were Middlesex, Worcester, and Norfolk.

Since 1980, the number of active sand and gravel pits declined from 160 to 135. For that same period, the average unit price of sand and gravel increased from $2.47 to $2.87.

Industrial.—Industrial sand was produced by three companies, two in Middlesex County and one in Plymouth County. The sand was sold primarily to foundries.

Table 4.—Massachusetts: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	5,046	$17,663	$3.50
Plaster and gunite sands	W	W	4.10
Concrete products	781	2,108	2.70
Asphaltic concrete	1,028	3,284	3.19
Road base and coverings[1]	2,094	5,006	2.39
Fill	1,796	3,144	1.75
Snow and ice control	738	1,619	2.20
Railroad ballast	W	W	1.50
Other	520	1,613	3.10
Total or average	12,003	[2]34,438	2.87

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (cement).
[2]Data do not add to total shown because of independent rounding.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	4,240	$12,558	$2.96
Gravel	NA	NA	NA	5,468	17,859	3.27
Sand and gravel (unprocessed)	NA	NA	NA	2,295	4,021	1.75
Total or average	[e]12,500	[e]$31,300	[e]$2.50	12,003	34,438	2.87
Industrial sand	87	W	W	140	1,615	11.56
Grand total or average	[e]12,587	W	W	12,143	36,053	2.97

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

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and finalized the following year.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.
[2]State geologist, Massachusetts Department of Environmental Quality, Boston, Mass.
[3]Brenninkmeyer, B. M., and J. S. Russo. Peat Resource Definition and Utilization in Massachusetts. Commonwealth of Massachusetts Executive Office of Energy Resources and the U.S. Department of Energy, 1982, p. 155; available from Massachusetts Department of Environmental Quality Engineering, Office of the State Geologist, 11 Winter St., Boston, MA 02110
[4]Norton Co. 1982 Annual Report. 52 pp.
[5]Rock Products. November 1982, p. 24.

Table 6.—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.
Nardone Co	37 Power Rd. Westford, MA 01886	Pit	Do.
Whitehead Bros. Co	64 River Rd. East Hanover, NJ 07936	Pit	Plymouth.
Stone:			
P. J. Keating Co	Box 367 Fitchburg, MA 01420	Quarries	Middlesex and Worcester.
John S. Lane & Son Inc	Box 125 Westfield, MA 01085	do	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 Tomasso Inc	Box 114 Acushnet, MA 02743	Quarry	Bristol.
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]

The value of Michigan's nonfuel mineral production was $1.04 billion in 1982, down from the $1.44 billion reported in 1981. This was the third consecutive year of decline in the State's nonfuel mineral value. Nationally, Michigan ranked sixth in value of mineral output and continued to lead in the production of calcium chloride, crude iron oxide pigments, magnesium compounds, and peat. The State ranked second in the production of bromine, crude iodine, iron ore, and industrial sand, and fourth in shipments of portland cement and pig iron.

Leading mineral commodities in terms of value were iron ore, portland cement, magnesium compounds, and salt. Other mineral commodities produced were clays, copper, crude gypsum, lime, masonry cement, sand and gravel, silver, and stone. Semiprecious gem stones and mineral specimens were collected by mineral dealers and rock hounds. Materials processed in the State

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

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
Cement:				
Masonry thousand short tons	173	$10,584	136	$8,752
Portland do	3,871	180,641	3,254	149,533
Clays do	1,610	5,862	1,022	4,370
Gem stones	NA	15	NA	15
Gypsum thousand short tons	1,066	6,762	682	5,150
Iron ore (usable) thousand long tons, gross weight	14,193	W	W	W
Lime thousand short tons	807	36,800	571	26,823
Peat do	237	4,540	241	4,917
Salt do	2,321	103,293	2,002	106,303
Sand and gravel:				
Construction do	e28,100	e68,050	20,567	47,726
Industrial do	4,393	29,787	2,920	21,934
Stone:				
Crushed do	30,013	94,324	p20,700	p67,100
Dimension do	6	129	p4	p110
Combined value of bromine, calcium chloride, copper, iodine, iron oxide pigments (crude), magnesium compounds, silver, and values indicated by symbol W	XX	899,618	XX	593,162
Total	XX	r1,440,405	XX	1,035,895

eEstimated. pPreliminary. 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 Michigan, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Alcona	W	(3)	
Alger	$25	(3)	
Allegan	W	$74	Stone (crushed), peat.
Alpena	W	W	Cement, stone (crushed), clays.
Antrim	W	W	Clays.
Arenac	W	931	Stone (crushed).
Baraga	270	W	Do.
Barry	W	W	Do.
Bay	16,992	16,230	Cement, sand and gravel (industrial), lime, stone (crushed).
Benzie	44	(3)	
Berrien	2,510	W	Sand (industrial).
Branch	W	W	Stone (crushed).
Calhoun	848	W	Do.
Cass	W	W	Do.
Charlevoix	W	W	Cement, stone (crushed).
Cheboygan	213	188	Stone (crushed).
Chippewa	W	W	Do.
Clare	448	(3)	
Clinton	W	W	Clays.
Delta	W	W	Stone (crushed).
Dickinson	W	W	Iron ore, stone (crushed).
Eaton	W	W	Stone (crushed), peat, stone (dimension).
Emmet	W	W	Cement.
Genesee	505	(3)	
Gladwin	W	(3)	
Gogebic	119	67	Stone (crushed).
Grand Traverse	78	(3)	
Gratiot	435	(3)	
Hillsdale	1,225	(3)	
Houghton	W	2	Stone (crushed).
Huron	W	W	Stone (crushed), lime.
Ingham	W	W	Peat.
Ionia	W	W	Stone (crushed).
Iosco	W	W	Gypsum.
Iron	W	(3)	
Isabella	W	(3)	
Jackson	1,014	W	Stone (dimension).
Kalamazoo	W	W	Stone (crushed).
Kalkaska	24	(3)	
Kent	W	W	Gypsum, peat.
Lake	126	(3)	
Lapeer	W	W	Peat, calcium chloride.
Leelanau	W	(3)	
Lenawee	964	(3)	
Livingston	3,440	(3)	
Luce	69	(3)	
Mackinac	W	W	Stone (crushed).
Macomb	6,321	W	Sand (industrial).
Manistee	101,601	105,207	Magnesium compounds, salt, bromine.
Marquette	W	W	Iron ore, stone (crushed), iron oxide pigments.
Mason	97,621	W	Calcium chloride, magnesium compounds, lime, bromine, sand (industrial).
Mecosta	W	W	Peat.
Menominee	393	(3)	
Midland	35,830	W	Bromine, calcium chloride, magnesium compounds, salt, iodine.
Missaukee	3	(3)	
Monroe	42,616	W	Cement, stone (crushed), clays, peat.
Montcalm	W	(3)	
Montmorency	W	(3)	
Muskegon	W	W	Sand (industrial), salt.
Oakland	21,934	W	Peat.
Oceana	2,704	W	Sand (industrial).
Ogemaw	1,107	(3)	
Ontonagon	W	W	Copper, silver.
Osceola	W	(3)	
Otsego	208	(3)	
Ottawa	5,063	W	Sand (industrial).
Presque Isle	W	36,582	Stone (crushed), stone (dimension).
Roscommon		40	Stone (crushed).
Saginaw	W	1,611	Sand (industrial), lime.
St. Clair	W	W	Salt.
St. Joseph	W	W	Stone (crushed), peat.
Sanilac	W	2,328	Peat, lime.
Schoolcraft	W	W	Stone (crushed), stone (dimension).
Shiawassee	W	1,270	Clays, peat.
Tuscola	W	W	Lime.
Van Buren	266	(3)	
Washtenaw	3,449	(3)	
Wayne	73,826	68,920	Cement, lime, salt, sand (industrial), stone (crushed), clays.
Wexford	1,230	W	Sand (industrial).

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Undistributed[4]	$1,061,633	$1,138,905	
Sand and gravel (construction)	XX	e68,050	
Total	[5]1,485,150	1,440,405	

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Crawford, Keweenaw, Newaygo, and Oscoda Counties are not listed because no nonfuel mineral production was reported.

[2]County distribution for construction sand and gravel is not available; total State value is shown separately under "Sand and gravel (construction)."

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

[4]Includes gem stones, sand and gravel that cannot be assigned to specific counties (1980), 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

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	4,309.0	4,276.0	-0.8
Unemployment	do	529.0	661.0	+25.0
Employment (nonagricultural):				
Mining[1]	do	12.9	10.6	-17.8
Manufacturing	do	979.0	874.1	-10.7
Contract construction	do	106.8	90.0	-15.7
Transportation and public utilities	do	147.9	141.5	-4.3
Wholesale and retail trade	do	714.7	689.4	-3.5
Finance, insurance, real estate	do	155.0	151.7	-2.1
Services	do	649.6	652.8	+.5
Government	do	598.4	579.3	-3.2
Total nonagricultural employment[1 2]	do	3,364.4	3,189.3	-5.2
Personal income:				
Total	millions	$99,017	$100,668	+1.7
Per capita		$10,758	$11,052	+2.7
Construction activity:				
Number of private and public residential units authorized		19,072	13,848	-27.4
Value of nonresidential construction	millions	$880.4	$831.6	-5.5
Value of State road contract awards	do	$186.4	$186.4	--
Shipments of portland and masonry cement to and within the State	thousand short tons	1,815	1,371	-24.5
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,440.4	$1,035.9	-28.1
Value per capita, resident population		$155	$114	-26.5
Value per square mile		$24,707	$17,794	-28.0

[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.

included perlite, iron and steel slag, and vermiculite. Also, sulfur was recovered as a byproduct at oil refineries and natural gas processing plants.

Trends and Developments.—In retrospect, 1982 was a bleak year for Michigan's mining, manufacturing, and construction industries. In the mining sector, both metallic and nonmetallic mineral producers were forced to suspend production and lay off personnel because of high inventories and declining sales. This was mainly caused by the decline in the regional manufacturing and construction base. Automobile manufacturing remained at low levels throughout the year, which in turn forced the State's steel industry to operate at levels well below capacity. Producers supplying the steel industry with mineral commodities (lime, flux stone, taconite, etc.) for the steelmaking process suffered reduced demand throughout the year.

Continued high interest rates and the depressed State economy severely hampered construction activity. The U.S. Department of Commerce reported a 27% drop in the number of construction permits issued for residential units (public and private), representing the fourth consecutive year of decline. Also, the value of private non-

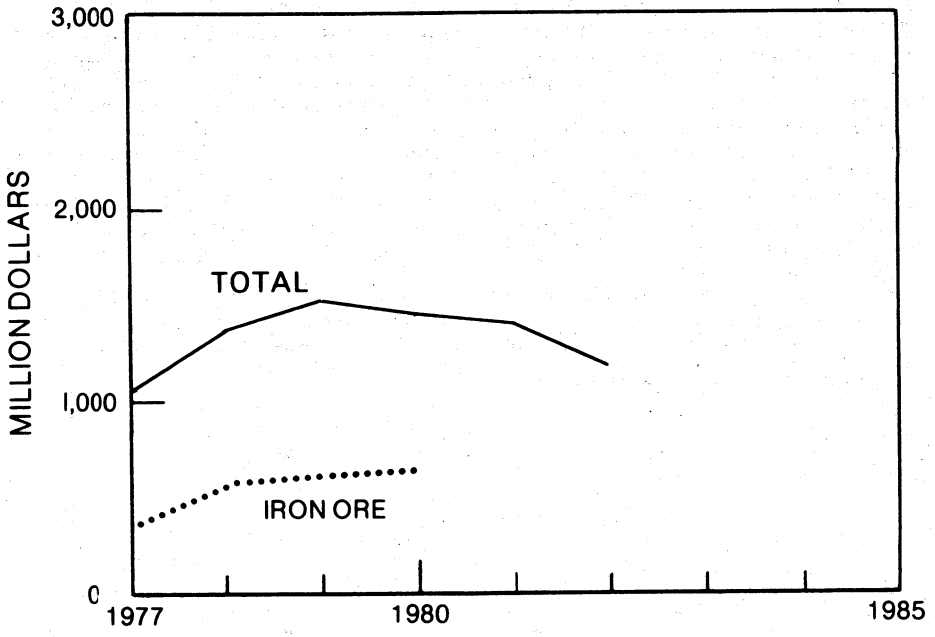

Figure 1.—Value of iron ore and total value of nonfuel mineral production in Michigan.

residential construction dropped 6% below 1981 figures, reflecting a decline for the third consecutive year. This, in turn, reduced demand for mineral commodities used in construction, such as sand and gravel, stone, cement, lime, gypsum, and clays.

Michigan's average annual rate of unemployment in 1982 was 15.5%, compared with 12.3% in 1981. The Nation averaged 9.7% in 1982, compared with 7.6% in 1981. Unemployment reached an alltime high in several areas of the State. In Marquette County, the unemployment rate was 31.4% in September, mainly because of the layoffs in the taconite industry. In Ontonagon County, the unemployment rate reached 42.7% in December because of layoffs at White Pine Copper Co. and at a local shipbuilding firm.

During the year, White Pine Copper, a division of Copper Range Co., which is a subsidiary of Louisiana Land and Exploration Co., announced several cutbacks in production at its mine and refinery complex in Ontonagon County and indefinitely suspended operations on October 1 because of depressed market conditions and high costs.

Cleveland-Cliffs Iron Co. (CCI) ceased production at the Empire and Tilden Mines in May because of high inventories and reduced demand for pellets by the steel industry. Limited operations resumed at the Tilden Mine in September, and more workers were recalled in November when several pellet lines were restarted at both the Empire and Tilden plants. The company's Republic Mine remained shut down throughout the year.

The Hanna Mining Co. announced it would permanently close its Groveland iron ore pellet operations near Iron Mountain because of depressed steel industry conditions. The operations had been shut down since January 1981.

In November, Cyrus Tang, a Chicago industrialist and owner of Tang Industries Inc., purchased the McLouth Steel Corp. mills and facilities at bankruptcy proceedings. The new firm was named McLouth Steel Products Corp.

According to figures released by the Lake Carriers' Association, shipments of basic bulk commodities on the Great Lakes declined about 27% from 1981 to 1982. Iron ore shipments in 1982 reached just over 43 million net tons, a 49% decline from the 84.1 million net tons shipped in 1981. Shipments of limestone totaled 15 million net tons, a drop of 40% from the 25 million net tons shipped in 1981 and the lowest single-season total in more than 30 years. Ship-

ments of taconite pellets through the ports of Escanaba and Marquette in the Upper Peninsula dropped from approximately 14.1 million gross tons in 1981 to 7.3 million gross tons in 1982.[2]

Exploration Activities.—Between October 1 and the end of the year, four companies reported drilling 27 exploration holes in the Upper Peninsula. Footage totaled slightly more than 6,000 feet. Records were not maintained from the beginning of the year to October. Several mining companies indicated they were waiting for the State to lease State-owned mineral rights before aggressively pursuing exploration plans. The State was expected to hold a mineral lease sale in 1983.

Legislation and Government Programs.—Several Michigan laws relating to the mineral industry were enacted during 1982. Three companion laws—Public Acts 67, 68, and 69—prohibit the Michigan Natural Resources Commission from issuing leasing and drilling permits for oil and gas in the Great Lakes or their connecting waterways unless directional drilling techniques are used that originate above and inland of the normal high water mark. The acts also strengthen the State's authority to enforce bans on drilling in Great Lakes waters by adding stronger civil and criminal penalties.

Public Act 303, the Michigan Surface and Underground Mine Reclamation Act, will regulate coal mining in the State. The act provides for the reclamation of land and controls the effects of mining. It also establishes fees, prescribes the duties of certain State agencies, and provides for fines and criminal penalties.

Public Act 327 created a Heritage Trust Fund to receive certain bonus and royalty payments from State-owned mineral interests. The law provides for the transfer of funds to the Michigan Economic Development Authority created by Public Act 70. The latter is responsible for providing aid to new business enterprises in distressed areas of the State.

Another law, Public Act 328, transferred money from the Kammer Recreational Land Trust Fund to the Economic Development Authority. The Kammer Fund, enacted in 1976, also receives funds from bonus and royalty payments for State-owned mineral interests.

The Michigan Supreme Court ruled in December that local zoning ordinances may not be used to prohibit extraction of natural resources. The court stated "Because of the important public interest in extracting and using natural resources, a more rigorous standard of reasonableness is applied when zoning would prevent the extraction of natural resources. Such zoning will not be sustained unless very serious consequences would result from the extraction; the party challenging the zoning has the burden of showing that there are valuable natural resources and that no very serious consequences would result from their extraction."[3] The ruling reversed Appeals Court decisions in cases involving gravel mining in Ada Township, Kent County, and sand mining in Brownstown Township, Wayne County.

During the year, the research division of Michigan Technological University at Houghton started a new institute for natural resource biotechnology called BioSource. The object of BioSource is to create and develop biotechnology in forestry, wood, water, and minerals for the ultimate economic benefit of Michigan. In the area of minerals, research efforts will be directed toward recovering gold and silver from low-grade ores, and copper from both low-grade ores and waste dumps. Also, research efforts will be directed toward desulfurizing coal to lessen sulfur dioxide and acid precipitation from powerplants, reducing the operating and capital cost of metal production, and recycling waste heavy-metal products from plating and steel plants to recover metal values and provide relief from dumping costs and pollution.

The Upper Great Lakes Regional Commission, abolished by Federal budget cuts during the year, was revived by the Governors of three Great Lakes States—Michigan, Minnesota, and Wisconsin—to form the Council of Upper Great Lakes Governors. The council will continue to pursue and distribute Federal grants to aid regional economic development, although it will not be directly funded by the Federal Government. The former commission, founded in 1965 to provide special aid to the 119 counties in the northern parts of the three States, had provided funds for several studies concerning the mining industry.

In January, the State Natural Resources Commission unanimously endorsed a new metallic mining lease form that provided the first changes in 55 years for regulating metal mining on State land. The lease form, under development since 1976, was designed by a special Metallic Minerals Task

Force composed of Michigan Department of Natural Resources (DNR) staff, industry representatives, and environmentalists. Major changes in leasing procedures included increasing land rental fees along with royalty fees that would vary for different minerals and market conditions. Mining companies must file annual exploration and reclamation plans with the State. The State's first lease sale was expected in 1983.

The Geological Survey Div. of DNR continued to provide information on Michigan's geology and mineral resources. State budget restrictions hampered some of the Survey's programs for the second consecutive year. The Reclamation and Mining Control Unit suspended field surveillance of mine reclamation and State-owned mineral pits programs. The federally funded Coal Management Program of the unit began preparing a State reclamation plan and developing plans for three abandoned coal mine reclamation projects. Personnel also helped in developing the State's Surface and Underground Mine Reclamation Act, which was passed during the year.

The Federal Government returned approximately $891,800 to the State in fiscal year 1982 for its share of funds generated by activities on national forest lands (timbering, minerals leasing, user fees, etc.). This compares with $808,000 the State received in fiscal year 1981.

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 totaled approximately $297,800 for the year.

The Mining and Mineral Resources and Research Institute at the Michigan Technological University in Houghton, which was created under title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives, Manufactured.—Metallic abrasives were manufactured by three companies in Michigan in 1982. Ervin Industries Inc., Lenawee County; Metal Tec Steel Abrasives Co., Wayne County; and Abrasive Materials Inc., Hillsdale County, sold steel shot and grit. The latter firm also produced cut wire shot. Sales of these commodities were down compared with those of 1981.

Bromine.—Michigan and Arkansas were the only States in which bromine was produced in 1982. Dow Chemical Co. produced bromine from brine wells in Mason and Midland Counties and Morton Chemical Co. from brine wells located in Manistee County. Production and value remained about the same as those of 1981. Bromine is used in the manufacture of flame retardants, agricultural chemicals, well-drilling and completion fluids, and other chemicals.

Calcium Chloride.—Michigan and California were the only States in which natural calcium chloride was produced in 1982, with Michigan accounting for most of the national production. Dow Chemical produced calcium chloride from brine wells in Mason and Midland Counties. Wilkinson Chemical Corp. produced from brine wells in Lapeer County. Calcium chloride is used for deicing, dust control, in various industrial applications, and in oil and gas drilling. Production was estimated to be slightly lower than that of 1981.

Cement.—Michigan continued to rank fourth nationally in 1982 in shipments of portland cement and seventh in shipments of masonry cement. Six plants were active during 1982. Two of these plants—the Aetna Cement Corp. plant near Essexville and the Wyandotte Cement Inc. plant near Wyandotte—were operated as grinding facilities using imported clinker. Shipments of cement, both portland and masonry, declined for the fourth consecutive year. All companies operating kilns reported some downtime because of high inventories and poor market conditions that resulted in several companies laying off personnel.

Table 4.—Michigan: Portland cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	6	6
Production	3,931,294	3,293,026
Shipments from mills:		
Quantity	3,871,319	3,254,113
Value	$180,641,283	$149,532,656
Stocks at mills, Dec. 31	356,362	325,719

Table 5.—Michigan: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	4	4
Production	181,087	140,101
Shipments from mills:		
Quantity	172,973	135,706
Value	$10,583,633	$8,752,370
Stocks at mills, Dec. 31	72,136	43,750

Cement was distributed mainly by lake vessel and barge to terminals from which it was shipped to consumers, primarily by truck. Most sales of cement were to ready-mix concrete companies, followed by concrete product manufacturers, building material dealers, and highway contractors.

Early in the year, National Gypsum Co. announced that it planned to retain its cement division after reevaluation of the operations. The company considered selling the division the previous year.

Clays.—Michigan ranked sixth among the States in the production of common clay and shale in 1982. Production and value decreased for the fourth consecutive year. Seven companies, each operating one mine, produced common clay or shale in six counties. Most of Michigan's clay production was for cement manufacture. Other uses were for the manufacture of face brick, pottery, drain tile, sewer pipe, and flue linings.

Gem Stones.—Mineral specimens and semiprecious gem stones were collected by mineral dealers and rock hounds. Estimated value in Michigan in 1982 totaled $15,000.

Gypsum.—Michigan ranked sixth nationally in the production of crude gypsum in 1982, after having ranked fifth in 1981. For the fourth consecutive year, output declined in the State. Four companies mined gypsum in two counties. National Gypsum, United States Gypsum Co., and Michigan Gypsum Co. mined in Iosco County; Georgia-Pacific Corp. produced in Kent County. One company in Kent County—Domtar Construction Materials Div. of Domtar Inc., Montreal, Canada—remained dormant throughout the year. The firm had purchased the Grand Rapids Gypsum Co. operations in 1981.

Michigan ranked 16th among the States in calcined gypsum production. Three companies—National Gypsum, Georgia-Pacific, and United States Gypsum—had plants in Iosco, Kent, and Wayne Counties, respectively. Gypsum is used in the manufacture of wallboard, cement, building plaster, and for agricultural purposes.

Iodine.—Only two States—Michigan and Oklahoma—had iodine production in 1982. Dow Chemical recovered iodine from subsurface brines at its operations in Midland County. Iodine is used in animal feed additives, catalysts, pharmaceuticals, disinfectants, stabilizers, and inks and colorants.

Iron and Steel Slag.—Nationally, Michigan ranked fourth in sales of processed iron and steel slag in 1982. Output was down compared with that of 1981 because of the depressed construction industry. Only one company, Edward C. Levy Co. in Wayne County, processed slag obtained from Rouge Steel Co., a subsidiary of Ford Motor Co.; from the Great Lakes Steel Div. of National Steel Corp.; and from McLouth. Processed slag is used for road base material, concrete aggregate, railroad ballast, fill, and in concrete products.

Lime.—Michigan ranked 10th nationally in lime production in 1982. For the past 6 years, lime output in the State has declined steadily. Five companies produced lime at nine plants located in seven counties. All companies produced quicklime; one company, Marblehead Lime Co., also produced hydrated lime. Lime was used in steelmaking, alkalies, sugar refining, water treatment, sewage treatment, and paper and pulp manufacture.

Magnesium Compounds.—Michigan is the Nation's leader in the production of magnesium compounds. Output and value dropped from 1981 to 1982. Dow Chemical produced magnesium compounds from well brines in Ludington and Midland; Martin Marietta Chemicals and Morton Chemical produced in Manistee. Magnesium compounds are used mainly in the production of high-temperature, basic refractories. Other uses are in animal feeds, fertilizers, construction materials, electrical heating rods, fluxes, petroleum additives, and rayon.

In July, Dow Chemical began reclaiming lime dust at its Ludington operation for use as agricultural lime. The waste material is generated during the manufacture of magnesium-hydrate for refractory products and piped to storage ponds to dry. The firm also is evaluating new technology on a plant scale for utilizing the lime dust in the manufacture of magnesium-hydrate. Current plans are to recover the material for both agricultural lime and as raw material for the magnesium-hydrate process. This

will eliminate the company's need to use or construct additional storage ponds.

Peat.—Michigan continued to lead the Nation in sales of peat, with production and value increasing slightly from 1981 to 1982. Peat was mined by 13 companies at operations in 11 counties. Lapeer, Sanilac, and Shiawassee Counties accounted for most of the State's production. Most of the peat produced in Michigan was sold in packaged form for soil improvement and as potting soil.

Two new companies began developing peat properties during the year, with production scheduled for 1983. Black Forest Ranch Peat Moss Co. Inc. began developing a deposit in Cheboygan County, and Milburn Peat Co. Inc. started development in St. Joseph County.

Perlite (Expanded).—Two companies expanded perlite shipped in from other States. Harborlite Corp. operated a plant in Vicksburg and United States Gypsum, a plant in Detroit. Sales almost doubled from 1981 to 1982. Most of the perlite was used as a filter aid and lesser amounts were used as plaster aggregate and for other miscellaneous purposes.

Salt.—Nationally, Michigan ranked fifth in sales of salt. After reaching 4.2 million tons in 1976, sales have declined every year, dropping to 2 million tons in 1982. A part of the slump can be attributed to the relatively mild winters in recent years and lesser quantities of salt used for deicing. Salt was produced by seven companies at operations in five counties. Six companies produced salt from well brines; one company mined salt by underground methods. Salt is used in food and chemical processing, as table salt, and for ice control.

Diamond Crystal Salt Co. signed an agreement with Consumers Power Co., a Michigan utility, to form underground caverns for gas storage. In return, Diamond Crystal will receive the brine formed through the cavernmaking process for use as feedstock in its evaporative salt production.

To offset slumping sales, International Salt Co. Inc. opened its Detroit Mine at Melvindale to public tours during the year. Most of the mine output is used for deicing, and salt sales had dropped owing to the recent mild winters. Three tours were held during the year, attracting 1,080 people. Because of the public interest, the tours were scheduled to continue in 1983.

Morton-Norwich Products Inc. merged with Thiokol Corp., a defense contractor specializing in high-technology propulsion systems for missile and space vehicles and a manufacturer of specialty chemicals. The new company is called Morton Thiokol Inc. The salt division of Morton-Norwich has operations in Manistee and St. Clair Counties that produce salt from well brines.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. Nationally, Michigan ranked sixth in the production of sand and gravel for construction purposes. Sand and gravel was extracted in 76 of the State's 83 counties by 201 companies and government agencies. Oakland County led in production, followed by Washtenaw, Livingston, and Kent Counties. Most of the construction sand and gravel was transported to the site of use by truck.

At midyear, Medusa Aggregates Co., a division of Medusa Corp., sold its Michigan sand and gravel plants to Edward C. Levy Co.[4]

Table 6.—Michigan: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	6,596	$14,016	$2.12
Gravel	NA	NA	NA	11,698	30,491	2.61
Sand and gravel (unprocessed)	NA	NA	NA	2,272	3,219	1.42
Total[1] or average	e28,100	e$68,050	e$2.42	20,567	47,726	2.32
Industrial sand	4,393	29,787	6.78	2,920	21,934	7.51
Grand total[1] or average	e32,493	e97,837	e3.01	23,486	69,659	2.97

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Table 7.—Michigan: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	5,540	$15,254	$2.75
Plaster and gunite sands	157	578	3.69
Concrete products	821	2,285	2.78
Asphaltic concrete	3,068	6,499	2.12
Road base and coverings	7,949	18,448	2.32
Fill	2,302	3,136	1.36
Snow and ice control	420	641	1.52
Railroad ballast	16	47	2.89
Other	293	839	2.86
Total[1] or average	20,567	47,726	2.32

[1]Data may not add to totals shown because of independent rounding.

Industrial.—Michigan continued to rank second behind Illinois in industrial sand output. Sand was produced in 12 counties by 11 companies. Both output and value declined compared with those of 1981 because of the depressed economy. Average value per ton increased approximately 11% over that reported in 1981. Major sales were for foundry applications, fiberglass manufacture, and glassmaking (containers and flat glass).

During the year, two companies received permits from DNR to mine industrial sand in dune areas. Construction Aggregates Corp. received a permit to expand its operations near Ferrysburg, although there were some local objections to the mining plan. Standard Sand Corp. also received a permit to expand its mining operations near Grand Haven. The issuance in 1981 of a DNR mining permit to Martin Marietta Aggregates for a site near Bridgman was appealed to the circuit court, and a final settlement of the litigation was expected in 1983.

Stone.—To reduce reporting burdens and costs, the U. S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be finalized the following year.

Crushed.—During the year, United States Steel Corp. appointed Ontario Stone Corp. of Cleveland, Ohio, as a distributor of limestone products from its Cedarville and Rogers City quarries to construction customers in the Lake Erie market area. United States Steel continued to supply on a direct basis metallurgical- and chemical-grade limestone and agricultural limestone products to customers in the Great Lakes area.[5]

Sulfur (Elemental).—Elemental sulfur continued to be recovered as a byproduct at three refineries during the year. Most was used in the manufacture of sulfuric acid. Marathon Oil Corp. recovered sulfur in Detroit; Total Petroleum Inc. in Alma; and Shell Oil Co. in Manistee.

Vermiculite (Exfoliated).—W. R. Grace & Co. continued to exfoliate vermiculite shipped in from other States at its plant in Dearborn, Wayne County. Sales were down for the year owing to the depressed economy. Major sales were for loose fill insulation, fireproofing, block insulation, and agricultural purposes.

METALS

Copper and Silver.—White Pine Copper continued to be Michigan's only producer of copper and byproduct silver at its mine, smelter, and refinery complex in Ontonagon County. Low copper prices, depressed markets, and high mining costs forced the company to reduce production several times during the year, and output dropped about 47% below 1981 levels.

In March, the company reduced its work schedule and laid off 125 employees; remaining workers were placed on a 4-day workweek. In June, another cutback put about 140 employees on layoff status and the remaining workers on a 3-day week. Effective October 1, the mine, mill, and smelter operations were suspended indefinitely, placing about 700 more employees on layoff. During this time, the firm also lost

one of its largest customers to a foreign copper producer.

By October, work on the new White Pine electrolytic refinery, under construction since 1981, was essentially completed. After work trials, it was placed in limited production using copper materials on hand. Later in the year, White Pine announced it would begin to import high-grade scrap to process in the refinery.

Iron Ore.—Michigan ranked second behind Minnesota in iron ore shipments in 1982. Shipments decreased about 45% from those of 1981 as the continued lack of demand for steel affected all taconite producers.

The Empire Mine, operated by CCI, was closed from January 1 to 11 and from May 1 until late November. The Tilden Mine was closed from May 15 until September 19. The Republic Mine remained closed throughout the year, although some taconite pellets were shipped from stockpile. Unemployment in Marquette County reached alltime highs during the summer with about 4,000 miners on layoff.

Hanna permanently closed its Groveland Mine and plant in Dickinson County at yearend. The mine and plant had been shut down since January 1981. Pellets from the plant, which had a capacity of 2 million tons per year, were sold on the open market. Hanna had tried to find partners to take some of the plant's production, but owing to depressed industry conditions was forced to close the facility permanently. During the year, some taconite pellets were shipped from a stockpile at the Groveland site.

In June, CCI acquired International Harvester's 15% interest in the Empire Iron Mining Partnership by assuming the latter's long-term debt. In a separate transaction, CCI acquired McLouth Steel's 25% interest in Empire at a bankruptcy auction by assuming McLouth's share of long-term debt in the partnership. These actions increased CCI's interest in the partnership to 60%, with the remaining interest owned by Inland Steel Co. CCI intended to find new steel company partners to take a share of the Empire production.

In a related action, Jones & Laughlin Steel Corp. (J&L) acquired International Harvester's 10% interest in the Marquette Iron Mining Partnership, which includes the Republic Mine. J&L now owns 56.5% of the Republic facility, which has a capacity of about 2.7 million tons of pellets per year. The remaining partners in the mining and pelletizing operation are Wheeling-Pittsburgh Corp. and CCI.

Table 8.—Michigan: Usable iron ore[1] produced (direct shipping and all forms of concentrates), by range

(Thousand long tons)

Year	Marquette Range	Menominee Range (Michigan part)	Gogebic Range (Michigan part)	Total		
				Gross weight		
				Ore	Iron content	Iron content (percent)
1854-1977	463,584	309,875	249,625	1,023,084	NA	NA
1978	W	W	--	16,752	10,652	63.6
1979	W	W	--	17,132	10,933	63.8
1980	W	W	--	16,421	10,482	63.8
1981	W	W	--	15,583	10,020	64.3
1982	W	W	--	6,874	4,426	64.4
Total	529,990	[2]316,232	[2]249,625	1,095,846	NA	NA

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Exclusive after 1905 of iron ore containing 5% or more manganese.
[2]Distribution by range partly estimated before 1906.

Iron Oxide Pigments.—Michigan continued to rank first nationally in shipments of crude iron oxide pigments. All shipments originated from a stockpile at the CCI Mather Mine in Marquette County, which closed in 1979. BASF Wyandotte Corp. was the State's only manufacturer of finished iron oxide pigments at a plant in Wyandotte, Wayne County. Pigments were used in paint and other coatings.

Pig Iron and Steel.—Michigan continued to rank fourth among the States in shipments of pig iron although the level of shipments dropped 28% from 1981 to 1982. All steel mills in the State operated below capacity and were forced to lay off personnel to reduce overhead costs and inventories.

During the year, McLouth Steel, which filed for bankruptcy late in 1981, was purchased by Cyrus Tang, a Chicago industrialist who owns Tang Industries and several other metal firms. The purchase saved the jobs of more than 2,000 McLouth employees.

Rouge Steel began talks with Japanese companies interested in purchasing the firm. No agreements were reached by year-end.

In June, Great Lakes Steel, a division of National Steel, was fined $3 million by the U.S. Department of Justice for violations of the Clean Air Act and a 1981 consent decree governing air pollution at its Ecorse plant. The fine is one of the largest imposed for pollution in Michigan.

[1]State Liaison Officer, Bureau of Mines, Minneapolis, Minn.
[2]Skillings' Mining Review. V. 72, No. 5, Jan. 29, 1983, p. 10.
[3]Michigan Supreme Court Reporter of Decisions. Syllabus of *Silva* v. *Ada Township* and *Ottawa Silica Co.* v. *Brownstown Township*. Docket Nos. 65815 and 66201. Decided Dec. 23, 1982.
[4]Rock Products. V. 86, No. 2, February 1983, p. 15.
[5]Pit and Quarry. June 1982, p. 18.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Dundee Cement Co.[1 2]	Box 122 Dundee, MI 48131	Quarry and plant	Monroe.
Medusa Cement Co., Medusa Corp., a subsidiary of Crane Co. [1 2]	Box 5668 Cleveland, OH 44101	do	Charlevoix.
National Gypsum Co., Cement Div.[1 2]	4000 Town Center, Suite 2000 Southfield, MI 48075	do Pit	Alpena. Antrim.
Peerless Cement Co., Gifford-Hill & Co. Inc.[1]	9333 Dearborn St. Detroit, MI 48209	Pit and plant	Wayne.
Clay and shale:			
Michigan Brick Inc	3820 Serr Rd. Corunna, MI 48817	do	Shiawassee.
Copper:			
White Pine Copper Co., a division of Copper Range Co.[3]	Box 427 White Pine, MI 49971	Underground mine and plant.	Ontonagon.
Gypsum:			
Georgia-Pacific Corp	133 Peachtree St., NE. Atlanta, GA 30306	do	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.[4]	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:			
Ford Motor Co	American Rd. Dearborn, MI 48121	Plant	Wayne.
McLouth Steel Corp	300 South Livernois Ave. Detroit, MI 48209	do	Do.
National Steel Corp	2800 Grant Bldg. Pittsburgh, PA 15219	do	Do.
Lime:			
Detroit Lime Co., a subsidiary of Edward C. Levy Co.	9300 Dix Ave. Dearborn, MI 48120	do	Do.
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	do	Wayne.
Natural salines:[5]			
Dow Chemical Co	2020 Dow Center Midland, MI 48640	Brine wells and plant	Mason and Midland.
Martin Marietta Chemicals, Refractories Div.	Executive Plaza II Hunt Valley, MD 21030	do	Manistee.
Morton Chemical Co	110 North Wacker Dr. Chicago, IL 60606	do	Do.
Peat:			
Al-Par Peat Co	9551 Krouse Ovid, MI 48866	Bog and plant	Shiawassee.
Anderson Peat Co	Box 575 Perry, MI 48872	do	Lapeer and Shiawassee.
Michigan Peat Inc	Box 66388 Houston, TX 77006	Bogs and plants	Sanilac.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Salt:			
Diamond Crystal Salt Co	916 South Riverside St. Clair, MI 48079	Brine wells and plant	St. Clair.
International Salt Co. Inc	12841 Saunders St. Detroit, MI 48217	Underground mine	Wayne.
Morton Norwich Products Inc., a division of Morton Salt Co.	110 North Wacker Dr. Chicago, IL 60606	Brine wells and plants	Manistee and St. Clair.
Sand and gravel (construction):			
American Aggregates Corp	Drawer 160 Greenville, OH 45331	Surface 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	Surface pit and plant.	Oakland.
Bill Smith Sand & Gravel Inc	Box 23 Otsego, MI 49078	Surface pits and plants	Allegan, Barry, Huron, Kalamazoo, Kent, Van Buren.
Whittaker & Gooding Co	5800 Cherry Hill Rd. Ypsilanti, MI 48197	____do	Lapeer and Washtenaw.
Sand (industrial):			
Nugent Sand Co. Inc	Box 1209 Muskegon, MI 49433	Surface pits and plant	Muskegon.
Ottawa Silica Co., Michigan Silica Div.	Box 100 Rockwood, MI 48173	Surface pit and plant	Wayne.
Sand Products Corp	2489 1st National Bldg. Detroit, MI 48226	Surface pits and plants	Oceana.
Sargent Sand Co	2840 Bay Rd. Saginaw, MI 48608	____do	Bay, Mason, Saginaw, Wexford.
Slag:			
Edward C. Levy Co	8800 Dix Ave. Detroit, MI 48209	Plant	Wayne.
Stone (1981):			
Limestone:			
Drummond Dolomite Inc., a division of Bethlehem Steel Corp.	Martin Tower Bethlehem, PA 18016	Quarry and plant	Chippewa.
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.
United States Steel Corp., Michigan Limestone Operations.	Rogers City, MI 49779	Quarries and plants	Mackinac and Presque Isle.
Marl:			
Kevin D. Brenner	Route 1 Hopkins, MI 49328	Quarry	Allegan.
Sandstone:			
Jude Stone Quarry Co	338 Austin Rd. Napoleon, MI 49261	____do	Jackson.

[1]Also clays and shale.
[2]Also stone.
[3]Also silver.
[4]Also iron oxide pigments.
[5]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]

The value of nonfuel mineral production in Minnesota during 1982 was $1,110.1 million, a 48% decrease from that of 1981, the lowest level since 1977. The decrease was attributed principally to the significant drop in taconite pellet production, coupled with slightly lower values for four of the other nine mineral commodities produced, compared with 1981 levels.

Minnesota ranked fifth among the States in the value of nonfuel mineral production, accounting for 6% of the U.S. total. The State led the Nation in iron ore output.

Iron ore, the leading commodity produced in the State in terms of value, accounted for approximately 92% of the State total, followed by construction sand and gravel, 4%; crushed and dimension stone, 3%; and clays, gem stones, lime, manganiferous ore, peat, and industrial sand, the remainder.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	84	$1,077	W	W
Gem stones	NA	5	NA	$5
Iron ore (usable) thousand long tons, gross weight	50,176	2,062,118	23,715	1,021,056
Lime thousand short tons	155	3,818	133	4,694
Manganiferous ore short tons	139,571	W	16,307	W
Peat thousand short tons	25	940	W	W
Sand and gravel:				
Construction do	e23,950	e49,770	20,276	44,222
Industrial do	W	W	694	5,903
Stone:				
Crushed do	6,995	18,438	p7,100	p20,900
Dimension do	41	14,298	p40	p11,940
Combined value of items indicated by symbol W	XX	r4,297	XX	1,406
Total	XX	r2,154,761	XX	1,110,126

eEstimated. pPreliminary. 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 Minnesota, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Aitkin	$39	$127	Peat.
Anoka	W	(3)	
Becker	143	(3)	
Beltrami	135	(3)	
Benton	W	(3)	
Big Stone	2,850	1,513	Stone (crushed), stone (dimension).
Blue Earth	2,420	1,572	Do.
Brown	W	W	Clays.
Carlton	W	W	Peat.
Carver	W	(3)	
Cass	751	(3)	
Chippewa	172	(3)	
Chisago	336	(3)	
Clay	3,095	636	Lime.
Clearwater	W	(3)	
Cook	47	(3)	
Cottonwood	399	(3)	
Crow Wing	W	W	Manganiferous ore.
Dakota	6,813	W	Stone (crushed).
Dodge	737	W	Do.
Douglas	413	(3)	
Faribault	W	(3)	
Fillmore	W	1,085	Stone (crushed).
Freeborn	625	(3)	
Goodhue	721	246	Stone (crushed).
Grant	W	(3)	
Hennepin	W	W	Clays, stone (crushed).
Houston	1,223	797	Stone (crushed).
Hubbard	333	(3)	
Itasca	109,263	152,964	Iron ore.
Jackson	W	(3)	
Kanabec	117	(3)	
Kandiyohi	W	(3)	
Kittson	W	(3)	
Koochiching	346	(3)	
Lac qui Parle	W	(3)	
Lake	W	(3)	
Le Sueur	W	W	Sand (industrial), stone (dimension), stone (crushed).
Lyon	W	(3)	
McLeod	W	(3)	
Mahnomen	208	(3)	
Marshall	255	(3)	
Meeker	255	(3)	
Mille Lacs	649	283	Stone (dimension).
Morrison	278	(3)	
Mower	234	269	Stone (crushed).
Murray	68	(3)	
Nicollet	994	W	Stone (crushed).
Nobles	W	(3)	
Norman	244	(3)	
Olmsted	2,159	1,200	Stone (crushed).
Otter Tail	460	20	Peat.
Pennington	79	(3)	
Pine	W	(3)	
Polk	2,384	1,676	Lime.
Pope	216	(3)	
Ramsey	W	(3)	
Redwood	187	W	Stone (dimension).
Renville	W	2,570	Lime, stone (dimension).
Rice	619	(3)	
Rock	W	36	Stone (dimension).
Roseau	70	(3)	
St. Louis	W	W	Iron ore, stone (crushed), peat.
Scott	W	3,636	Stone (crushed).
Sherburne	2,440	(3)	
Sibley	W	(3)	
Stearns	W	W	Stone (dimension), stone (crushed).
Steele	W	W	Stone (crushed).
Stevens	W	(3)	
Swift	115	(3)	
Todd	517	(3)	
Wabasha	741	244	Stone (crushed).
Wadena	99	(3)	

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Waseca	W	(3)	
Washington	$7,564	W	Stone (crushed), sand (industrial).
Watonwan	105	(3)	
Wilkin	W	(3)	
Winona	2,182	$1,525	Stone (dimension), stone (crushed).
Wright	622	W	Stone (crushed).
Yellow Medicine	1,723	1,354	Do.
Undistributed[4]	r1,625,564	1,933,233	
Sand and gravel (construction)	XX	e49,770	
Total[5]	r1,782,010	2,154,761	

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

[1]Isanti, Lake of the Woods, Lincoln, Martin, Pipestone, Red Lake, and Traverse Counties are not listed because no nonfuel mineral production was reported.

[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, sand and gravel that cannot be assigned to specific counties (1980), and values indicated by symbol W.

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

Table 3.—Indicators of Minnesota business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,153.0	2,166.0	+0.6
Unemployment	do	119.0	169.0	+42.0
Employment (nonagricultural):				
Mining	do	15.6	9.5	-39.1
Manufacturing	do	364.0	346.3	-4.9
Contract construction	do	67.7	59.7	-11.8
Transportation and public utilities	do	98.8	94.9	-4.0
Wholesale and retail trade	do	439.9	430.9	-2.0
Finance, insurance, real estate	do	97.8	98.2	+.4
Services	do	379.9	380.6	+.2
Government	do	299.0	288.8	-3.4
Total nonagricultural employment	do	1,762.7	[1]1,708.7	-3.1
Personal income:				
Total	millions	$44,060	$45,802	+4.0
Per capita		$10,762	$11,082	+3.0
Construction activity:				
Number of private and public residential units authorized		17,413	17,699	+1.6
Value of nonresidential construction	millions	$651.3	$736.3	+13.1
Value of State road contract awards	do	$125.0	$216.0	+72.8
Shipments of portland and masonry cement to and within the State	thousand short tons	1,276	1,145	-10.3
Nonfuel mineral production value:				
Total crude mineral value	millions	$2,154.8	$1,110.1	-48.5
Value per capita, resident population		$528	$269	-49.1
Value per square mile		$25,597	$13,205	-48.4

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.

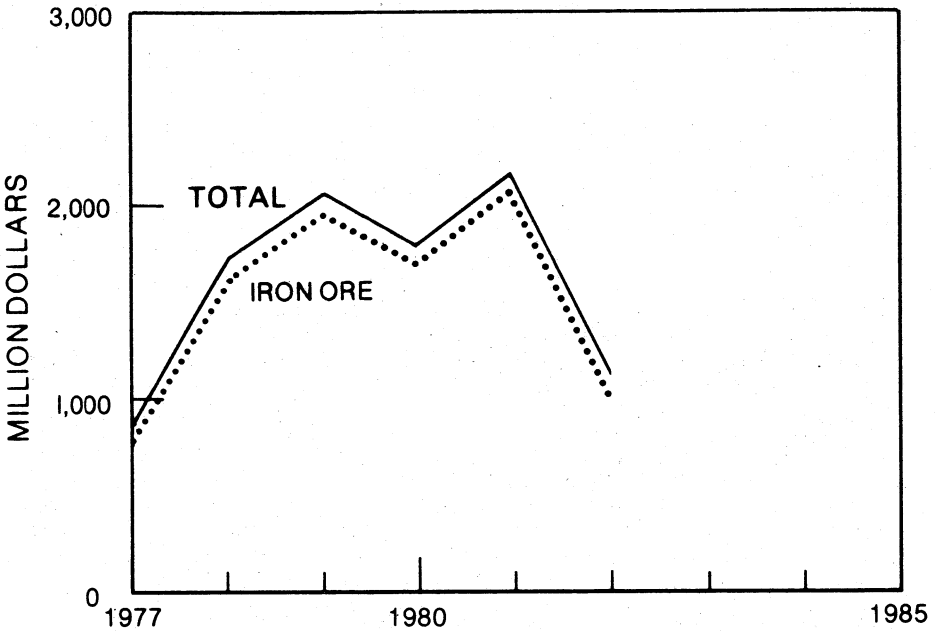

Figure 1.—Value of iron ore shipments and total value of nonfuel mineral production in Minnesota.

On the Mesabi Range, closures, production cutbacks, or maintenance shutdowns at all taconite pellet-production facilities resulted in layoffs for nearly 11,000 of the industry's 14,000-person work force for at least part of 1982. Taconite-pellet production for the year averaged approximately 37% of the annual production capacity of the State's eight plants. Shipments of usable iron ore in 1982 dropped to the lowest level since 1938.

AMAX Exploration Inc., of Greenwich, Conn., discontinued developing its Minnamax copper and nickel project near Babbitt in northeastern Minnesota. The company canceled its lease agreement with Bear Creek Mining Co., a subsidiary of Kennecott Minerals Co., which owns mining leases for 6,000 acres that include the Minnamax project site near Babbitt. AMAX, which has spent approximately $21 million since 1974 on the project, indicated its pullout was due primarily to the sagging economy, faltering copper and nickel prices, and the marginal-to low-grade of the ore.

No cement has been manufactured in the State since the closure of the Duluth plant of Universal Atlas Cement Div., United States Steel Corp., in 1975. In 1982, St. Lawrence Cement Inc. completed a $18 million cement distribution center at the Port of Duluth. Site preparation for the 43,000-ton-capacity silo complex was begun in September 1980, and the first cement shipments were received from the company's plant at Mississauga, Ontario, in May 1982. Cement from the facility will be shipped throughout the Upper Midwest and into northwestern Ontario by truck and rail.

Exploration drilling conducted in the search for minerals during the year involved sites in a 12-county area. According to data the Minnesota Department of Natural Resources, Minerals Division, prepared, 2 companies registered for the first time in 1982, and 16 others renewed their registrations for exploratory boring in the State. Permits were granted to 10 companies to conduct drilling at 109 proposed drill sites. Fifty-three test borings were completed during the year.

Employment.—During most of 1982, employment in the mining and quarrying industry fluctuated widely on a monthly basis. These variances in monthly employment reflected the significant effects of closures, cutbacks, and restarts of the taconite pellet-production facilities on the Mesabi Range. Statistics developed and publish-

ed by the Minnesota Department of Economic Security cited that employment in the State's mining and quarrying industry ranged from a high of 13,700 in February to a low of 5,700 in August. At yearend, employment was 6,200, approximately a 58% decline from the corresponding period in 1981.

During 1982, those employed in the metal mining sector represented, on the average, approximately 65% of the total mining and quarrying employed work force. At yearend, the average hourly earnings of the mining and quarrying work force was $13.27; those in the metal-mining sector received the highest hourly rate, averaging $14.69, an 8% increase over that received at yearend 1981.

Legislation and Government Programs.—The Minnesota Legislature enacted a tax that is to become effective in January 1983 on natural aggregate material produced in the State. The aggregate material, which will be subject to a tax of 10 cents per cubic yard or 7 cents per ton of material removed, includes sand and gravel and crushed stone but excludes dimension stone. Responsible for administering the law, the county boards in the aggregate-producing counties will receive the tax proceeds. Distribution of the "aggregate tax" fund will be 60% to the county road and bridge fund, 30% to towns and cities as determined by the county board, and 10% to a special reserve fund for reclaiming abandoned pits on public or tax-forfeited land.

In a 1-day special session, the State legislature approved an emergency jobs and long-range economic development program for the Mesabi Range area, where high unemployment followed the cutbacks in taconite production. The bill provided $2.5 million immediately for temporary public service jobs for unemployed "Iron Rangers" who have no source of income. Another $5 million would be made available if more jobs are needed. In addition, the legislature provided $8.7 million to help establish new and diversified industries for this depressed area.

The Minnesota Department of Revenue, Minerals Tax Division, published a document titled "Minnesota Mining Tax Guide." The tax guide is intended to serve as a quick reference to Minnesota's mining tax structure as it existed at yearend 1982. The guidebook, available from the agency, explains the following State mining taxes: ad valorem tax on unmined natural iron ore; occupation tax on taconite, semitaconite, and iron ore; taconite production tax; gross-earnings tax on taconite railroads; royalty taxes; tax on unmined taconite; sales and use tax; tax on severed mineral interests; and taxes on copper-nickel mining.

Minnesota's Department of Natural Resources (DNR) held a copper-nickel exploration lease-sale offering on approximately 1 million acres of State and county lands in a seven-county area in the northern part of the State. The lease sale was the first offering by Minnesota since 1973 when a moratorium was placed on leasing State lands for copper-nickel exploration. The lease sale resulted in awarding exploration leases to 12 firms on 387 mining units totaling approximately 180,000 acres. The lands cover portions of the Greenstone Formation that, DNR indicated, has significant potential for discovery of mineral resources on the basis of recently developed geologic data. Action was delayed on leasing an additional 32 units in St. Louis County near the environmentally sensitive Boundary Waters Canoe Area, pending a decision by the Minnesota Executive Council.

The Minnesota Geological Survey was involved in several projects to provide a better understanding of the State's underlying geology and associated mineral and water resources. Included among these projects, in progress or completed during the year, were (1) a Quaternary geologic map of the State; (2) isopach, facies, and structure contour maps of Paleozoic formations in southeastern Minnesota; (3) stratigraphic columns for the western Great Lakes region; (4) a bedrock geologic map of the Lake Superior region; (5) lineament maps of the Hibbing and International Falls areas; (6) bedrock geology map of the Two Harbors area; and (7) a simple Bouguer gravity map of the St. Paul and Cedar Mountain Complex areas.

Minnesota's Department of Energy, Planning and Development (DEPD) initiated a program of test burning peat to determine its potential as an energy resource for use as a boiler fuel in conventional coal-fired boilers. The test burns were conducted at the public utility plant of Virginia, Minn., in the plant's 60,000-pound-per-hour coal-fired boiler. The peat used in the tests was in the form of pellets supplied by a local manufacturer. Minnesota has vast resources of peat, estimated to cover more than 6 million acres. The DEPD indicated that the use of this resource, if a workable energy-producing source, would greatly benefit the State by reducing its total dependence on fuel minerals currently obtained

from out-of-State sources.

The relevance of the State's mineral industry and the need for the wise nurturing of that industry was set forth in an Executive Order issued by the Governor of Minnesota, which read in part, "The responsible departments and agencies of the State of Minnesota are directed to recognize the importance of mining to Minnesota, the tremendous potential for future mineral development, and the impact of their programs on mining; and further, these responsible departments and agencies are directed to encourage the development of mining in this state, with due concern for the effects of mining on the environment."[2]

The Federal Bureau of Mines Twin Cities Research Center in Minneapolis pursued many and varied research programs relating to mineral resources and mining in the State, including a cooperative effort with the U.S. Department of Energy and 20 private firms on gasification of coal, subbituminous coal, and lignite, and on use of the gas for induration of taconite pellets; beneficiation of oxidized taconite from the Mesabi Range by wet high-intensity magnetic separation and flotation; direct reduction of pellets utilizing solid fuels; reclamation of process water; vegetation studies for reclaiming taconite tailings areas; and nonfreezing dust suppressants for winter shipment of pellets. Published reports included findings on the use of low-British thermal unit (Btu) gas processed from a lignite source in pelletizing iron ore[3] and the separation of copper-nickel mattes from the Duluth Gabbro concentrates by flotation and magnetic methods.[4]

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Iron Ore.—Heading the Nation in iron ore production during 1982, Minnesota accounted for 66% of the total usable iron ore shipped from all domestic mines during the year. State shipments, at their lowest levels in more than four decades, came from both stockpiled and newly mined ore sources at 18 open pit mines or groups that 9 companies operated on the Mesabi Range in Itasca and St. Louis Counties.

A continuing sluggish national economy, adversely affecting the demand for iron and steel, caused a 53% decline in the State's iron ore production from that of 1981. Widespread layoffs of iron ore production workers were commonplace owing to the combination of closures, cutbacks, and reduced work schedules at all taconite-production operations; major cutbacks also resulted in the ore-transportation sectors. The duration of shutdowns at each pellet production facility in 1982 varied widely: Eveleth Taconite Co., 1 week; Hibbing Taconite Co., 3 months; Inland Steel Mining Co., 4 months; Reserve Mining Co. and Erie Mining Co., 6 months; Butler Taconite Co. and United States Steel, 7 months; and National Steel Pellet Co., 8 months. Preliminary figures the Lake Superior Industrial Bureau released indicated that wages paid to the State's iron ore workers totaled $242 million, a decrease of approximately 42% from those paid in 1981. Correspondingly, monies the industry reportedly paid for goods and services totaled $462 million, a drop of 48% from that of 1981.

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)
1978	5,829	49,487	55,316	62.4	5,445	51,029	[2]56,473	90.3
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

[1]Exclusive of ore containing 5% or more manganese.
[2]Data do not add to total shown because of independent rounding.

Jones & Laughlin Steel Corp. (J&L) was preparing to reopen two inactive natural iron ore mines near Aurora—the Stephens Mine and the Donora Mine—in 1983. The two properties, which will be operated as the McKinley Extension, have been idle since their last shipment of ore in 1979. J&L indicated that these properties, leased from United States Steel, contain a reported combined total of about 10 million tons of commercial-grade natural iron ore. In late summer, J&L permanently closed its McKinley Mine, the only natural iron ore operation in production during the year, because ore reserves were exhausted. The ore-concentration equipment from the McKinley Mine was being dismantled and will be reerected at the McKinley Extension Mine.

In September, the National Park Service presented a plaque to Hibbing city officials, recognizing the Hull-Rust-Mahoning Mine in North Hibbing as a National Historic Site. Inactive for nearly a decade, the mine is the largest open pit iron ore mine in the world; 3 miles long, 1-1/2 miles wide, and more than 500 feet deep. It has yielded more than one-half billion tons of ore during its lifetime, which began in 1895.

Erie Mining, Hoyt Lakes, was honored in the large industrial category of Energy Savers Award of Excellence annual competition, sponsored by the Minnesota DEPD and the Natural Gas Council of Minnesota. Erie Mining was cited for employing an innovative system that uses waste furnace heat to aid in the firm's production of iron pellets. The estimated annual energy savings from the system, when the plant is operating at full capacity, is equivalent to the energy required to heat the residences of a city having a population of 12,000.

In 1982, the published prices for various grade classifications of Minnesota iron ores remained nearly unchanged from those of the previous year. The exceptions were an approximate 8% price increase for pellets The Hanna Mining Co., Oglebay Norton Co., and United States Steel produced. The published prices in effect at yearend for ore delivered at rail-of-vessel at lower lake ports and based on 51.50% natural iron content were as follows: Mesabi non-Bessemer, $32.53 per ton; Old Range non-Bessemer, $32.78 per ton; and manganiferous, $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 mine value of Minnesota iron ore shipped in 1982 was $43.06 per ton.

Published freight rates, including rail and water, for transporting iron ore from the Mesabi Range to lower lake ports, ranged from $11.76 to $13.39 per gross ton at midyear, compared with $10.59 to $12.39 per gross ton in mid-1981. These rates exclude 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	1981			1982		
	First shipment	Final shipment	Total tonnage (thousand long tons)	First shipment	Final shipment	Total tonnage (thousand long tons)
Duluth, Minn.: DM&IR	Apr. 1	Dec. 16	[1]13,071	Apr. 29	Dec. 4	[1]5,982
Silver Bay, Minn.: Reserve	Apr. 8	Dec. 10	6,351	Apr. 30	Oct. 22	2,124
Superior, Wis.: Burlington-Northern	Apr. 13	Dec. 17	10,669	Apr. 13	Dec. 13	7,958
Taconite Harbor, Minn.: Erie	Apr. 13	Dec. 10	7,644	Apr. 22	Nov. 28	3,624
Two Harbors, Minn.: DM&IR	Apr. 2	Dec. 28	9,996	Apr. 29	Dec. 24	4,478
Total			[2]47,730			24,166

[1]Includes the following tonnages of flue dust from the former Duluth works of the United States Steel Corp.: 1981—522,000 tons; 1982—909 tons.
[2]Data do not add to total shown because of independent rounding.

Sources: American Iron Ore Association and various issues of Skillings' Mining Review.

The 1982 navigation season marked the first year in a decade that no new ore-carrying vessels were completed at lake ports and put in service to operate on the Great Lakes. Between 1972 and 1981, 4 U.S. shipyards on the lakes constructed 27 new lakers; 13 were of the 1,000-foot class. In this decade, several vessels in the U.S. lakes fleet also were lengthened and/or converted to self-unloaders.

Manganiferous Ore.—Shipments of manganiferous ore (containing 5% to 35% man-

ganese, natural) dropped to the lowest annual level of the past half century. The State's entire output came from the Algoma-Zeno pit, operated by the Pittsburgh Pacific Co. on the Cuyuna Range near Ironton in Crow Wing County. The manganiferous ore concentrate shipped was processed from stockpiled crude ore mined in prior years.

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)
1978	226,249	28.22	12.98
1979	162,056	28.82	14.09
1980	106,276	32.00	14.04
1981	124,617	29.84	14.84
1982	14,560	30.19	16.30

[1]All manganiferous ore shipped from the Cuyuna Range during 1978-82 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

Abrasive Stone.—At a quarry near Jasper in Rock County, Jasper Stone Co. mined an abrasive material from rock of Precambrian age. Canvassing for production information has been discontinued.

Clays.—Common clay and shale production in 1982 fell to its lowest level in nearly four decades. Compared with that of 1981, output for the year decreased sharply in quantity and value. Ochs Brick & Tile Co., the State's sole producer during 1982, mined common clay and shale at Springfield in Brown County and kaolin near Morton in Redwood County. The output was used principally in manufacturing face brick.

During the year, Western Minerals Exploration Co., a Colorado company, continued investigating kaolin resources in the Redwood Falls area.

Gem Stones.—No commercial gem stone mining operations were reported in Minnesota during 1982. The value shown in this chapter represents an estimate for material that rockhounds, mineral collectors, and other hobbyists collected.

Lime.—Lime produced in the State was at its lowest level since the mid-1970's; output dropped significantly from that of 1981. American Crystal Sugar Co. and Southern Minnesota Sugar Coop. produced the State's entire lime output in 1982. American Crystal Sugar's production was from plants at Moorhead in Clay County and at Crookston and East Grand Forks in Polk County. Southern Minnesota Sugar's plant was at Renville in Renville County. These two companies consumed all the lime production in their sugar-refining operations at these same locations. Limestone the companies used in manufacturing lime was all obtained from out-of-State sources.

Of the approximately 231,000 tons of domestically produced lime consumed within Minnesota during 1982, about 58% was produced within the State.

Peat.—Consisting principally of reed-sedge and sphagnum types and a small amount of hypnum moss, peat production increased slightly in quantity and total value compared with that of 1981. Four firms conducted peat-harvesting operations in 1982 from bogs in Aitkin, Carlton, Otter Tail, and St. Louis Counties. Most of the peat was marketed in packages for use in general soil improvement and other horticultural purposes.

Near midyear, Minnesota Gas Co. (Minnegasco) announced dropping further efforts to develop a peat gasification plant in the State. Minnegasco had been studying the possibilities of peat gasification since 1975. The company concluded that such a project, which could have resulted in mining as much as 80,000 acres of peatland in Koochiching County in northern Minnesota, would cost $1.8 billion and was not commercially workable at the time.

Perlite (Expanded).—The Conwed Corp. expanded processed perlite from out-of-State sources at its plant near Cloquet in Carlton County. The expanded product was used mostly in manufacturing formed products.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. Construction sand and gravel, the second leading mineral commodity produced in the State in quantity and value, fell slightly from the production levels estimated for 1981. Output was recorded for 191 firms and government

agencies operating at 373 sites located throughout 78 of the State's 87 counties. Clay, Dakota, Hennepin, and Washington Counties, collectively accounting for 40% of the State total, each recorded production in excess of 1 million tons.

During the year, the National Sand & Gravel Association (NSGA) honored two of the State's aggregate producers for their safety accomplishments in 1981. Rochester Sand & Gravel Inc., Rochester, was awarded a Special Honor Roll Certificate for having an accident-free record for the last 5 or more consecutive years. NSGA awarded a Certificate of Achievement in Safety to J. L. Shiely Co., St. Paul, for its record of no reported accidents during 1981 at its Nelson plant.

Table 7.—Minnesota: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	5,587	$14,881	$2.66
Plaster and gunite sands	142	503	3.54
Concrete products	1,447	3,394	2.34
Asphaltic concrete	3,005	5,775	1.92
Road base and coverings[1]	7,683	15,721	2.05
Fill	1,684	2,424	1.44
Snow and ice control	191	349	1.82
Railroad ballast	30	97	3.24
Other	506	1,078	2.13
Total or average	[2]20,276	44,222	2.18

[1]Includes road and other stabilization (cement and lime).
[2]Data do not add to total shown because of independent rounding.

Table 8.—Minnesota: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	5,564	$11,332	$2.04
Gravel	NA	NA	NA	12,480	29,611	2.37
Sand and gravel (unprocessed)	NA	NA	NA	2,232	3,279	1.47
Total or average	[e]23,950	[e]$49,770	[e]$2.08	20,276	44,222	2.18
Industrial sand	W	W	8.06	694	5,903	8.50
Grand total or average	W	W	2.15	[1]20,971	50,125	2.39

[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.

Table 9.—Minnesota: Construction sand and gravel sold or used by producers, by county[1]

County	1980			1982		
	Number of mines	Quantity (thousand short tons)	Value (thousands)	Number of mines	Quantity (thousand short tons)	Value (thousands)
Aitkin	--	--	--	1	11	$21
Becker	3	65	$143	6	255	756
Beltrami	2	W	135	26	132	193
Benton	2	W	W	4	37	38
Brown	3	400	446	3	146	155
Carlton	4	77	102	5	294	508
Cass	3	305	751	9	117	188
Chippewa	4	121	172	2	W	W
Chisago	5	233	336	3	W	W
Clay	14	1,445	2,582	13	1,055	2,928
Cook	2	W	47	1	10	32
Cottonwood	3	191	399	--	--	--
Crow Wing	3	156	349	8	127	322
Dakota	12	3,161	6,074	11	2,934	5,616
Douglas	4	147	413	7	175	418
Fillmore	2	W	W	1	17	36
Freeborn	7	322	625	5	447	984
Goodhue	6	254	399	5	134	293
Hennepin	15	3,185	6,046	12	2,102	4,636
Houston	2	W	W	20	238	811
Hubbard	3	97	333	14	121	280
Isanti	--	--	--	1	78	102
Itasca	4	599	1,441	2	236	812
Kanabec	3	110	117	2	W	W
Koochiching	8	212	346	19	84	85
Lac qui Parle	1	32	W	1	56	107
Lake of the Woods	--	--	--	14	56	56
Le Sueur	5	W	W	3	943	1,940
Lincoln	--	--	--	1	4	8
McLeod	2	W	W	5	181	296
Mahnomen	2	100	208	2	89	211
Marshall	6	154	255	4	61	79
Martin	--	--	--	1	60	60
Meeker	3	168	255	2	W	W
Mille Lacs	3	174	426	1	W	W
Morrison	3	134	278	4	190	487
Mower	3	64	75	3	218	366
Murray	5	64	68	2	23	23
Norman	3	188	244	3	W	W
Olmsted	4	354	595	6	199	389
Otter Tail	8	265	460	8	820	1,784
Pennington	1	W	79	3	43	81
Polk	5	510	825	6	386	551
Pope	3	108	216	4	137	319
Rice	4	389	543	3	313	345
Roseau	1	70	70	9	42	63
St. Louis	21	589	1,557	14	736	1,403
Sherburne	9	1,034	2,440	6	268	529
Stearns	4	124	251	4	93	239
Steele	4	326	685	6	580	960
Swift	1	114	115	10	W	W
Todd	9	266	517	4	196	238
Wabasha	2	115	333	2	84	282
Wadena	1	99	99	2	W	W
Washington	10	W	W	11	1,945	4,282
Watonwan	3	52	105	2	W	W
Wilkin	3	W	W	2	50	84
Winona	5	314	809	4	191	606
Wright	5	180	622	4	209	871
Yellow Medicine	3	81	135	2	W	W
Undistributed[2]	r38	7,962	15,659	35	3,355	8,351
Total[3]	294	25,110	49,180	373	20,276	44,222

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]Pipestone, Red Lake, and Traverse Counties are not listed because no production was reported.

[2]Includes Anoka, Big Stone (1982), Blue Earth, Carver, Clearwater, Dodge, Faribault (1980), Grant (1980), Jackson (1980), Kandiyohi, Kittson, Lake, Lyon, Nicollet, Nobles (1980), Pine, Ramsey, Redwood, Renville, Rock, Scott, Sibley, Stevens, and Waseca (1980) Counties, sand and gravel that cannot be assigned to specific counties (1980), and data indicated by symbol W.

[3]Data may not add to totals shown because of independent rounding.

Industrial.—Industrial sand production was recorded from four operations in Scott, Washington, and Le Sueur Counties. Compared with the production level of 1981, the State's output of industrial sand increased markedly.

At midyear, UNIMIN Corp. of New Canaan, Conn., opened a new industrial sand plant at Kasota on a 625-acre site in Le Sueur County. The Kasota plant followed by 2 years the company's construction of a new, similar plant about 10 miles away.

Minnesota Frac Sand Co., a division of J. L. Shiely, St. Paul, marked its first year of operation in the fall of 1982. The 520-million-year-old, slightly consolidated Jordan Sandstone mined from a 190-acre site near Jordan, Scott County, was processed onsite and marketed principally as a proppant for the oil industry in a process known as hydrofracturing to enhance oil-well production.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and preliminary estimates, only, for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Crushed.—The estimated quantity of crushed stone produced during the year, slightly more than that of 1981, was 3% below the record level set in 1979.

Dimension.—Minnesota ranked 10th among the 38 States for which dimension stone production was estimated. Granite, marketed for monumental and cut stone purposes, accounted for the bulk of production. A small quantity of dimension limestone and quartzite was also quarried.

Sulfur (Recovered Elemental).—Sulfur was recovered as a byproduct of the petroleum refining operations of Koch Refining Co., a division of Koch Industries Inc., near Pine Bend in Dakota County, and of Northwestern Refining Co., a division of Ashland Oil Inc., near St. Paul Park in Washington County. Sales increased in quantity and value compared with those of 1981.

Vermiculite (Exfoliated).—W. R. Grace & Co. at a plant in Hennepin County exfoliated processed vermiculite from out-of-State sources. Sales of the exfoliated material decreased in quantity and value compared with 1981 levels. Approximately two-thirds of the output was marketed for loose-fill and block insulation; the remainder was used in fireproofing and concrete and plaster aggregate applications.

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[1]State Liaison Officer, Bureau of Mines, Minneapolis, Minn.

[2]State Register, State of Minnesota. Executive Order No. 82-1. Feb. 15, 1982, p. 1413.

[3]Nigro, J. C. Firing an Iron Ore Pelletizing Kiln With Low-Btu Gas From Lignite. BuMines RI 8670, 1982, 22 pp.

[4]Schluter, R. B. Separation of Copper-Nickel Mattes From Duluth Gabbro Concentrates by Flotation and Magnetic Methods. BuMines RI 8646, 1982, 14 pp.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Clay and shale:			
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. Northwest Ore Div.:	Virginia, MN 55792		
McKinley		Mine and concentrator.	Do.
Oglebay Norton Co.:	1200 Hanna Bldg. Cleveland, OH 44115		
Eveleth Mines		Mine, concentrator, agglomerator.	Do.
Pickands Mather & Co.:	1100 Superior Ave. Cleveland, OH 44114		
Erie Commercial		do	Do.
Hibbing Taconite		do	Do.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Iron ore —Continued			
Pittsburgh Pacific Co.:	2521 1st Ave. Hibbing, MN 55746		
Connie, Pittsburgh Pacific Fee, and Silver.	----------	Stockpile shipments.	St. Louis.
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, and Sharon Culver.	----------	Stockpile shipments.	St. Louis.
United States Steel Corp.	Box 417		
Minnesota Ore Operations:	Mountain Iron, MN 55768		
Minntac	----------	Mine, concentrator, agglomerator.	Do.
Plummer Group	----------	Stockpile shipments.	Itasca.
Stevens	----------	----do----------	St. Louis.
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	Box 3006 Houston, TX 77001	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	332 Minnesota St. St. Paul, MN 55110	Plant	Carlton.
Sand and gravel (construction):			
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 Sand & Aggregate 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.
Sand (industrial):			
Minnesota Frac Sand Co., a division of J. L. Shiely Co.	1101 North Snelling Ave. St. Paul, MN 55108	----do----------	Scott.
Twin City Silica Inc	Lake Elmo, MN 55042	----do----------	Washington.
UNIMIN Corp	Greenwich Office Park 4 Greenwich, CT 06830	----do----------	Le Sueur.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone (crushed, 1981):			
Granite:			
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.	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.
Hector Construction Co	Box 410 Caledonia, MN 55921	do	Fillmore, Houston, Winona.
Edward Kraemer & Sons Inc	1000 West 122d St. Burnsville, MN 55378	Quarry and plant	Dakota.
Lundin Construction Co. Inc	1905 3d Ave. Mankato, MN 56001	Quarries and plants.	Blue Earth, Le Sueur, Steele.
Mankato Aglime & Rock Co	Box 254 Mankato, MN 56001	Quarry and plant	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 122 Chaska, MN 55318	Quarry and plant	Scott.
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.
Stussy Construction Inc	Box 187 Mantorville, MN 55955	do	Dodge.
Quartzite:			
New Ulm Quartzite Quarries, Inc.	Route 3, Box 21 New Ulm, MN 56073	Quarry and plant	Nicollet.
Traprock (basalt):			
Arrowhead Blacktop Co	Box 6568 Duluth, MN 55806	do	St. Louis.
Stone (dimension, 1981):			
Granite:			
Cold Spring Granite Co	Cold Spring, MN 56320	Quarries	Big Stone, Mille Lacs, Renville.
Do	do	Quarries and plant	Stearns.
Delano Granite Works Inc	Delano, MN 55328	Quarry and plant	Big Stone.
View Quarry Co., a division of Rex Granite Co.	Box 924 St. Cloud, MN 56302	do	Redwood.
Limestone:			
Biesanz Stone Co. Inc	Box 768 Winona, MN 55987	do	Winona.
Mankato Stone Center. a division of Babcock Co.	Box 3088 Mankato, MN 56001	do	Do.
Vetter Stone Co	Route 5 Mankato, MN 56001	do	Blue Earth and Le Sueur.
Sulfur (recovered elemental):			
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 production in 1982 was $72.7 million, a decrease of $19.6 million from that of 1981, continuing a downward trend that started in mid-1979. The decrease in value was a result of a decline in production as the demand for much of the State's mineral output fell owing to the nationwide recession. The mineral value decline did not parallel production decreases, as inflated selling prices for some commodities offset cutbacks in production. In some instances, declining mineral sales coupled with an increase in inventories forced some producers to reduce prices to maintain manageable stocks and sales.

Mississippi ranked second nationally in the production of recovered sulfur, second in bentonite, third in ball clay, and fourth in fuller's earth. Major commodities produced were cement, clays, and sand and gravel; production of these commodities declined from that of 1981. Most of the nonfuel minerals produced in the State were utilized in the construction and automotive industries, both of which have been adversely affected by the national economic slowdown. Reduced road maintenance programs throughout the State also impacted on crushed stone and sand and gravel demand.

According to an analysis by the Federal Reserve Bank of Atlanta,[3] the full impact of the recession hit Mississippi in 1982, when the State's manufacturing income fell by 3.1% in the first half of the year, while the Nation's fell by only 0.5%. By the end of 1982, unemployment in the State was 11.4%, up from 9.0% at yearend 1981. There was some improvement in residential construction by yearend, although it was weak; nonresidential construction was weaker. State and local government budgets were at austerity levels, thereby limiting funding for public construction projects.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	1,218	$23,309	805	$21,181
Sand and gravel (construction)	do.	e10,480	e29,260	9,455	27,115
Combined value of cement, sand and gravel (industrial), and stone (crushed)		XX	r39,682	XX	24,389
Total		XX	r92,251	XX	72,685

eEstimated. rRevised. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Adams	W	[3]	
Benton	W	W	Clays.
Bolivar	$204	[3]	
Carroll	W	$121	Clays.
Clay	W	W	Stone (crushed).
Copiah	6,333	[3]	
De Soto	1,939	[3]	
Forrest	W	[3]	
George	53	[3]	
Hancock	W	[3]	
Harrison	116	[3]	
Hinds	W	W	Stone (crushed), clays.
Holmes	W	[3]	
Itawamba	952	[3]	
Jackson	W	--	
Jasper	W	104	Stone (crushed).
Jefferson Davis	W	[3]	
Jones	W	W	Clays.
Kemper	W	W	Do.
Lincoln	W	W	Do.
Lowndes	32,846	W	Cement, stone (crushed), clays.
Marion	W	[3]	
Marshall	W	W	Clays.
Monroe	8,579	7,060	Do.
Newton	W	[3]	
Noxubee	W	683	Stone (crushed), clays.
Panola	W	W	Clays.
Pearl River	449	[3]	
Perry	196	[3]	
Pike	W	[3]	
Quitman	W	--	
Rankin	W	W	Cement, stone (crushed), clays.
Smith	10	27	Stone (crushed).
Stone	797	[3]	
Sunflower	18	13	Clays.
Tate	W	[3]	
Tippah	W	W	Clays.
Tishomingo	1,923	W	Stone (crushed), sand and gravel (industrial).
Walthall	174	[3]	
Warren	W	[3]	
Washington	W	[3]	
Wayne	W	W	Stone (crushed).
Winston	W	W	Clays.
Yalobusha	W	[3]	
Yazoo	1,278	[3]	
Undistributed[4]	48,072	54,983	
Sand and gravel (construction)	XX	[e]29,260	
Total	[5]103,940	92,251	

[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, Lauderdale, Lawrence, Leake, Lee, Leflore, Madison, Montgomery, Neshoba, Oktibbeha, Pontotoc, Prentiss, Scott, Sharkey, Simpson, Tallahatchie, Tunica, Union, Webster, and Wilkinson.

[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 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

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,055.0	1,058.0	+0.3
Unemployment	do	88.0	117.0	+33.0
Employment (nonagricultural):				
Mining[1]	do	12.8	12.4	-3.1
Manufacturing	do	220.3	203.5	-7.6
Contract construction	do	42.3	40.9	-3.3
Transportation and public utilities	do	40.5	39.7	-2.0

See footnotes at end of table.

Table 3.—Indicators of Mississippi business activity —Continued

		1981	1982[p]	Change, percent
Employment and labor force, annual average —Continued				
Employment (nonagricultural) —Continued				
Wholesale and retail trade	thousands	163.4	162.0	-0.9
Finance, insurance, real estate	do.	32.8	32.9	+.3
Services	do.	121.0	122.1	+.9
Government	do.	185.9	179.9	-3.2
Total nonagricultural employment[1 2]	do.	819.1	793.3	-3.2
Personal income:				
Total	millions	$18,752	$19,876	+6.0
Per capita		$7,409	$7,792	+5.2
Construction activity:				
Number of private and public residential units authorized		5,901	6,064	+2.8
Value of nonresidential construction	millions	$130.5	$113.5	-13.0
Value of State road contract awards	do.	$111.8	$108.0	-3.4
Shipments of portland and masonry cement to and within the State	thousand short tons	892	712	-20.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$92.3	$72.7	-21.2
Value per capita, resident population		$36	$28	-22.2
Value per square mile		$1,924	$1,523	-20.8

[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.

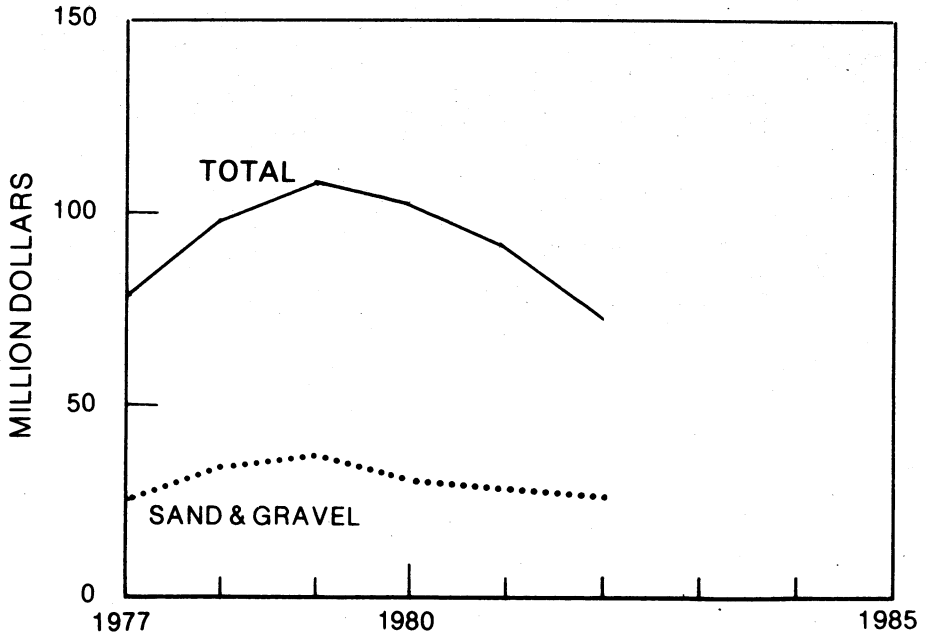

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Mississippi.

Trends and Developments.—Aggregate output has historically ranked first in value over all other mineral commodities produced in Mississippi. Continued high interest rates throughout 1982 deterred activities by the construction industry, the primary market for the State's aggregate producers.

Construction, however, continued on the Tennessee-Tombigbee Waterway in the northeastern part of the State and provided an important market for crushed stone and sand and gravel operations in the area. By yearend, about 82% of the navigational facilities were complete, with all major contracts awarded. With the project 82% complete, the market for construction aggregates is expected to drop off significantly in 1983. Eight of the ten locks and dams are completed, with the other two under construction. Approximately 130 miles of the 234-mile project were open. By yearend, about $1.4 billion had been expended, with completion scheduled for 1985. Several mineral producers in the northeastern part of the State have indicated that the waterway would be beneficial to movement of their clay, gravel, and crushed stone.

The Tennessee Valley Authority (TVA) made a decision to defer construction of the Yellow Creek nuclear generating unit in northeastern Mississippi. Construction aggregate producers in the area were adversely affected by this action.

Mississippi Chemical Corp., one of the largest corporations in the State, cut production at its Pascagoula fertilizer plant by nearly one-half. Depressed fertilizer sales were cited for the reduction. The corporation also traded title to phosphate lands in Florida for a 22-year contract to buy phosphate rock from International Minerals & Chemical Corp. (IMC). Mississippi Chemical had spent $7 million and 7 years seeking permits to mine phosphate in Florida.

Armco Inc., citing market conditions, postponed indefinitely its previously announced plans to build a $343 million seamless pipe finishing plant in Gulfport. The facility was to be the finishing plant for seamless pipe manufactured in Ashland, Ky., for use in the oil industry. Armco's construction plans in other States were also affected. Mississippi Steel Div. of Magna Corp., Flowood, operated its minimill producing reinforcing bar. During the year, Mississippi Steel lowered its price of bar to prevent other mills from underselling in its prime market in the South. This was the first time in the 26-year history of Mississippi Steel that the company led a product price move. According to the Mississippi Manufacturer's Directory, eight small gray iron foundries and one steel foundry operated during 1982.

Output from the two titanium dioxide pigment plants in the State remained fairly stable during the year. Rated capacity of the two chloride process plants exceeds 200,000 tons per year. During 1982, 188,000 tons of ilmenite from Australia was imported through the Port of Gulfport, compared with 110,000 tons in 1981. The ilmenite was shipped to E. I. du Pont de Nemours & Co.'s pigment plant at Pass Christian. Kerr-McGee Chemical Corp., Hamilton, received synthetic rutile from its plant in Mobile for use at its pigment plant. Raw material was imported from Australia through the Port of Mobile and shipped by rail to Hamilton. The company contracted with Rust Engineering Co., Birmingham, to study the feasibility of adding a 10,000-ton-per-year manganese metal plant adjacent to existing facilities. The company also announced plans for a $5 million expansion program to increase sodium chlorate capacity from 40,000 to 52,000 tons per year. The facility, in addition to producing titanium dioxide, manganese metal, and sodium chlorate, also produces manganese briquets and nitrided manganese. Output of manganese decreased slightly from that of 1981.

Legislation and Government Programs.—The U.S. Bureau of Mines and the Mississippi Bureau of Geology and Energy Resources renewed their Memorandum of Understanding for the collection of statistical data on nonfuel mineral production, which will remain in effect until December 1987.

During the year, the Mississippi Bureau of Geology and Energy Resources continued investigation of the geology and mineral resources of the State. It also administered reclamation activities and the leasing of State-owned lands for mineral exploration and conducted geological assessments for sanitary landfills. A study of the Cretaceous System geology was published (Information Series 82-1) during the year, along with a minerals producers directory.

The ground water geology section ran 171 geophysical logs on water wells and stratigraphic test holes. Seventeen of these logs were on test holes drilled for the Bureau of Geology; the others were for water well contractors and private citizens. A program for collecting water samples was devised for

an underground injection investigation in cooperation with the Bureau of Pollution Control.

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 Mississippi Coastal Program was awarded a $706,000 grant in September for funding through mid-1984. Activities include administration of the wetlands use permit, policy coordination, and several special management area programs, including planning for the Ports of Pascagoula and Bienville.

During the year, the U.S. Geological Survey conducted fieldwork to locate, study, and sample deposits of nonswelling bentonites. Results of these studies will be used to compile a map showing the bentonite resources of the United States. A cooperative drilling program for lignite was conducted in the border area of Mississippi and Alabama as part of a study of gulf coast lignites. Several major companies have lignite leases in the State, and Fluor Corp. received approval from the Mississippi Energy and Transportation Board for a comprehensive study of a 1,000-megawatt generating facility utilizing lignite.

The U.S. Bureau of Land Management announced that $7.4 million in mineral revenues was given to the State in fiscal year 1982. The Federal Government splits bonuses, rentals, and royalties received from Federal mineral leasing activities on public lands equally with the States in which the minerals are recovered.

The Mining and Mineral Resources and Research Institute at the University of Mississippi in University, which was created under title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Mississippi's cement industry, composed of one company, was located in the central part of the State. Cement was one of the leading commodities, value wise, produced in the State, although portland and masonry cement shipments decreased significantly from those of 1981. Shipments of portland and masonry cement have been on the decline since 1977 and 1978, respectively. The decline in construction activities, including road construction, have adversely affected cement operations. United Cement Co., in Lowndes County, produced portland and masonry cement. Increased operating costs and poor market conditions forced closure of the Marquette plant, and the company sold its facilities to Lone Star Industries Inc. in 1981. Lone Star plans to use the facilities as a distribution center, with cement being shipped from its Missouri plant.

Principal consumers of portland cement included ready-mix concrete companies, building materials dealers, concrete products manufacturers, highway contractors, and other contractors. Raw materials used by cement producers were limestone, chalk, sand, gypsum, and iron ore; limestone, chalk, and sand were mined adjacent to the plantsites, with gypsum and iron ore shipped in from out of State. Cement was shipped within the State and to contiguous States.

Clays.—Mississippi's clay industry consisted of 17 companies operating 20 mines in 12 counties in the northern and northeastern parts of the State. Total clay output decreased to its lowest level in over 10 years. Common clay, ball clay, bentonite, and fuller's earth were produced in Mississippi. The State ranked second in bentonite, third in ball clay, and fourth in fuller's earth. Clays produced in the State were used in the automotive, construction, and agricultural and animal-feed industries. Because of continued depressed markets, sales for all clay types decreased.

Common clays were mined by 11 companies operating 14 pits in 9 counties, centering in Hinds, Noxubee, and Winston Counties. Major sales were for brick, concrete block, highway surfacing, and structural concrete. Output was 330,000 tons compared with 649,000 tons in 1981, the lowest production level in over 10 years. The continued high interest rate resulted in decreased home construction during most of the year, severely depressing the demand for common clay products.

One company, Ky-Tenn Clay Co., produced ball clay from a surface mine in Panola County. Clay was trucked about 10 miles to the plant where it was processed for use in animal feed, wallboard, and

ceiling tile. Demand decreased to its lowest level since 1977.

Mississippi's bentonite producers, Ashland Chemical Co., American Colloid Co., and IMC, operated three surface mines in Monroe County. Overburden of up to 130 feet was removed to recover 6 to 8 feet of clay. The 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 in fertilizer manufacture. Demand decreased to its lowest production level since 1975.

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
1978	358	7,742	W	W	1,356	3,034	1,960	19,623
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

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. Fuller's earth from deposits that averaged up to 25 feet thick with less than 20 feet of overburden was processed at nearby plants for sale to the agricultural industry. Market conditions were depressed during the year, with production down to its lowest level since 1977.

Peat.—Mississippi Peat Co. mined peat from the Powell pit at Preston, about 50 miles north of Meridian. The peat was solar dried, bagged, and shipped for use as potting soil and in general soil improvement. Demand increased because the State now requires the use of moss peat in reclamation work along highways.

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 for formed products. Markets are primarily in commercial construction, which was not as severely depressed as other construction. Production increased slightly while value decreased from that of 1981.

Sand and Gravel.—Mississippi produced both construction and industrial sand and gravel in 1982. Production was from 54 companies operating 69 pits in 30 counties. Total output decreased from that of 1981. None of the operations produced over 1 million tons in 1982.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	3,046	$7,464	$2.45
Gravel	NA	NA	NA	5,813	18,906	3.25
Sand and gravel (unprocessed)	NA	NA	NA	596	745	1.25
Total or average	e10,480	e$29,260	e$2.79	9,455	27,115	2.87
Industrial sand	W	W	8.61	W	W	13.41

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

Construction.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. Construction sand and gravel was the leading commodity in value among the nonfuel minerals produced in Mississippi. Production has continued to decline since the peak production year of 1979. The decrease in 1982 was caused by a general slowdown of construction and reduced road maintenance programs throughout the State. Economic recovery was expected to be slow and to extend over a long period of time. The decreased requirements for the Tennessee-Tombigbee Waterway construction and the deferral of construction by TVA of the Yellow Creek nuclear plant had an adverse impact on producers in the northeastern part of the State.

Industrial.—Sand for industrial uses was produced by two companies in Jackson and Tishomingo Counties with output increasing. The sand was used in blasting, cores, and molds.

Table 6.—Mississippi: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,324	$9,358	$2.82
Plaster and gunite sands	W	W	1.45
Concrete products	267	579	2.16
Asphaltic concrete	2,939	9,741	3.31
Road base and coverings[1]	2,293	6,332	2.76
Fill	512	787	1.54
Snow and ice control	W	W	2.94
Other	119	320	--
Total[2] or average	9,455	27,115	2.87

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (cement).
[2]Data may not add to totals shown because of independent rounding.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures in 1981 for its surveys of stone producers. Beginning with the collection of 1982 production data, the survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Crushed.—Production decreased significantly as reduced local market demand strongly influenced operations. Reductions in road maintenance programs, closure of a cement plant, and winddown of construction on the Tennessee-Tombigbee Waterway kept production at reduced levels. Upon completion of the waterway, operators in the northeastern part of the State anticipated shipping crushed stone to more distant markets by barge. Operations supplying material for agricultural use also experienced fluctuating market conditions.

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. Sulfur sold or used in 1982 totaled 602,000 metric tons, valued at $71.7 million, a decrease of 11.1% in shipments and 9.1% in value from that of 1981.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, Ala.
[2]State geologist, Bureau of Geology and Energy Resources, Jackson, Miss.
[3]Federal Reserve Bank of Atlanta. Economic Review. February 1983, pp. 59-66.

Table 7.—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:			
American Sand & Gravel Co	Box 272 Hattiesburg, MS 39401	Stationary plant	Forrest.
Blain Gravel Co	Box 278 Mount Olive, MS 39119	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 1609 Jackson, MS 39205	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]

Nonfuel mineral production in Missouri during 1982 was valued at $733.8 million, a 16.2% decrease from the value of 1981. Nevertheless, the State rose from eighth rank in 1981 to seventh nationally in 1982. In 1972 constant dollars, the value of nonfuel minerals in Missouri declined nearly 11% in the 1972-82 decade.

Eight lead mines in Missouri yielded more than 92% of total national output. Lead output in the State increased 21.7% over that of 1981, attributed to a full year of production; no strikes or unexpected interruptions occurred in the southeast Missouri lead district except for the closing of the nearly depleted Indian Creek Mine.

Among the metallic minerals, copper production decreased 5.6% and iron ore shipments decreased substantially; however, silver and zinc output increased 22% and 20%, respectively.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Barite	thousand short tons	185	$9,725	107	$5,703
Cement:					
Masonry	do.	103	5,495	88	4,855
Portland	do.	3,732	168,567	3,205	120,339
Clays	do.	1,747	18,414	[2]1,383	[2]13,409
Copper (recoverable content of ores, etc.)	metric tons	8,411	15,783	7,941	13,010
Gem stones		NA	10	NA	10
Iron ore	thousand long tons	W	W	717	W
Lead (recoverable content of ores, etc.)	metric tons	389,721	313,870	474,460	267,150
Sand and gravel:					
Construction	thousand short tons	e7,500	e16,900	6,359	14,477
Industrial	do.	778	8,602	750	8,997
Silver (recoverable content of ores, etc.)	thousand troy ounces	1,837	19,322	2,241	17,817
Stone (crushed)	thousand short tons	40,910	116,297	p38,600	p113,300
Zinc (recoverable content of ores, etc.)	metric tons	52,904	51,966	63,680	54,009
Combined value of iron oxide pigments (crude), lime, stone (dimension), and values indicated by symbol W		XX	r130,317	XX	100,698
Total		XX	r875,268	XX	733,774

eEstimated. pPreliminary. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Andrew	W	W	Stone (crushed).
Atchison	W	(3)	
Audrain	$3,266	$2,875	Clays.
Barry	743	805	Stone (crushed).
Barton	W	W	Do.
Bates	613	654	Do.
Benton	W	W	Do.
Bollinger	W	(3)	
Boone	W	W	Stone (crushed), clays.
Buchanan	W	W	Stone (crushed).
Butler	W	360	Stone (crushed), clays.
Caldwell	311	241	Stone (crushed).
Callaway	W	3,328	Stone (crushed), clays.
Camden	W	143	Stone (crushed), stone (dimension).
Cape Girardeau	W	W	Cement, stone (crushed), clays.
Carroll	—	W	Clays.
Cass	1,562	1,630	Stone (crushed).
Cedar	W	W	Do.
Christian	1,266	862	Do.
Clark	W	1,307	Do.
Clay	6,530	4,267	Do.
Clinton	444	407	Do.
Cole	W	318	Do.
Cooper	W	481	Do.
Crawford	W	W	Stone (crushed), clays.
Dade	144	162	Stone (crushed).
Dallas	W	W	Do.
Daviess	W	W	Do.
De Kalb	W	267	Do.
Dent	102	81	Do.
Douglas	356	197	Do.
Franklin	W	W	Stone (crushed), clays.
Gasconade	W	W	Clays, stone (crushed).
Gentry	W	W	Stone (crushed).
Greene	W	W	Lime, stone (crushed).
Grundy	W	542	Stone (crushed).
Harrison	W	591	Do.
Henry	W	W	Do.
Hickory	W	W	Do.
Holt	W	W	Do.
Howard	W	W	Do.
Howell	W	510	Do.
Iron	353,395	W	Zinc, lead, silver, iron ore, copper, stone (crushed).
Jackson	W	W	Cement, stone (crushed), clays.
Jasper	W	3,944	Stone (crushed).
Jefferson	W	W	Cement, stone (crushed), sand and gravel (industrial), clays.
Johnson	530	400	Stone (crushed).
Knox	W	1,290	Do.
Laclede	W	W	Do.
Lafayette	418	260	Do.
Lawrence	—	203	Do.
Lewis	W	(3)	
Lincoln	W	979	Stone (crushed).
Livingston	W	W	Stone (crushed), clays.
McDonald	W	W	Stone (crushed).
Macon	W	(3)	
Madison	W	(3)	
Maries	W	W	Clays, stone (crushed).
Marion	W	83	Stone (crushed).
Mercer	543	427	Do.
Miller	W	W	Do.
Moniteau	144	W	Do.
Monroe	W	1,062	Stone (crushed), clays.
Montgomery	3,379	2,790	Clays, stone (crushed).
Morgan	302	149	Stone (crushed).
Newton	439	W	Do.
Nodaway	W	W	Do.
Oregon	397	20	Do.
Osage	W	W	Do.
Ozark	W	(3)	
Pemiscot	W	(3)	
Perry	W	688	Stone (crushed).
Pettis	W	W	Do.
Phelps	W	334	Do.
Pike	W	W	Cement, stone (crushed), clays.
Platte	W	W	Stone (crushed), clays.
Polk	W	W	Stone (crushed).
Pulaski	W	W	Do.

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Putnam	W	$238	Stone (crushed).
Ralls	W	W	Cement, stone (crushed), clays.
Randolph	W	W	Stone (crushed).
Ray	$436	332	Do.
Reynolds	206,112	W	Lead, zinc, silver, copper.
Ripley	W	(3)	
St. Charles	W	W	Stone (crushed), sand and gravel (industrial), clays.
St. Clair	W	W	Stone (crushed).
St. Francois	W	W	Lime, stone (crushed).
St. Louis	W	44,350	Cement, stone (crushed), sand and gravel (industrial), clays.
St. Louis City	W	(3)	
Ste. Genevieve	W	W	Lime, stone (crushed), stone (dimension).
Saline	1,814	1,771	Stone (crushed).
Scotland	1,504	966	Do.
Scott	W	W	Do.
Shannon	64	57	Do.
Shelby	1,036	749	Do.
Stoddard	W	--	
Stone	120	59	Do.
Sullivan	W	214	Do.
Taney	W	484	Do.
Texas	W	W	Do.
Vernon	1,710	637	Do.
Warren	W	W	Clays, stone (crushed).
Washington	r99,769	93,798	Iron ore, lead, barite, zinc, copper, silver, iron oxide pigments (crude).
Wayne	3,813	4,237	Stone (crushed).
Webster	W	W	Do.
Worth	337	213	Do.
Wright	W	W	Do.
Undistributed[4]	362,465	677,604	
Sand and gravel (construction)	XX	e16,900	
Total	r1,054,064	5875,268	

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: Adair, Carter, Chariton, Dunklin, Linn, Mississippi, New Madrid, and Schuyler.

[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 stone and 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.

Among the nonmetallic minerals, barite output decreased 42%; clays (excluding fuller's earth in 1982), 21%; construction sand and gravel, 15%; masonry cement, 15%; portland cement, 14%; crushed stone, 5.6%; and industrial sand and gravel, 4%.

Industrial mineral production, mainly from stone quarries and sand and gravel pits, was scattered across Missouri, generally as near to markets as the natural occurrences of usable rock allowed and communities would agree to. Metallic ore production of copper, iron, lead, silver, and zinc was geographically and geologically confined to southeastern Missouri, in Iron, Reynolds, and Washington Counties.

Employment.—The unemployment rate in the State in January 1982 was 9.7%, but by yearend had increased to 10.9%. In the metal mining and milling counties of southeastern Missouri, the unemployment rate from January to the end of December 1982 increased from 11.4% to 13.5% in Dent County, from 9.7% to 12.7% in Iron County, from 9.2% to 15.2% in Reynolds County, and from 23.5% to 32.3% in Washington County.[3]

The Kansas City, Mo.-Kans., area employment in mining and quarrying fluctuated between 400 and 600 during 1982, resulting in no net change for the year. The St. Louis, Mo.-Ill., metropolitan area employment in mining fluctuated between 2,700 and 3,400, resulting in a net decrease of 100 during the year. The Springfield area employment in mining and construction rose from a low of 2,400 in January to a summer high of 3,700, after which employment dropped to 3,000 at yearend, a net increase of 300.[4]

Table 3.—Indicators of Missouri business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,319.0	2,311.0	-0.3
Unemployment	do	179.0	214.0	+19.6
Employment (nonagricultural):				
Mining[1]	do	7.0	7.1	+1.4
Manufacturing	do	427.5	407.3	-4.7
Contract construction	do	79.0	74.3	-6.0
Transportation and public utilities	do	137.2	131.5	-4.2
Wholesale and retail trade	do	467.3	459.0	-1.8
Finance, insurance, real estate	do	108.5	108.4	-.1
Services	do	403.3	404.2	+.2
Government	do	326.6	324.4	-.7
Total nonagricultural employment[1]	do	[2]1,956.3	1,916.2	-2.0
Personal income:				
Total	millions	$47,697	$50,374	+5.6
Per capita		$9,654	$10,175	+5.4
Construction activity:				
Number of private and public residential units authorized		10,144	11,100	+9.4
Value of nonresidential construction	millions	$770.2	$739.5	-4.0
Value of State road contract awards	do	$190.0	$162.0	-14.7
Shipments of portland and masonry cement to and within the State	thousand short tons	1,460	1,278	-12.5
Nonfuel mineral production value:				
Total crude mineral value	millions	$875.3	$733.8	-16.2
Value per capita, resident population		$177	$148	-16.4
Value per square mile		$12,489	$10,530	-15.7

[p]Preliminary.
[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.

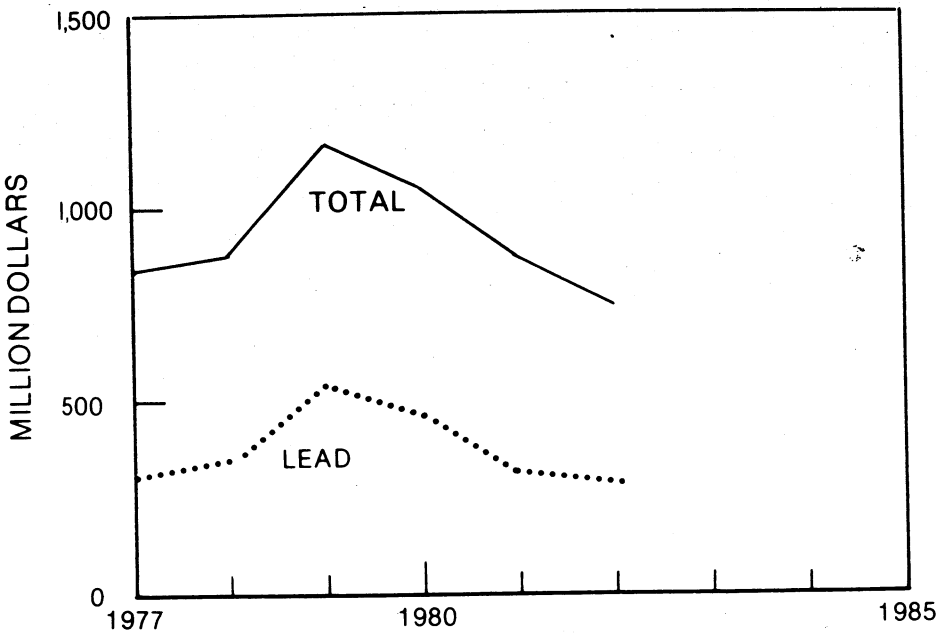

Figure 1.—Value of lead and total value of nonfuel mineral production in Missouri.

Trends and Developments.—Missouri's lead mines provided 92.6% of the Nation's total 1982 lead output, and St. Joe Minerals Corp. was the Nation's leading producer (with 36.9% of the Nation's lead production) from its five Missouri lead mines. However, the St. Joe Minerals chairman said that the firm had been spared the brunt of the recession because of its limited copper holdings (copper prices had been most hurt by the recession) and because of its diverse mineral holdings—coal, base and precious metals, and oil and gas. These worldwide holdings counteracted the drop in domestic metal prices that affected many other mining companies.[5]

Approximately 5 miles south of Viburnum, near Bixby, Iron County, the 1,193-foot-deep, 12.5-foot-diameter Viburnum No. 35 shaft was to be completed by the end of April 1983. Site preparation, begun in April 1980, was completed in July 1981. On August 3, 1981, the project was turned over to a handpicked shaft-sinking crew of 28 employees, selected from among St. Joe Lead Co. employees at the company's other lead mines and service facilities. Shaft sinking was to be completed in August 1983, and development work, including the skip-loading station, raises, and inclines, was to be started. The surface installations were modeled after Viburnum No. 27 Mine, and all salvageable materials from the old minesite—including headframe, hoist room, change room, offices, and shaft collar to 20 feet below the surface—were used for the new mine.

Until suspended in September, ASARCO Incorporated continued development work on its new West Fork Mine in Reynolds County, 23 miles west of its smelter at Glover. In September, the production and service shafts had been completed, the ventilation shaft was 35% complete, and 1,400 feet of lateral drifts had been excavated. Construction of the mill and other surface facilities continued and were to be completed by June 1983, when the project was to be placed on standby until 1985. When completed, the West Fork mill will be capable of processing 3,450 metric tons of ore per day containing 46,000 metric tons of lead annually. The measured reserves were stated at 15 million short tons equivalent to 13.6 million metric tons, containing 0.30 ounce of silver per ton, 0.04% copper, 5.5% lead, and 1.2% zinc.

Cominco American Incorporated and Dresser Industries Inc. expected to bring their Magmont West ore body in Iron County into production in 1983. The ore body was reached by a 10,500-foot production drift originating at the main mine workings. The new ore area was intercepted in November, and mine production and development were initiated at that time.

To reduce concentrate stocks during the year, according to Asarco's annual report, a newly installed blast furnace at their Glover smelter-refinery was operated in excess of its rated capacity of 100,000 metric tons and produced 123,600 metric tons of refined lead in 1982.

In April, Homestake Mining Co. and AMAX Lead Co. of Missouri submitted for State approval an ambient-lead monitoring plant for the Buick smelter. Results demonstrated near compliance for ambient lead at current levels of control, and the plan was expected to be approved in early 1983.

In applying the State's solid waste regulations, Missouri granted an exemption for lead mine tailings but not for smelter slag dumps. The Buick smelter filed a suit challenging the denial of an exemption for the slag dumps; if the suit is successful, significant savings will result for the smelter.

On October 4, AMAX announced discussions with Exxon Minerals Co. about the sale to Exxon of AMAX's 50% interest in the Buick Mine, mill, and smelter complex in Iron County. Homestake was expected to file an action for a declaratory judgment that it had the right to manage the Buick operation if AMAX should sell its interest.

The University of Missouri-Rolla was host to participants from nine countries at its International Conference on Mississippi Valley-Type Lead-Zinc Deposits, holding technical sessions for 3 days in October. More than 200 participants traveled to the Nation's largest lead-zinc district, the Viburnum Trend, visiting the Milliken, Buick, Magmont, and Fletcher Mines.

Researchers from Washington University in St. Louis were using remote-sensing satellites to help identify and locate concealed structural features that may have had a bearing on localizing the lead and iron ore deposits in southeast Missouri. The researchers believe that fracture patterns in the Earth's crust control lead and iron ore formation.[6]

Mallinckrodt Inc. in St. Louis, a major processor of columbium, was purchased by Avon Products Inc. on March 8, becoming a wholly owned subsidiary.

Lone Star Industries Inc. expanded its leadership as the country's largest producer of portland cement by purchasing Mar-

quette Co. and becoming the owner and operator of a newly completed "flagship" dry cement plant at Cape Girardeau.

Road base aggregates stabilized with lime and fly ash incurred structural failure at two extensive road projects in Kansas City. Officials planned to investigate the failures, characterized by buckling of pavements in frigid weather, to learn whether the lime-fly ash mixture was at fault.[7]

North American Refractories Co. decreased dolomitic lime output in 1982 nearly 30% but produced a better quality material by installing an oxygen-enrichment system. Introducing pure liquid oxygen enabled the kiln operator to stretch kiln output to new levels and to reduce fuel consumption per ton to less than 50% of normal fuel requirements. The new system also enabled North American Refractories to increase petroleum coke consumption from 12% to 25% and realize a fuel-cost savings because petroleum coke is cheaper than coal.[8]

Ore moving logistics for five room-and-pillar mines in the Viburnum Trend were described in a paper by L. A. Weakly.[9] The five mines described are AMAX-Homestake's Buick Mine, Asarco's West Fork Mine, Cominco and Dresser's Magmont Mine, Kennecott Minerals Co.'s Frank R. Milliken Mine, and St. Joe Lead's Viburnum No. 29 Mine. Mining methods and equipment at the five mines are fairly similar: All are classified as trackless, and all mining equipment operates on rubber tires. Three systems move ore from the active heading underground to the ore shaft for hoisting approximately 1,000 feet to the surface.

The first system employs a front-end loader and truck haulage combination; the second, a front-end loader and truck, with mainline track haulage combination; and the third, a front-end loader and truck, with conveyor-haulage combination. The logistics of each system—method of use, equipment specifications, ore handling rate, and such cost figures permitted to be made public—were described in the article.

The two main reasons for diversity in ore moving methods among the five mines reviewed are the shape of the ore body and each company's mining philosophy. Possible future changes in mining methods will be based on reevaluations of changes in the ore body shape, mining distance away from the production shaft, increased labor cost, rising diesel-fuel and electrical-power cost, more stringent government regulations, increased demand for ventilation to dilute diesel exhaust, and newly available mining equipment.

A sixth Missouri lead mine was described in another journal article.[10] St. Joe Lead's Fletcher Mine was mined by the open stope, room-and-pillar method. Mining equipment included hydraulic drill jumbos with remote controls and parallel-positioning extendible booms, front-end loaders that act as 10-ton load-haul-dump (LHD) units, and 40- to 50-ton trucks used when the length of a haul made the LHD system inefficient. The primary crusher is underground. After crushing, the ore is conveyed to the 5,000-short-ton-per-day mill, where lead, zinc, and copper concentrates are recovered.

Legislation and Government Programs.—Under a mining research contract sponsored by the U.S. Bureau of Mines, the Missouri Department of Natural Resources, Division of Geology and Land Survey, made a 2-year investigation of possibly hazardous sites in the now-abandoned lead-zinc mining district in southwestern Missouri. The Tri-State mining district is known to contain many mines, shafts, open pits, tailings ponds, and waste piles, as well as hazards related to subsidence. A report on stability problems and hazard evaluations in the Missouri portion of the Tri-State district was to be issued in the spring of 1983.

On January 1, 1982, because of funding limitations imposed by Congress, a temporary restraint of the Mine Safety and Health Administration's (MSHA) enforcement of safety rules in surface mining of stone and sand and gravel operations went into effect. This temporary restraint was lifted on July 15, 1982, and MSHA's inspectors resumed enforcing the safety rules, but under new guidelines that reduced the number of citations to only those that were significant and substantial violations.

As of September 30, 1982, nearly 196,000 acres in the State of Missouri were under continuing nonfuel mineral leases, licenses, and permits on acquired, military, and other Federal lands. Other nonfuel mineral leases, licenses, and permits, amounting to 195,222 acres of acquired lands were divided: 400 acres, barite; 783 acres, clays; 192,151 acres, lead-zinc-copper; 1,248 acres, tungsten; and 640 acres, uranium.[11]

Early in December the Occupational Safety and Health Administration postponed indefinitely the submittal date of in-plant engineering control programs to reduce workers' exposure to lead in smelters and in battery and lead oxide plants. Recent evidence indicated that the proposed standard

of 50 micrograms per cubic meter may be too stringent and costly and that there was no apparent, direct correlation between "air leads" and levels of lead in the blood.

During the week of December 13, the Environmental Protection Agency published final regulations under the Clean Water Act that establish standards for direct discharges of cadmium, copper, lead, mercury, and zinc into industrial waste waters. For lead the standard is 0.09 parts per million average, with a daily maximum of 0.10 parts per million; there are no provisions for emergency stormwater overflows.

The Mining and Mineral Resources and Research Institute at the University of Missouri-Rolla, which was created under title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines. In addition, a generic mineral technology research center in pyrometallurgy was established with a grant of $1,044,000.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Aluminum.—Aluminum production was nearly 15% below that of 1981. Noranda Aluminum Inc. increased the annual production capacity at its New Madrid smelter during 1982 by adding an 85,000-ton potline using proprietary Aluminum Co. of America (Alcoa) technology. The new potline was to be put into operation in early 1983, but access to the facility is restricted until expiration of the agreement with Alcoa in 1996.

Copper.—In constant dollars, U.S. producers' prices for copper in 1982 were at the lowest point since the 1940's. The current dollar price of wire bar copper averaged 74 cents per pound during 1982, a 12.7% decrease from that of 1981. The quantity of copper recovered as a byproduct from ores mined in the Viburnum Trend decreased 5.6% from that of 1981. AMAX's Buick Mine, the largest producer, was followed in descending order by Magmont, Viburnum No. 29, Viburnum No. 28, Milliken, Fletcher, Brushy Creek, and Indian Creek.

Iron Ore.—Missouri ranked fifth of 12 States in iron ore shipments. Pea Ridge Iron Ore Co., a subsidiary of St. Joe Minerals, operated the Nation's only underground iron mine. The high-grade iron mine and pelletizing plant near Sullivan employed 325 persons at midyear 1982. The facility produced about one-half of its 1.65-million-metric-ton annual pellet capacity because of the reduced demand for domestic steel.

Iron Oxide Pigments.—Shipments and value of crude iron oxide pigments from the Pea Ridge Iron Ore mine in Washington County both increased about 13% over those of 1981. Sales of finished iron oxide pigments decreased 8% during 1982.

Lead.—The 1982 Missouri lode mine production of recoverable lead rose 21.7% over that of 1981 to about 474,500 metric tons. Seven of Missouri's eight lead mines were the Nation's top seven producers during 1982. In descending order of output they were the Buick, Milliken, Fletcher, Magmont, Viburnum No. 29, Viburnum No. 28, and Brushy Creek Mines. The Indian Creek Mine, which closed during the year, ranked 11th.

Ore production at the AMAX-Homestake Buick Mine in 1982 was a record high, about 28% more than in 1981, when ore production was affected by a 2-1/2 month strike; the average mine grade of both lead and zinc improved significantly in 1982, according to Homestake's annual report. Intensive cost-reduction programs begun in late 1981 produced excellent results throughout the year and were the major factors in helping to offset the effects of the lower metal prices.

Total Buick Mine reserves were estimated to be about 36 million metric tons, at an average grade of 5.8% lead and 1.5% zinc (1982 AMAX and Homestake annual reports). The Buick operation milled about 25% of the lode ores produced in Missouri, at an average grade of 7.6% lead and 2% zinc, up 10% and 25%, respectively, over those of 1981 (companies' annual reports). The Buick operation was the largest single lead-concentrate producing unit and the fifth largest zinc-concentrate producer in the United States.

The AMAX-Homestake smelter-refinery southwest of Bixby produced lead from the concentrates produced at their Buick Mine and at Cominco-Dresser's Magmont Mine. Smelter production increased 16% over that of 1981. The smelter has an annual design capacity of 127,000 metric tons of refined lead (1982 AMAX annual report), one-half of which is used for smelting the AMAX-Homestake concentrate production; the oth-

er one-half is committed under long-term contracts that expire in 1983.

Ozark Lead Co., a subsidiary of Standard Oil Co. of Ohio's (Sohio) Kennecott Minerals Co., mined lead and zinc ore from the Milliken Mine, the second largest domestic lead mine. The Milliken produced 80,650 metric tons of lead in concentrates (1982 Sohio annual report), a 15% increase over that of 1981.

The expansion program at the Milliken Mine, including a new shaft that began operation late in 1982, increased production capacity from about 62,000 to about 82,000 metric tons of lead per year. Ore reserves (proved and probable) were estimated to be 24.2 million metric tons, containing about 1.09 million metric tons of recoverable lead and 0.09 million metric tons of recoverable zinc (company annual report at the end of 1981).

Ozark Lead had a work force of 309 hourly and salaried employees at yearend. During 1982, employees agreed to a new 3-year labor contract.

Facilities adjacent to Ozark Lead's Milliken Mine include a concentrator but no smelter. Concentrates were sold directly to Asarco for processing at its custom smelter-refinery at nearby Glover.

Asarco's smelter-refinery at Glover produced 123,600 tons of refined lead in 1982, from Missouri and Illinois concentrates. A newly installed blast furnace, which was completed in 1981, contributed to the effort to reduce concentrate stocks and resulted in production being considerably in excess of the rated capacity.

St. Joe Lead completed its first full year as a wholly owned subsidiary of Fluor Corp. in 1982. St. Joe Lead operated five lead mines (Fletcher, the third largest lead producer; Viburnum No. 29; Viburnum No. 28; Brushy Creek; and Indian Creek) and four mills (Brushy Creek, Fletcher, Indian Creek, and Viburnum) in the State. The mines produced 188,700 metric tons of lead in concentrates during the fiscal year ending October 31, 1982, a 24% increase over that of 1981, according to Fluor's annual report. The mills treated 4.16 million metric tons of ore averaging 4.6% lead during the year. St. Joe Lead had proven reserves of 56.5 million metric tons of ore containing 5% lead. The company expected to have a daily production capacity of 18,000 metric tons of ore late in 1983 when Viburnum No. 35 was to come onstream (see Trends and Developments).

On April 30, St. Joe Lead permanently closed its Indian Creek Mine, but the new Viburnum No. 35 Mine will provide more than double the output of Indian Creek when fully operating.

The lead deposits at Indian Creek in north-central Washington County were discovered by St. Joseph Lead Co. in 1948, about 7 years before the initial discovery in the Viburnum Trend. The 2,500-ton-per-day mine and mill near Potosi went into production at yearend 1953. Indian Creek was the first major development in the western mining area and incorporated some important innovations. The mill was designed exclusively for froth flotation and the mine was fitted with large-scale trackless haulage. In the nearly 28 years of operation, about 15 million metric tons of ore was mined, containing more than 370,000 metric tons of lead and significant amounts of zinc, copper, and silver. The decision to permanently close the Indian Creek Mine was based on declining ore grades and reserves, safety problems in the mine, and on low metal prices, according to company announcements.[12]

During the year, the St. Joe lead smelter-refinery at Herculaneum, the Nation's largest at a rated capacity of 204,000 metric tons per year, produced 195,000 metric tons of lead, a 28% increase over that of 1981.

Cominco and Dresser were joint owners of the Magmont Mine in Iron County. Magmont dropped from its position as the third largest domestic lead producer to fourth in 1982, partly because mining was concentrated in the lower grade East extension while development work continued on the new East ore body (see Trends and Developments). Magmont produced slightly more than 1 million metric tons of ore, averaging 6.5% lead and yielding about 80,800 metric tons of concentrates averaging 78.9% lead, according to Cominco's annual report; inferred ore reserves were given as 3.5 million metric tons grading 3.4% lead and 1.5% zinc for Magmont East and West combined.

Table 4.—Missouri: Tenor of lead ore milled and concentrates produced in 1982

Total material	metric tons	8,530,735
Metal content of ore:[1]		
Copper	percent	.09
Lead	do.	5.74
Zinc	do.	.85
Concentrates produced and average content:		
Copper	metric tons	10,502
Average copper content	percent	29.86
Lead	metric tons	639,253
Average lead content	percent	76.28
Zinc	metric tons	118,261
Average zinc content	percent	58.22

[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)
1978	461,762	$343,070	87.2	529,661	$393,516
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	512,425	288,528

Table 6.—Missouri: Mine production (recoverable) of gold, silver, copper, lead, and zinc

	1980	1981	1982
Mines producing: Lode	8	8	8
Material sold or treated: Lead ore thousand metric tons	9,092	7,729	8,531
Production:			
Quantity:			
Gold troy ounces	W	--	--
Silver do.	2,357,236	1,837,011	2,241,159
Copper metric tons	13,576	8,411	7,941
Lead do.	497,170	389,721	474,460
Zinc do.	62,886	52,904	63,680
Value:			
Gold thousands	W	--	--
Silver do.	$48,653	$19,322	$17,817
Copper do.	$30,655	$15,783	$13,010
Lead do.	$465,393	$313,870	$267,150
Zinc do.	$51,893	$51,966	$54,009
Total do.	W	[1]$400,942	$351,986

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

Silver.—From more than 9.4 million short tons of Missouri lead ores, 2,241,159 troy ounces of silver was produced during 1982, a production total exceeded only four times in the past. When compared with the silver production of 20 and 30 years ago (1962 and 1952), the quantity of silver produced in 1982 increased by 356% and 333%, respectively.

All eight lead-zinc mines in the Viburnum Trend were byproduct silver producers in 1982. In descending order of quantity produced, they were the Buick, Fletcher, Magmont, Milliken, Viburnum No. 29, Viburnum No. 28, Brushy Creek, and Indian Creek Mines. More than 37% of the silver production in the State came from the lead-zinc mines in Iron County. The Buick Mine, ranked 13th in the Nation among 25 leading silver-producing mines, produced ore concentrates containing about 1,050,000 troy ounces of recoverable silver, according to the AMAX and Homestake annual reports. Ozark Lead's Milliken Mine was estimated in the company annual report to have recoverable reserves of silver amounting to 4.3 million troy ounces.

The price of silver averaged $7.95 per troy ounce, a 24.4% decline from the 1981 price.

Zinc.—During 1982, the following mines produced byproduct zinc in decreasing order of amount recovered: Buick, Fletcher,

Magmont, Brushy Creek, Milliken, Viburnum No. 29, and Viburnum No. 28. The Iron County mines—Buick, Magmont, and Viburnum No. 28—accounted for 66% of the State's zinc production. Zinc averaged 38.5 cents per pound in 1982, a 13.6% decline from the 1981 average price.

The relative values of the primary product, byproducts, and coproducts from Missouri's lead-zinc ores during 1982 were lead, 75.9% of total value; zinc, 15.3%; silver, 5.1%; and copper, 3.7%.

NONMETALS

Barite.—Demand in the drilling mud market, which consumed more than 90% of the total national barite supply, dropped significantly during the last half of 1982, and Missouri barite producers slowed down or closed their plants. Missouri, however, was among the few States that continued to supply the nondrilling markets. Producers in the State, in decreasing order of quantity mined, were Dresser, Magcobar Group; De Soto Mining Co.; NL Industries Inc., NL Baroid Div.; Agers Bros. Inc.; and General Barite Co. at its Old Mines pit and plant. General Barite had no production from its Blackwell pit and plant; and Halliburton Co., IMCO Services Div., had no production from its mine at Mineral Point during the year. Milchem Inc., which had ceased mining operations in 1979, continued to operate its barite grinding plant until September 1982; and De Soto permanently shut down its operation November 19. All operations were in Washington County.

Cement.—Among nonmetallic nonfuel minerals produced in the State, cement manufacture again generated the largest value. Missouri ranked 5th in output and 6th in value out of 40 portland cement-producing States, and 8th in output and 11th in value out of 38 masonry cement-producing States. Portland and masonry cement total values, however, decreased 28.6% and 11.6%, respectively, from those of 1981. The value of portland cement was lower in 1982 than for any other year since 1975. On the other hand, masonry value was ranked second behind the 1981 record-high total value.

Two companies, Alpha Portland Cement Co. and Missouri Portland Cement Co., shut down unprofitable and outdated wet-process operations in the St. Louis area.

In April, Lone Star acquired from Gulf + Western Industries Inc. the Marquette Co. and its properties, including its state-of-the-art, dry-process cement plant on the Mississippi River at Cape Girardeau. The 1.2-million-ton plant, considered to be the most efficient cement facility in the United States, increased production capacity in Lone Star's Southwest Region by 40%. An extensive waterborne distribution system expanded and improved the company's ability to serve customers at minimum cost. Under the ownership of Marquette, in 1981, the plant was automated and the new 14.5-foot-diameter, 235-foot-long, 125-ton-per-hour kiln was installed.

Compared with portland cement production a decade ago in 1972 when seven plants were operating, only 63% of capacity was used in 1982, and output was 28% less from five operating plants. Compared with masonry cement production a decade ago when five plants were active, 1982 production was 11.8% less and only three plants produced masonry cement.

In decreasing order of quantity used, finished portland cement was distributed as follows: 76.8% to ready-mix companies, 10.2% to concrete product manufacturers, 8.8% to highway contractors, 1.5% to other contractors, 1.1% to building materials dealers, and the remainder to miscellaneous customers.

During the year, the industry operated seven kilns having a total production capacity of 14,380 tons of cement per 24 hours. Dundee Cement Co., at Clarksville, and Continental Cement Co. Inc., at Hannibal, both used the wet process; Lone Star, at Cape Girardeau, Missouri Portland Cement, at Kansas City, and River Cement Co. (a subsidiary of Instituto Finanzario Industriale S.p.A), at Festus, used the dry process.

The industry consumed 143,620 tons of gypsum, as well as limestone, cement rock, clay, shale, sand, sandstone, pyrite mill scale, fly ash, and bottom ash from powerplants.

Natural gas was the major fuel consumed, 596.3 million cubic feet during the year; other fuels were bituminous coal, fuel oil, and petroleum. Natural gas consumption decreased 18.7% from that of 1981. The amount of purchased electrical energy was nearly 20% less in 1982 than in 1981.

The average value of all types of portland cement in 1982 declined to $37.55 per ton, a 16.9% decrease from the average unit value attained in 1981. Conversely, the average value of masonry cement was $55.49 per ton, a 4.3% increase from that of 1981.

Table 7.—Missouri: Portland cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	7	5
Production	3,621,309	3,104,238
Shipments from mills:		
Quantity	3,731,566	3,205,031
Value	$168,566,558	$120,339,462
Stocks at mills, Dec. 31	460,482	356,586

Table 8.—Missouri: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	4	3
Production	96,289	75,316
Shipments from mills:		
Quantity	103,257	87,505
Value	$5,495,467	$4,855,257
Stocks at mills, Dec. 31	21,955	9,866

Clays.—Missouri continued to rank eighth in the Nation in clay and shale production, even though output decreased 11%. The State ranked first in the Nation as a fire clay producer. Quantities of common clay and shale, fire clay, and kaolin declined 12.6%, 33%, and 19%, respectively, from those of 1981.

Of Missouri's 70 active clay mines, 10 were sources of common clay and shale; 44, fire clay; 2, fuller's earth; and 14, kaolin.

Nine companies produced common clay and shale from 10 mines in Boone, Butler, Cape Girardeau, Crawford, Livingston, Pike, Platte, and Ralls Counties; Dundee in Pike County and Continental in Ralls County were the largest producers.

In decreasing order of quantity produced, 11 companies mined fire clay from 44 pits in Gasconade, Montgomery, Audrain, Callaway, Warren, St. Charles, Franklin, Maries, and Osage Counties. The two largest producers were Kaiser Aluminum & Chemical Corp. and Dresser Industries Inc., Harbison-Walker Refractories Div.

Lowe's Southern Clay Inc. produced fuller's earth from its Broomfield and Oran pits in Stoddard County; and Allied Chemical Corp. produced kaolin from its mines in Gasconade County.

Common clay and shale averaged $3.05 per short ton; fire clay, $19.73; fuller's earth, $60; and kaolin, $23.37.

Harbison-Walker completed the addition to an existing building and the construction of an additional plant at its Vandalia complex in Audrain County. The new plant was built using a 160-foot-wide, clear-span rigid-frame system, which was required to accommodate the manufacturing process. The structure is 225 feet long and 30 feet high.[13]

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
1978	773	12,190	1,434	3,817	51	873	2,258	16,880
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

[1]Data may not add to totals shown because of independent rounding.
[2]Excludes fuller's earth.

Lime.—Lime production declined 21% from that of 1981 because of reduced demand for quicklime and hydrated lime, mainly in the steel industry. Nationally, 30% of the lime produced for water purification came from Missouri.

Mississippi Lime Co.'s plant in Ste. Genevieve County was the Nation's leading lime producer; both hydrated lime and quicklime were produced during 1982. The dolomitic quicklime and dead-burned dolomite lime plant at Bonne Terre in St. Francois County, purchased in March 1980 from Valley Mineral Products Corp. by North American Refractories Co., changed its name to North American Refractories Co. in January 1982.

Ash Grove Cement Co. operated a plant at Galloway near Springfield in Greene County, producing quicklime and hydrated lime.

Perlite (Expanded).—Brouk Co. and Georgia-Pacific Corp. expanded perlite in St. Louis and Crawford Counties. In decreasing order of quantity sold, the perlite was used in concrete aggregate, fillers, soil

conditioners, loose-fill insulation, masonry, and plaster aggregates.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

St. Louis and Clay Counties and St. Louis City were the largest producers of construction sand and gravel during 1982; 11 companies operating 14 of the State's 92 pits produced 53% of Missouri's total construction sand and gravel output from these areas. Throughout the State, 62 companies had 79 operations, but fewer than 20 operations produced more than 100,000 tons each and no operation produced as much as 700,000 tons.

Construction sand and gravel was used, in descending order of volume, for concrete aggregate, road base and coverings and road stabilization, asphaltic concrete aggregate, fill, concrete products (blocks, bricks, etc.), and several other uses. Of the State's 114 counties, 43 produced construction sand and gravel. From 40 of those counties 63% of the material was shipped by truck; the remainder, by rail and waterways or was used at the site.

Unit prices for construction sand and gravel, depending on end use, ranged from $1.43 to $3.21, averaging $2.28 per ton.

Industrial.—The State's largest producer, Pennsylvania Glass Sand Corp., operated industrial sand facilities in St. Charles and St. Louis Counties. Three other companies, UNIMIN Corp., Martin Marietta Aggregates, and Masters Bros. Silica Sand Co., operated quarries in Jefferson County. Of the four quarries, one underground mine, and five plants operated by the four firms, none produced more than 350,000 tons of industrial sand during 1982.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	4,553	$9,505	$2.09
Gravel	NA	NA	NA	1,467	4,258	2.90
Sand and gravel (unprocessed)	NA	NA	NA	338	713	2.11
Total[1] or average	e7,500	e$16,900	e$2.25	6,359	14,477	2.28
Industrial sand	778	8,602	11.06	750	8,997	12.00
Grand total[1] or average	e8,278	e25,502	e3.08	7,108	23,474	3.30

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Table 11.—Missouri: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,241	$8,513	$2.63
Plaster and gunite sands	8	27	3.21
Concrete products	145	428	2.95
Asphaltic concrete	747	1,870	2.50
Road base and coverings[1]	1,712	2,459	1.44
Fill	343	659	1.92
Snow and ice control	68	170	2.49
Other	95	350	3.70
Total or average	6,359	[2]14,477	2.28

[1]Includes road and other stabilization (cement).
[2]Data do not add to total shown because of independent rounding.

About 54% of industrial sand output, valued at $3.8 million, was used to make glass containers; the unit price was $9.49. Industrial sand for ground fillers (used in rubber, paints, glazes, acid-proof cement, etc.) commanded the highest unit price, $62.17, a 32% increase over that of 1981. Industrial sand used as flux for metal smelting brought the lowest price per ton, $7.50, 50 cents higher than that of 1981. The average unit value for all industrial sand uses was $12. More than 57% of industrial sand production was shipped by rail; the remainder was shipped by truck.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and completed the following year.

Missouri ranked 5th in the Nation in crushed stone output and 10th in value in 1982, rising from 11th in value in 1981. In descending order of production the following companies produced limestone in 1982: River Cement's Selma quarry in Jefferson County; Dundee's Clarksville quarry in Pike County; Mississippi Lime's Peerless underground mine, and Tower Rock Stone Co.'s Ste. Genevieve quarry, both in Ste. Genevieve County; and Fred Weber Inc.'s North quarry in St. Louis County. The major producer of crushed granite was Missouri Pacific Corp. from the Gads Hill quarry in Wayne County.

Sulfur (Recovered).—Standard Oil Co. of Indiana's refinery at Sugar Creek in Jackson County was closed in April 1982, and the recovery of elemental sulfur ceased; production for the year was 62% less than that of 1981. Sulfuric acid, a byproduct from Missouri's lead smelters, was 3.6% less than in 1981; its value, however, increased more than 26%.

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 use as insulation (block, loose fill, packing, and pipe covering), aggregates (concrete, plaster, and roofing), agriculture (fertilizer carrier, horticulture, litter, and soil conditioning), and fireproofing and filler. Brouk produced and sold 20% less exfoliated vermiculite than it did in 1981 and received an average value of $300.74 per ton, just less than a 1% price increase over that of 1981.

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[1]State Liaison Officer, Bureau of Mines, Denver, Colo.
[2]Geologist, Missouri Department of Natural Resources, Division of Geology and Land Survey, Rolla, Mo.
[3]Missouri Department of Labor and Industrial Relations, Division of Employment Security. Missouri Area Labor Trends. January 1983, table 1.
[4]———. Missouri Area Labor Trends. Data Month: December 1982, 15 pp.
[5]Engineering and Mining Journal. St. Joe Chief Sees Company Poised for Metals Upturn. V. 183, No. 8, August 1982, p. 11.
[6]Mining Engineering. V. 34, No. 8, August 1982, p. 1208.
[7]Rock Products. Lime-Fly Ash Mixture Re-examined in K.C. V. 85, No. 5, May 1982, p. 26.
[8]Bruell, G. M. Oxygen Enrichment Aids Rotary Kiln Operator. Pit & Quarry, v. 75, No. 11, May 1983, pp. 70-71.
[9]Weakly, L. A. Ore Moving Logistics for Room and Pillar Mines in the Viburnum Trend. Min. Eng., v. 34, No. 4, April 1982, pp. 403-409.
[10]Mining Congress Journal. Fletcher Mine Profile. V. 68, No. 2, February 1982, p. 19.
[11]U.S. Bureau of Land Management. Public Land Statistics, 1982. U.S. Government Printing Office, Washington, D.C., pp. 118-119.
[12]St. Joe Headframe. Operations Cease at Indian Creek Division; The Wheels of Production Stop. V. 18, No. 2, Summer 1982, pp. 5-6.
[13]Brick & Clay Record. New Harbison-Walker Vandalia, Mo., Plant Completed. V. 180, No. 5, May 1982, p. 15.

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.
Dresser Industries Inc	Box 8 Potosi, MO 63664	Mine and mill	Do.
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	One Greenwich Plaza Box 5050 Greenwich, CT 06836	Quarries and plants	Cape Girardeau, Jackson, St. Louis.
River Cement Co., a subsidiary of Instituto Finanzario Industriale S.p.A.[2]	Box 14545 Festus, MO 63028	Quarry and plant	Jefferson.
Clays:			
Allied Chemical Corp., Industrial Chemicals Div.	Box 517 Owensville, MO 65066	Mine and plant	Gasconade.

See footnotes at end of table.

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Clays —Continued			
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	Mine 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:[3]			
AMAX Lead Co. of Missouri and Homestake Mining Co.	Boss, MO 65440	do	Iron.
Cominco American Incorporated	Bixby, MO 65439	do	Do.
Ozark Lead Co., a subsidiary of Kennecott Minerals Co., a subsidiary of Standard Oil Co. of Ohio.	Sweetwater, CPO Ellington, MO 63680	do	Reynolds.
St. Joe Lead Co., a division of St. Joe Minerals Corp., a subsidiary of Fluor Corp.	Box 500 Viburnum, MO 65566	Underground mines and plants.	Iron, Reynolds, Washington.
Lime:			
Ash Grove Cement Co.[2]	920 Main St. Suite 1000 Kansas City, MO 64105	Plant	Greene.
Mississippi Lime Co.[2]	7 Alby St. Alton, IL 62002	Quarry and plant	Ste. Genevieve.
North American Refractories Co., a division of Allied Chemical Corp.	Locus St. Farber, MO 63345	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.
Limited Leasing Co., a subsidiary of St. Charles Sand Co.	Route 1, Box 158 Hazelwood, MO 63042	do	St. Charles and St. Louis.
Riverside Sand & Dredging Co., a subsidiary of Moline Consumers Co.	5000 Bussen Rd. St. Louis, MO 63129	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[2]	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	do	St. Charles and St. Louis.
UNIMIN Corp	South Locust Ave. 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.[4]	313 16th St. Moline, IL 61265	Quarries	Jefferson, Knox, 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, Cole, St. Louis, Scott.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	St. Louis.

[1] Also clays.
[2] Also stone.
[3] Also silver, copper, and zinc.
[4] Also sand and gravel in Lewis County.

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 H. R. Babitzke,[1] E. C. Bingler,[2] and D. C. Lawson[3]

The value of nonfuel mineral production in Montana was $267 million in 1982, a decrease of 12% from that of 1981. The value of the metals produced—antimony, copper, gold, iron ore, lead, silver, tungsten, and zinc—accounted for 64% of the total nonfuel mineral value in 1982. The nonmetallic minerals—barite, cement, clays, gem stones, graphite, gypsum, lime, peat, phosphate rock, sand and gravel, stone, talc, and vermiculite—accounted for the remainder. The gains made by gold and silver production were not adequate to offset the large losses in copper, clays, and cement production.

Compared with that of other States, Montana's production value ranked in the top four in 1982 for clays, copper, gold, and silver, and first in talc and vermiculite. Montana was the only producing State for amorphous graphite, and one of only two producing antimony.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony—short tons	214	W	209	W
Clays—thousand short tons	601	$23,111	[2]218	[2]$8,064
Copper (recoverable content of ores, etc.)—metric tons	62,485	117,257	57,086	93,521
Gem stones	NA	100	NA	225
Gold (recoverable content of ores, etc.)—troy ounces	54,267	24,943	75,171	28,258
Lead (recoverable content of ores, etc.)—metric tons	194	157	661	372
Lime—thousand short tons	194	7,621	45	2,331
Sand and gravel (construction)—do	e5,640	e12,910	5,338	12,794
Silver (recoverable content of ores, etc.)—thousand troy ounces	2,989	31,437	6,169	49,041
Stone (crushed)—thousand short tons	1,582	5,137	p1,400	p4,700
Zinc (recoverable content of ores, etc.)—metric tons	25	24	W	W
Combined value of barite, cement, clays (fire clay, 1982), graphite (1982), gypsum, iron ore, peat, phosphate rock, sand and gravel (industrial), stone (dimension), talc, tungsten ore and concentrate, vermiculite, and values indicated by symbol W	XX	80,384	XX	67,288
Total	XX	r303,081	XX	266,594

eEstimated. pPreliminary. 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 Montana, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Beaverhead	$1,119	$402	Silver, stone (crushed), lead, gold, copper, zinc.
Big Horn	567	(3)	
Broadwater	41	W	Gold, tungsten, silver, zinc, lead, copper.
Carbon	W	W	Clays, stone (crushed).
Carter	W	W	Clays.
Cascade	W	W	Stone (crushed), silver, lead, zinc.
Chouteau	W	(3)	
Daniels	28	(3)	
Dawson	618	(3)	
Deer Lodge	9,021	6,053	Lime, stone (crushed), copper, clays, silver, lead.
Fergus	W	852	Gypsum, gold, silver, copper, lead, zinc.
Flathead	2,778	206	Stone (crushed).
Gallatin	17,736	21,949	Cement, stone (crushed), clays.
Granite	6,646	W	Silver, gold, copper, lead, zinc.
Hill	W	(3)	
Jefferson	18,900	19,529	Cement, stone (crushed), silver, gold, lead, clays, copper, zinc.
Judith Basin	W	W	Gypsum.
Lake	W	6	Peat.
Lewis and Clark	1,718	W	Lead, gold, zinc, silver, copper.
Liberty	W	(3)	
Lincoln	W	W	Vermiculite, silver, copper, lead, gold.
Madison	12,183	W	Talc, copper, silver, gold, stone (crushed), lead, zinc.
Meagher	4	W	Iron ore, gold.
Mineral	W	(3)	
Missoula	W	4,269	Barite, stone (crushed).
Musselshell	48	(3)	
Park	621	155	Stone (dimension), silver, sand and gravel (industrial), lead.
Petroleum	35	(3)	
Phillips	29,908	W	Gold, silver.
Pondera	W	(3)	
Powell	W	W	Phosphate rock.
Ravalli	W	W	Peat, silver, zinc, lead, gold, copper.
Richland	W	W	Lime.
Rosebud	345	(3)	
Sanders	W	W	Antimony, lead, silver, copper.
Sheridan	48	(3)	
Silver Bow	126,035	W	Copper, silver, gold, sand and gravel (industrial).
Stillwater	W	10	Stone (crushed).
Teton	9	--	
Toole	168	(3)	
Valley	W	W	Clays.
Wibaux	9	(3)	
Yellowstone	W	W	Lime.
Undistributed[4]	50,959	236,736	
Sand and gravel (construction)	XX	e12,910	
Total[5]	279,550	303,081	

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

[1]Blaine, Custer, 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.

[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 stone production that cannot be assigned to specific counties and values indicated by symbol W.

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

Trends and Developments.—The new ASARCO Incorporated Troy Mine in Lincoln County boosted silver mine output to a record level in the State since 1953. Commercial production at the mine began in 1981, and in its first full year of operation in 1982, the company produced at its capacity level of 4.2 million troy ounces of silver, making it the top silver producer of any mine in the United States. The mine also produced 8,210 metric tons of copper. The Troy Mine demonstrated that hard-rock mining can coexist with the pristine environment by functioning with minimum disturbance to the surrounding area. Mining of the 48-million-ton ore body is expected to continue for 16 years.

Table 3.—Indicators of Montana business activity

		1981	1982[P]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	383.0	391.0	+2.1
Unemployment	do	27.0	34.0	+25.9
Employment (nonagricultural):				
Mining[1]	do	11.5	9.6	-16.5
Manufacturing	do	23.2	20.1	-13.4
Contract construction	do	13.3	12.3	-7.5
Transportation and public utilities	do	22.6	21.8	-3.5
Wholesale and retail trade	do	72.9	72.4	-.7
Finance, insurance, real estate	do	12.9	12.8	-.8
Services	do	56.1	55.8	-.5
Government	do	69.3	67.1	-3.2
Total nonagricultural employment[1]	do	281.8	271.9	-3.5
Personal income:				
Total	millions	$7,460	$7,810	+4.7
Per capita		$9,412	$9,750	+3.6
Construction activity:				
Number of private and public residential units authorized		1,954	1,906	-2.5
Value of nonresidential construction	millions	$85.6	$86.5	+1.0
Value of State road contract awards	do	$61.0	$79.4	+30.2
Shipments of portland and masonry cement to and within the State	thousand short tons	302	229	-24.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$303.1	$266.6	-12.0
Value per capita, resident population		$388	$333	-14.2
Value per square mile		$2,073	$1,812	-12.6

[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.

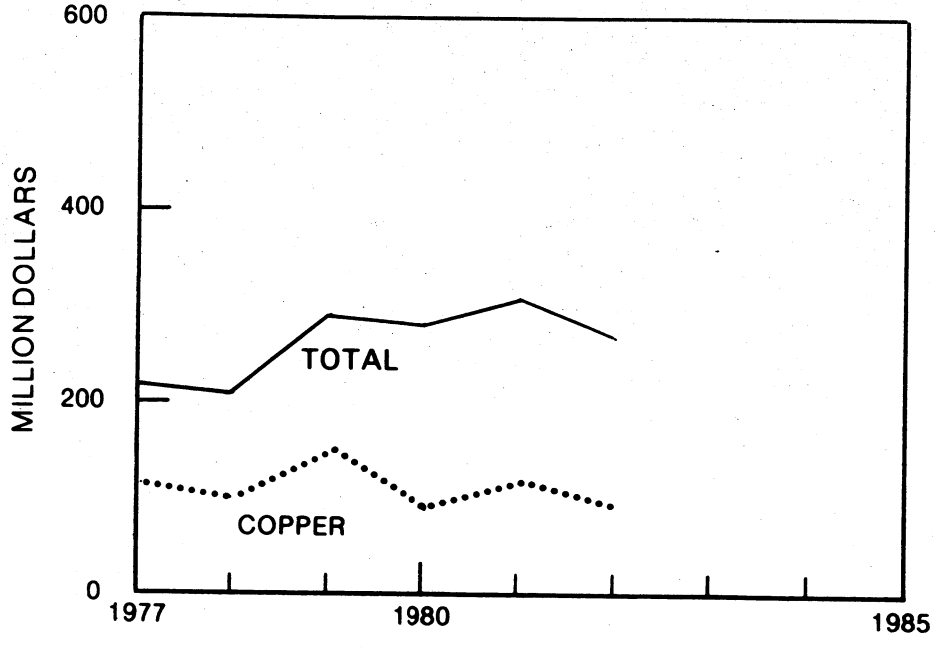

Figure 1.—Value of copper and total value of nonfuel mineral production in Montana.

Effective January 1, 1982, Anaconda Copper Co. changed its name to The Anaconda Minerals Co. Anaconda Minerals is a unit of Atlantic Richfield Co. In April, Anaconda Minerals laid off 270 Butte workers when it abandoned the 2,000-foot-deep Berkeley Pit copper mine in Silver Bow County. Pumps were stopped and flooding of the underground mines began. With a reduced work force, the company shifted operations to the smaller East Berkeley Pit. It was projected that mining there would continue at the rate of 42,000 tons of ore per day. Beginning in February 1982, the ore was processed at the Weed concentrator. In addition to copper concentrates, the plant also processed a molybdenum concentrate. The copper concentrate was transported by rail to Vancouver, British Columbia, Canada. In 1981, Anaconda signed an agreement to ship 400,000 tons of copper concentrate to Japan, beginning in July 1982.

The Anaconda Aluminum Co., a division of Atlantic Richfield Co., at Columbia Falls, continued to suffer cutbacks in aluminum production with the closure of two potlines in February. More cuts were scheduled for early 1983. The reduction was the result of a slack aluminum market, compounded by electrical rate increases from the Bonneville Power Administration. Three potlines were still operating at yearend. During the year, construction began to replace the casting plant at the Columbia Falls facility to enable the use of current environmental technology and a more energy efficient system to produce aluminum ingot. Completion was scheduled for yearend 1983.

On October 1, Asarco shut down indefinitely its zinc fuming operation in East Helena. The shutdown was due to depressed zinc markets.

Placer Amex Inc. continued development of its Golden Sunlight mineral claims near Whitehall, in Jefferson County. Construction of the roads and plant was nearly complete at yearend, with production startup scheduled for February 1983. Anticipated annual production was about 72,000 troy ounces of gold. The property contains about 26 million tons of minable ore at an average grade of 0.050 troy ounce of gold per ton. Mining will be by open pit.

Zortman & Landusky Mining Inc. continued to improve its two gold properties in the Little Rockies with an enlarged assay office, new recovery plants, and modification of the existing leach pads.

A significant development for industrial minerals was the startup in September of Continental Lime Inc.'s Indian Creek plant northwest of Townsend, in Broadwater County. Construction of the plant and a loading facility began in September 1981. The mine can supply 1,000 tons of ore per day to the plant, which has the capacity to produce 500 tons of quicklime per day.

Legislation and Government Programs.—A total of 14 mineral-related contracts amounting to $417,695 was granted during fiscal year 1982 to the Montana College of Mineral Science and Technology (Montana Tech) and others by the U.S. Bureau of Mines. Montana Tech was also awarded a $150,000 general assistance grant. This was a title III grant authorized under the Surface Mining and Reclamation Act of 1977 (Public Law 95-87).

During the year, the Montana Bureau of Mines and Geology (MBMG) responded to more than 18,000 mineral-related public inquiries, published 19 reports and maps, and released 18 open file reports. The Geology and Mineral Resources Division of MBMG conducted mineral-potential investigations, including topical studies of mineral deposits, in support of the State map-atlas program for characterization and analysis of major mining districts and for regional assessment of geologic hazards. Major projects included a compilation and review of Montana barite deposits, geochemical targeting of lode gold and volcanogenic metal sulfide deposits in the Rochester district, regional analyses of favorable geologic environments for stratabound and stratiform precious metals and base metal ore deposits, regional evaluation of metalliferous oil shale deposits in central Montana, and a regional appraisal of economic mineral potential in the Belt 1:100,000-scale quadrangle, also in central Montana.

Montana received about $92 million, or 19.6% of State tax revenues, from special mineral taxes in 1982, and also received $17.6 million from mineral leases on Federal lands in the State.

Exploration Activities.—The level of exploration activity decreased during the year as a result of generally lower metal prices. Most new exploration and development involved precious metals. Despite the decreased activity, the number of exploration licenses granted by the State increased—161 licenses compared with 155 in 1981. These licenses were granted to 64 companies compared with 55 in 1981. The number of small-mine exclusion permits increased

from 1,248 in October 1981 to 1,360 as of September 22, 1982.

Both Asarco and the U.S. Borax & Chemical Corp. drilled in the Chicago Peak area of the Cabinet Mountains Wilderness. Asarco, in its fourth season, drilled 22 holes, and U.S. Borax, in its first season, drilled 11 holes in exploration for stratabound copper and silver in the Revett Formation of the Precambrian Belt Subgroup. In its first 3 years, Asarco had drilled more than 60 holes under provisions of the Federal Wilderness Act of 1964. Plans have been submitted to the U.S. Forest Service by both companies for approval of drilling during the next season. The Cabinet Mountains Wilderness area covers 94,274 acres in the Kootenai and Kaniksu National Forests. Chevron USA Inc. and Exxon Co. USA also filed notice of intent to conduct exploratory drilling inside and outside the wilderness area. Canyon Gold Properties of Sandpoint, Idaho, also filed to reopen a gold mine in the Kootenai National Forest that was active in the 1930's.

Noranda Mines Ltd. evaluated Coeur d'Alene-type vein mineralization adjacent to the Nancy Lee Mine northwest of Superior. Noranda also explored for gold and silver in Flume Gulch, northwest of Butte. AMAX Exploration Inc. drilled on a prospect at Marysville, northwest of Helena. The Elkhorn silver mine area was the site of considerable geothermal and geophysical exploration by Pioneer Nuclear Co.

Denison Mines Ltd. explored in the Pony district north of Philipsburg, Mavros Associates explored in the Anaconda Pintlar Wilderness, and St. Joe American Minerals Co. conducted core drilling in the Mill Creek Falls area southeast of Anaconda. Anaconda Minerals drilled for stratabound copper in the southern part of the Pioneer Range. Anaconda Minerals also did exploration work at the Mayflower Mine southeast of Whitehall. Cyprus Exploration Co. drilled on its Black Lion Prospect in the east Pioneers. Freeport Exploration Co. completed a drilling project northwest of the Golden Sunlight Mine near Whitehall. Hecla Mining Co. explored the Florence-Queen groups of claims near Neihart and found ore-grade silver-lead intercepts. Hecla and Goldfields Mining Co. evaluated a property for gold in the North Moccasin Mountains. Meridian Land and Minerals Co. continued exploration on its block of claims situated between gold deposits at Zortman & Landusky. Homestake Mining Co. was conducting a detailed evaluation of all its past exploration work done in the Jardine gold district. Molycorp Inc. conducted exploration in the Big Belt Mountains northeast of Townsend in Broadwater County.

PGM Resources Inc. and Chevron continued mapping and drilling on their extensive holdings of the platinum-palladium J-M Reef in the Stillwater Complex. A joint venture was being negotiated with Anaconda Minerals, which holds claims on the Howland Reef, also a platinum-palladium horizon.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Metals accounted for 64% of the total value of nonfuel mineral production in Montana in 1982. Despite the low prices of base metals and other difficulties with the general recession, there were several positive developments in the State's metal mining industry, especially for gold and silver.

Antimony.—The U.S. Antimony Corp. mined and processed ore in Sanders County. All production was from the Babitt, Bardot, and Black Jack Mines at Thompson Falls. The U.S. Antimony plant was one of only two in the Nation that produced antimony in 1982, and Montana was the only State with recorded mine production of stibnite.

Copper.—Copper was recovered from the ores of 12 mines in 8 counties in 1982. This compares with production from 20 mines in 11 counties in 1981. The copper produced by Anaconda Minerals in Butte accounted for 84% of the State's total production value for copper. Montana's copper production ranked fourth in the Nation in quantity and value, accounting for about 5% of the primary production in 1982, compared with 4% in 1981. Production was down 9% in quantity and 20% in value from that of 1981.

Gold.—Gold was recovered from the ores of 22 mines in 9 counties in 1982. Recovery was also from retreatment of old mine tailings and from placer operations. Montana ranked fourth in the Nation in primary gold production, accounting for 5% of the total U.S. production. Zortman & Landusky, with its heap leaching operation in

Phillips County, produced 93% of the total gold recovered in the State in 1982. That operation placed Phillips County first in the State in gold production for the third consecutive year.

Molybdenum.—With completion of the molybdenum circuit in its Weed concentrator, Anaconda Minerals produced molybdenum concentrate from ores mined at the East Berkeley Pit at Butte. All concentrates were shipped out of State to both domestic and foreign destinations.

Silver.—Asarco produced 69% of Montana's silver in 1982, at the Troy Mine in Lincoln County. Total production was 4.2 million troy ounces of silver valued at $34 million. Anaconda Minerals produced 12% of the State's silver at its Butte operation in Silver Bow County. There was a total of 28 mines producing silver in 9 counties during the year. Production more than doubled that of 1981, and value increased 56%. Montana produced 15% of the Nation's silver in 1982, ranking third in a move up from fifth in 1981.

Table 4.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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]	12	3,522,468	67,924	147,079	W	4	--
Gold-silver	4	11,151	538	29,821	7	98	W
Silver	9	2,765,481	W	5,246,510	W	559	W
Total	25	6,299,100	W	5,423,410	W	661	W
Copper	1	12,846,681	W	739,338	43,087	--	--
Other lode material:							
Gold tailings	--	174,306	W	5,963	W	(3)	
Copper precipitates	1	7,677	--	--	5,057	--	--
Grand total	26	19,327,764	[4]75,171	6,168,711	[4]57,086	661	W

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 zinc are recovered from tailings only are not counted as producing mines.
[2]Includes material that was leached.
[3]Less than 1/2 unit.
[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		Material sold or treated[1] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1980, total	26	1	8,760,354	48,366	$29,627,079	2,023,893	$41,773,150
1981, total	41	1	14,824,914	54,267	24,943,285	2,988,810	31,437,409
1982:							
Beaverhead	2	--	W	W	W	W	W
Broadwater	5	--	17,637	W	W	837	6,654
Granite	3	--	W	W	W	W	W
Jefferson	7	--	11,190	547	205,623	30,267	240,622
Lincoln	1	--	2,579,021	W	W	4,243,075	33,732,446
Madison	4	--	4,733	W	W	1,210	9,620
Meagher	1	--	8	14	5,263	4	32
Phillips	2	--	3,672,093	69,550	26,144,540	151,536	1,204,711
Silver Bow	1	--	12,854,357	3,361	1,263,434	739,338	5,877,737
Total	26	--	[2]19,327,764	[2]75,171	[2]28,257,533	[2]6,168,711	[2]49,041,253

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1980, total	37,749	$85,236,299	295	$276,441	71	$58,758	$156,971,727
1981, total	62,485	117,257,165	194	156,574	25	24,166	173,818,599

See footnotes at end of table.

Table 5.—Montana: 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	
1982:							
Beaverhead	W	W	W	W	W	W	W
Broadwater	W	W	4	$2,142	--	--	W
Granite	W	W	W	W	W	W	W
Jefferson	7	$10,876	99	55,656	W	W	W
Lincoln	8,193	13,422,226	W	W	--	--	[2]$47,475,632
Madison	W	W	1	492	--	--	W
Meagher	--	--	--	--	--	--	5,295
Phillips	W	W	W	W	--	--	[2]27,349,384
Silver Bow	48,144	78,872,000	--	--	--	--	86,013,171
Total	[2]57,086	[2]93,521,447	[2]661	[2]372,410	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1]Does not include gravel washed.
[2]Includes items indicated by symbol W.

Table 6.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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	67,582	146,217	--	--	--
Smelting of concentrates from:					
Ore	W	5,975,641	52,025	623	W
Tailings	W	5,963	W	[1]	--
Direct smelting of:					
Ore	314	40,890	W	38	W
Precipitates	--	--	5,057	--	--
Total lode material	[2]75,171	6,168,711	[2]57,086	661	W

W Withheld to avoid disclosing company proprietary data.
[1]Less than 1/2 unit.
[2]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)
1978	1	16,233	16,949	2,281
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
1882-1982	--	[1]535,729	2,684,239	683,037

	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)	Total value (thousands)
1978	66,741	--	--	$113,446
1979	69,133	--	--	177,800
1980	37,467	--	--	124,602
1981	59,477	--	--	139,555
1982	48,144	--	--	86,013
1882-1982	8,684,136	415,442	2,406,823	5,997,036

[1]Complete data not available for 1882-1904.

NONMETALS

As with metal mining, production of industrial minerals was adversely affected by the recession. Major developments were Continental Lime's new Indian Creek quarry and plant; the Cyprus Industrial Minerals Co., a subsidiary of AMOCO Minerals Co., construction of an expanded facility for sorting talc, south of Ennis; and increased exploration activities for talc in southwestern Montana.

Barite.—During 1982, barite was mined at the underground Elk Creek Mine in the Garnet Range, which was reopened in 1981. Mining also continued at the Kenelty open pit mine southeast of Libby and at a smaller mine east of Hamilton. The ore from these mines was processed at the Montana Barite Co. Inc. plant at Missoula. Production declined from that of 1981.

Cement.—Portland cement was produced at two plants in 1982; Ideal Basic Industries Inc. at Trident and Kaiser Cement Corp. at Montana City. Both plants used coal and natural gas as fuel. Ideal Basic and Kaiser Cement produced masonry cement. Ideal Basic stopped production in July and December to reduce inventories. Cement production decreased significantly from that of 1981 owing to the general recession and a decrease in construction activity. Production of cement was from locally mined limestone. The cement produced in the State was used by ready-mix concrete companies (59%), other contractors (25%), highway contractors (6%), concrete product manufacturers (5%), building material dealers (3%), and government agencies and miscellaneous customers (2%). Raw materials used in the manufacture of cement were limestone, clays, sandstone, sand, iron ore, slag, gypsum, and other additives. Shipments to the users were by truck and rail.

Clays.—Montana ranked third in bentonite production in 1982. Production was by 8 companies from 15 mines in 6 counties, and was down 64% in quantity and 65% in value from that of 1981. The decreased demand for bentonite by the drilling industry, as well as a slackened demand by the steel industry, resulted in a slow market for this commodity. Exploration for bentonite dropped off substantially from that of 1981, although some activity was reported in the Malta area. The material was used mainly for drill mud, iron ore pellets, and foundry sand.

Graphite.—Montana was the only producing State for amorphous graphite in 1982. National Minerals Corp. started production in 1982 in Broadwater County and was the sole producer.

Gypsum.—United States Gypsum Co. continued to mine 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. continued to mine gypsum from two open pit mines south of Raynesford in Judith Basin County. The gypsum produced was shipped to the Kaiser Cement plant at Montana City and to Ideal Basic at Trident. Production was at about the same level as that of 1981.

Lime.—Continental Lime, Holly Sugar Corp., and Great Western Sugar Co. produced lime in Broadwater, Richland, and Yellowstone Counties. Production declined to about one-fourth that of 1981. The lime produced was used in metallurgical processes, pollution abatement, and sugar refining.

Phosphate Rock.—Cominco American Inc. continued to mine phosphate rock from its underground Warm Springs Mine in Powell County. This was the 53d consecutive year of phosphate rock mining in Powell County. The product was shipped to Canada for further processing.

Sand and Gravel.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted in 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Production of construction sand and gravel has declined since 1980. Record highs were recorded in 1979 for quantity and in 1980 for value. In 1982, four counties—Cascade, Flathead, Silver Bow, and Yellowstone—accounted for 61% of the State's total sand and gravel production tonnage. Major uses were for road base and coverings (50%), concrete aggregate (17%), fill (14%), asphaltic concrete (13%), and other uses (6%). Most of the sand and gravel was transported by truck (87%). Industrial sand and gravel was produced only in Beaverhead and Park Counties.

Table 8.—Montana: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	883	$2,826	$3.20
Plaster and gunite sands	W	W	3.20
Concrete products	60	253	4.23
Asphaltic concrete	712	2,021	2.84
Road base and coverings[1]	2,636	5,998	2.28
Fill	750	1,164	1.55
Snow and ice control	98	172	1.76
Railroad ballast	W	W	4.50
Other	200	361	1.81
Total[2] or average	5,338	12,794	2.40

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (cement).
[2]Data may not add to totals shown because of independent rounding.

Table 9.—Montana: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	891	$2,508	$2.82
Gravel	NA	NA	NA	3,455	8,937	2.59
Sand and gravel (unprocessed)	NA	NA	NA	993	1,349	1.36
Total or average	e5,640	e$12,910	e$2.29	[1]5,338	12,794	2.40
Industrial sand	W	W	r12.06	W	W	5.20
Grand total or average	W	W	e2.38	W	W	2.42

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

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The estimates will be revised the following year. In view of the above, the principal producers shown for stone in table 10 are based on 1981 data.

Based on a 9-month preliminary survey, conducted in October 1982, it was estimated that production and value of stone declined 12% and 9%, respectively, from that of 1981.

Sulfur (Recovered).—Montana Sulphur & Chemical Co. and Farmers Union Central Exchange recovered sulfur as a byproduct from petroleum refineries in Yellowstone County.

Talc.—Montana was the leading producing State for talc in 1982. All of the talc mined was from Madison County. Cyprus Industrial Minerals began construction of a new expanded sorting facility at the Yellowstone Mine, which was scheduled for completion in 1983. The talc mined in 1982 was processed at the Cyprus plant at Three Forks. In October, production was reduced at the Yellowstone Mine in order to consume the excess inventory and because the industry had been affected adversely by the general recession. The Beaverhead Mine became inactive, but Cyprus Industrial Minerals continued to sort and ship talc from the stockpiled ore. Pfizer Inc. continued to mine talc from its Treasure Chest Mine. All the talc mined was milled at Pfizer's plant south of Dillon. The talc produced in Montana was used primarily in ceramics, cosmetics, insecticides, paint, paper, plastics, roofing, and rubber.

Exploration for talc proceeded at a substantial pace in southwestern Montana dur-

ing 1982, with at least four companies involved other than the two producers.

Vermiculite.—Montana was the leading producing State for vermiculite in 1982. W. R. Grace & Co. continued to produce crude vermiculite from its Rainy Creek Mine in Lincoln County. Robinson Insulation Co. at Great Falls, Cascade County, produced exfoliated vermiculite. Construction was underway on an exfoliated vermiculite plant at the Gilliam Vermiculite Properties near Pony, in Lincoln County. No date for production was announced.

[1]State Liaison Officer, Bureau of Mines, Spokane, Wash.
[2]Director, Montana Bureau of Mines and Geology, Butte, Mont.
[3]Staff field agent, Montana Bureau of Mines and Geology, Butte, Mont.

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.	Box 460 Belle Fourche, SD 57717	Pits	Carter.
Copper:			
The Anaconda Minerals Co.[2]	Box 689 Butte, MT 59701	Open pit mine and plant	Silver Bow.
Gold:			
Zortman & Landusky Mining Inc.[3]	Zortman, MT 59546	do	Do.
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:			
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:			
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.[6]	Box 610 Philipsburg, MT 59858	Underground mine	Granite.
Midnite Mines Inc.[7]	14040 NE. 8th St. Suite 105, Bldg. C Bellevue, WA 98007	Surface mine	Beaverhead.
Stone (1981):			
DeAtley Corp	Box 648 Lewiston, ID 83501	Quarry	Flathead.
Janney Construction Co. Inc	Box 517 Deer Lodge, MT 59722	do	Missoula.
Weaver Construction Co	Box 817 Iowa Falls, IA 50126	Quarries	Carbon and Granite.
Sulfur (recovered):			
Montana Sulphur & Chemical Co	Box 31118 Billings, MT 59107	Plant	Yellowstone.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
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.
Pfizer Inc	Box 1147 Dillon, MT 59725	____do	Do.
Vermiculite:			
W. R. Grace & Co., Zonolite Div	62 Whittemore Ave. Cambridge, MA 02140	____do	Lincoln.

[1]Also clays and stone.
[2]Also gold, molybdenum, and silver.
[3]Also silver.
[4]Also stone.
[5]Also copper, gold, and lead.
[6]Also copper, gold, lead, and zinc.
[7]Also gold, lead, and zinc.

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 Jane P. Ohl[1]

The value of nonfuel minerals produced in Nebraska in 1982 was $79.6 million; this was an insignificant decrease from that of 1981. In 1972 constant dollars, the value of nonfuel minerals in Nebraska declined about 12% in the 1972-82 decade. Nonfuel mineral activity in the State was centered on the construction commodities—portland cement, sand and gravel, and crushed stone. Although portland cement and crushed stone increased in value per short ton during the year, only crushed stone gained in total value.

During 1982, Cass County ranked first in value of nonfuel mineral production—including cement but excluding stone—followed by Nuckolls, Douglas, and Saunders Counties.

From January through December 1982, employment in Nebraska's mining industry declined more than 20%.[2]

Trends and Developments.—In late May, Gould Inc. announced plans to suspend operations indefinitely at its secondary lead smelter in Omaha.

ASARCO Incorporated, United Steelworkers of America, and the Occupational Safety and Health Administration (OSHA) reached agreement on controls and procedures for complying with OSHA's arsenic control standards at Asarco's Omaha lead refinery.

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

Mineral		1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
Clays	thousand short tons	136	$409	134	$392
Sand and gravel:					
Construction	do.	e11,770	e28,310	11,282	28,128
Industrial	do.	19	144	14	105
Stone (crushed)	do.	3,139	14,024	p3,100	p14,300
Combined value of cement, gem stones, and lime		XX	36,718	XX	36,632
Total		XX	r79,605	XX	79,557

eEstimated. pPreliminary. rRevised. 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 Nebraska, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Antelope	$342	(3)	
Box Butte	--	$2	Stone (crushed).
Brown	W	(3)	
Buffalo	835	(3)	
Burt	1	(3)	
Butler	338	(3)	
Cass	W	W	Cement, stone (crushed), clays.
Cedar	W	(3)	
Chase	123	(3)	
Cheyenne	45	(3)	
Clay	W	(3)	
Colfax	766	(3)	
Cuming	W	(3)	
Custer	556	(3)	
Dawson	1,082	(3)	
Deuel	100	(3)	
Dixon	W	(3)	
Dodge	644	(3)	
Douglas	W	2	Clays.
Dundy	W	(3)	
Fillmore	W	(3)	
Franklin	327	(3)	
Frontier	W	(3)	
Furnas	70	(3)	
Gage	W	W	Stone (crushed).
Garden	W	(3)	
Grant	9	(3)	
Hall	1,135	(3)	
Hamilton	W	(3)	
Hayes	W	(3)	
Hitchcock	125	(3)	
Holt	543	(3)	
Howard	W	(3)	
Jefferson	W	245	Clays.
Kearney	53	(3)	
Keith	152	(3)	
Knox	344	(3)	
Lancaster	W	W	Stone (crushed), clays.
Lincoln	251	(3)	
Loup	W	(3)	
Madison	894	(3)	
Merrick	226	(3)	
Morrill	W	W	Lime.
Nance	201	(3)	
Nemaha	W	W	Stone (crushed).
Nuckolls	W	W	Cement, stone (crushed).
Pawnee	W	W	Stone (crushed).
Perkins	5	(3)	
Phelps	W	(3)	
Pierce	382	(3)	
Platte	703	(3)	
Polk	111	(3)	
Red Willow	239	(3)	
Richardson	--	(3)	
Rock	W	(3)	
Sarpy	W	230	Stone (crushed), clays.
Saunders	W	W	Stone (crushed), sand and gravel (industrial).
Scotts Bluff	W	W	Lime.
Seward	86	105	Stone (crushed).
Sheridan	W	(3)	
Stanton	387	(3)	
Thayer	815	(3)	
Thomas	W	(3)	
Valley	569	(3)	
Washington	W	W	Stone (crushed).
Webster	W	(3)	
York	173	(3)	
Undistributed[4]	67,842	50,710	
Sand and gravel (construction)	XX	e28,310	
Total	80,474	[5]79,605	

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, Arthur, Banner, Blaine, Boone, Boyd, Cherry, Dakota, Dawes, Garfield, Gosper, Greeley, Harlan, Hooker, Johnson, Keya Paha, Kimball, Logan, McPherson, Otoe, Saline, Sherman, Sioux, Thurston, Wayne, and Wheeler.

[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 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 Nebraska business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	774.0	787.0	+1.7
Unemployment	do	32.0	48.0	+50.0
Employment (nonagricultural):				
Mining[1]	do	1.9	1.8	-5.3
Manufacturing	do	94.9	86.5	-8.9
Contract construction	do	26.1	21.3	-18.4
Transportation and public utilities	do	47.4	44.3	-6.5
Wholesale and retail trade	do	161.8	156.8	-3.1
Finance, insurance, real estate	do	41.2	41.3	+.2
Services	do	120.1	122.8	+2.2
Government	do	129.7	128.7	-.8
Total nonagricultural employment[1]	do	[2]623.2	603.5	-3.2
Personal income:				
Total	millions	$16,344	$16,632	+1.8
Per capita		$10,366	$10,489	+1.2
Construction activity:				
Number of private and public residential units authorized		4,101	4,072	-.7
Value of nonresidential construction	millions	$131.6	$127.1	-3.4
Value of State road contract awards	do	$70.7	$110.1	+55.7
Shipments of portland and masonry cement to and within the State	thousand short tons	679	687	+1.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$79.6	$79.6	--
Value per capita, resident population		$47	$50	+6.4
Value per square mile		$958	$1,030	+7.5

[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.

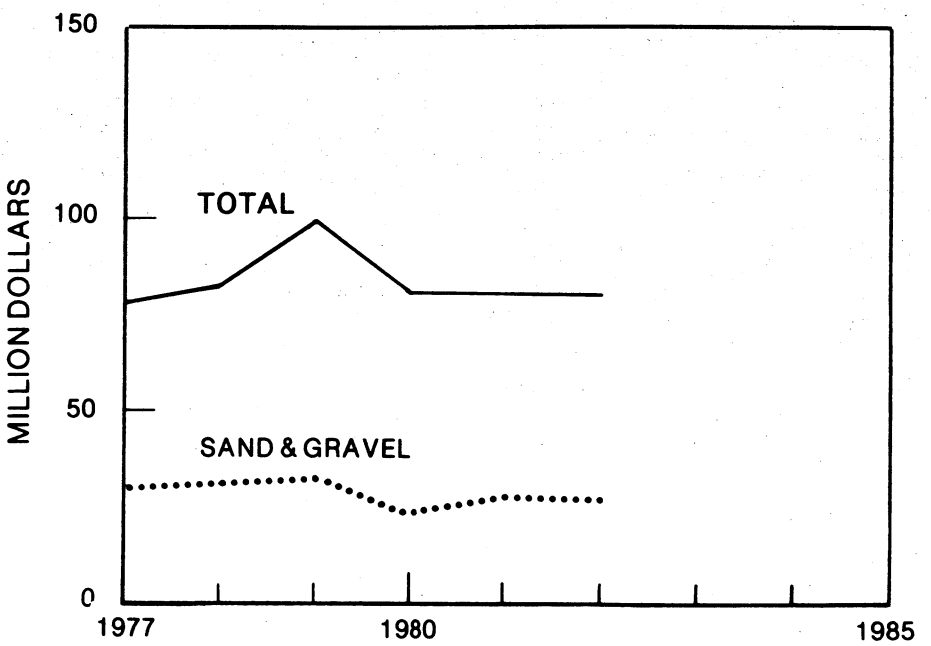

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Nebraska.

Molycorp Inc. exploration teams worked at a carbonatite rock complex in Pawnee County in southeastern Nebraska, conducting a widespread drilling program in the area of a gravity anomaly and identifying a few rare-earth minerals, notably bastnaesite; bastnaesite is the chief source of rare-earth elements in the United States. Molycorp operated the only major rare-earth mine in the United States at Mountain Pass, Calif., in a similar carbonatite source rock. Major end uses for rare earths are in petroleum catalysis and metallurgical applications.

C. F. Industries Inc., a producer of anhydrous ammonia in Fremont, was among 16 such producers nationwide to shut down a total of 5.4 million tons per year capacity and lay off approximately 3,500 employees, about 40 of whom were in Nebraska.

Ash Grove Cement Co. completed a $25 million expansion of its Louisville plant by adding a new line designed to produce 600,000 tons per year. The new system has a four-stage suspension preheater, precalciner, 12.5- by 164-foot coal-fired kiln with a direct-firing system, and grate cooler. The process-control and monitoring system features the latest design in digital process control and programmable motor control.

In late November, Ideal Cement Co. revealed that a full-scale curtailment of cement production at its Superior plant was to take effect about January 1, 1983. The work force was to be cut from 104 to 21; however, employees could be recalled in 2 or 3 months when the normal seasonal increase in cement demand was expected.

Legislation and Government Programs.—On January 1, 1982, because of funding limitations the U.S. Congress imposed, a temporary restraint of the Mine Safety and Health Administration's (MSHA) enforcement of safety rules in surface mining of stone and sand and gravel operations went into effect. This temporary restraint was lifted on July 15, 1982, and MSHA's inspectors resumed enforcing the safety rules, but under new guidelines that reduced the number of citations to only those that were significant and substantial violations.

After the uranium discovery in northwestern Nebraska, which may be minable by the solution or in situ mining method, State legislators considered writing laws to give the State Health Department environmental-protection enforcement authority over mining operations, including in situ mining. The proposed bill required that each mining project be licensed and evaluated for its effect on air and water quality and public health.

In January, after a declared emergency, legislative bill 772, the Nebraska Mining and Reclamation Act, was introduced to ensure that all mining activities in the State be conducted in a safe and environmentally sound manner and to minimize or eliminate public health hazards and undesirable effects on the environment. The act dealt with radioactive material and the tailings or wastes produced by extraction or concentration of uranium or thorium from any ore processed primarily for its source material content and with fluid or gas injection into the ground for extracting minerals or energy.

The Nebraska Game and Parks Commission rejected a staff proposal to declare a moratorium on exploration for uranium and other hard-rock minerals in lands the commission owns or controls. Instead, the policy was adopted that, unless otherwise legally obligated, the commission would take separate action on each proposal to explore or extract energy-producing resources from all commission-owned lands.

Nebraska legislative bill 708 was enacted July 17, 1982, to provide that geothermal deposits shall be treated as mineral interests.

The Surface Transportation Assistance Act (STA Public Law 97-424) that Congress passed on December 23, 1982, and signed by the President on January 6, 1983, initiated a 5-cent-per-gallon user fee, effective April 1, 1983. The act was called a very important step toward achieving a strong recovery in the U.S. economy in general and in the stone industry in particular. States were required to provide matching funds for interstate highway work, and some projects were scheduled to begin in the first half of 1983. The law extended the Federal Highway Trust Fund to September 30, 1988, and, effective April 1, 1983, increased the Federal fuel taxes from 4 to 9 cents per gallon as well as other fees highway users pay. The additional funding was expected to increase crushed stone demand significantly.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Ash Grove Cement and Ideal Basic Industries Inc. produced cement at plants in Louisville (Cass County) and Superior (Nuckolls County). Both firms produced gray portland cement types I and II (general use and moderate heat) and type III (high-early-strength) as well as prepared masonry cement.

In decreasing order of quantity, finished portland cement was sold to ready-mix companies, highway contractors (an 85% increase over highway use in 1981), concrete product manufacturers (a 31% decrease from such use in 1981), building materials dealers, other contractors, government agencies, and miscellaneous customers. Finished portland cement was shipped to customers either in bulk (96%) or containers (4%), by truck (98.9%), railroad (1.06%), or other methods. Mainly natural gas was used to operate the kilns, but its consumption decreased 70% from that of 1981. The remainder of the fuel was bituminous coal and small amounts of fuel oil and coke.

Clays.—In decreasing order of output, Endicott Clay Products Co., Ash Grove Cement, Yankee Hill Brick Manufacturing Co., and Omaha Brick Works Inc. produced common clay and shale from five mines in Jefferson, Cass, Lancaster, Sarpy, and Douglas Counties. The clay, averaging $2.93 per ton, was used, in decreasing order of quantity, in face brick, portland cement, and common brick.

Lime.—Great Western Sugar Co. produced quicklime at three plants in Scotts Bluff County and at one plant in Morrill County. Total output declined 46%, but total value declined only 10% from output and value in 1981.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. Of 160 operations during 1982, only 3 each produced more than 400,000 short tons of construction sand and gravel and 65 each produced less than 25,000 tons.

Hartford Sand & Gravel Co., the State's largest producer of construction sand and gravel, operated in Douglas, Dodge, and Hall Counties, all of which border the Platte River.

In decreasing order of quantity, construction sand and gravel was used for road base and coverings and road and other stabilization, concrete aggregate, asphaltic concrete aggregates, concrete products (blocks, bricks, pipe, decorative products, etc.), fill, plaster and gunite sands, snow and ice control, railroad ballast, and other uses.

More than 91% of construction sand and gravel was shipped by truck; the remainder was transported by railroad and other methods. Construction sand and gravel averaged $2.49 per ton.

Industrial.—The State's entire output of industrial sand was from Western Sand & Gravel Co.'s two operations in Saunders County.

About 85% of the industrial sand output was used for engine traction; the remainder was used as blasting abrasive.

About 85% was transported by railroad; the remainder, by truck. Industrial sand prices averaged $7.36 per ton.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	3,216	$7,363	$2.29
Gravel	NA	NA	NA	7,515	19,830	2.64
Sand and gravel (unprocessed)	NA	NA	NA	552	935	1.69
Total[1] or average	e11,770	e$28,310	e$2.41	11,282	28,128	2.49
Industrial sand	19	144	7.54	14	105	7.36
Grand[1] total or average	e11,789	e28,454	e2.41	11,297	28,234	2.50

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Table 5.—Nebraska: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,453	$5,930	$2.42
Plaster and gunite sands	W	W	1.72
Concrete products	713	1,928	2.70
Asphaltic concrete	1,392	3,458	2.48
Road base and coverings[1]	5,720	14,676	2.57
Fill	661	1,124	1.70
Snow and ice control	25	49	1.92
Railroad ballast	W	W	5.35
Other	318	964	3.03
Total or average	11,282	[2]28,128	2.49

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (cement).
[2]Data do not add to total shown because of independent rounding.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and completed the following year.

Nebraska was estimated to have produced more than 3 million short tons of crushed stone during 1982, only slightly less than the 1981 output. Major producers were the Louisville quarry of Ash Grove Cement and the Weeping Water quarry of Kerford Limestone Co., both in Cass County; and the East quarry of Fort Calhoun Stone Co. in Washington County.

Talc.—Cyprus Industrial Minerals Co., a division of Amoco Minerals Co., ground talc at its Grand Island mill in Hall County. The talc was sold for use in ceramics, cosmetics, paint, paper, plaster, rubber, and other products.

Vermiculite (Exfoliated).—Vermiculite, shipped in from out of State, was exfoliated at the W. R. Grace & Co. plant in Douglas County. Output declined although total value increased from 1981 figures. In decreasing order, principal uses of exfoliated vermiculite were in block and loose-fill insulation, as fireproofing, in concrete aggregates, and for horticultural purposes and soil conditioning.

[1]State Liaison Officer, Bureau of Mines, Denver, Colo.
[2]Bureau of Labor Statistics. Employment and Earnings, Table B-8, Employees on Nonagricultural Payrolls for States and Selected Areas by Industry Division. March 1983, pp. 86-96.

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, Platte, York.
Hartford Sand & Gravel Co	Box Z Valley, NE 68604	Dredges and pits	Dodge, Douglas, Hall.
Lyman-Richey Sand & Gravel Corp	4315 Cuming St. Omaha, NE 68131	Pits and plants	Cass, Dodge, Douglas, Morrill, Platte, 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.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
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 Basic Products Co., Construction Aggregates 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 total value of Nevada's nonfuel mineral production in 1982 was $526 million, an increase of nearly 4% from that recorded in 1981. Gold was the leading commodity produced in terms of value, accounting for $277.5 million or 53% of the total nonfuel mineral value produced in the State. The State again was ranked as the leading gold producer nationally, accounting for 51% of the total produced in 1982, and also led the Nation in the production of barite, magnesite, and mercury. Nevada ranked 13th nationally in the value of its nonfuel minerals production.

The Nation's declining economic climate had a dramatic effect on the State's mineral producing sector. Numerous mining operations either suffered closures or were put on standby throughout the year. However, because most gold mines remained open, the decline was less than in most other States.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Barite	thousand short tons	2,482	$79,716	1,575	$52,727
Clays	do.	73	2,948	103	2,640
Gem stones		NA	1,000	NA	1,200
Gold (recoverable content of ores, etc.)	troy ounces	524,802	241,220	738,321	277,542
Gypsum	thousand short tons	778	6,914	656	4,523
Iron ore	thousand long tons	99	1,490	77	1,119
Mercury	76-pound flasks	27,819	11,514	25,760	W
Sand and gravel (construction)	thousand short tons	e7,065	e15,770	6,027	11,724
Silver (recoverable content of ores, etc.)	thousand troy ounces	3,039	31,970	3,142	24,981
Stone (crushed)	thousand short tons	1,343	5,664	p1,300	p4,500
Zinc (recoverable content of ores, etc.)	metric tons	W	W	--	--
Combined value of cement (portland), copper, diatomite, fluorspar, lead, lime, lithium compounds, magnesite, molybdenum (1982), perlite, salt, sand and gravel (industrial), tungsten ore and concentrate, and values indicated by symbol W		XX	r108,453	XX	144,944
Total		XX	r506,659	XX	525,900

eEstimated. pPreliminary. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Carson City	$409	$522	Stone (crushed).
Churchill	W	2,391	Diatomite, gold, iron ore, salt, silver, tungsten, lead, zinc.
Clark	37,178	22,008	Lime, sand and gravel (industrial), gypsum, stone (crushed), gold, silver, copper.
Douglas	W	W	Silver, gold, copper, lead.
Elko	17,098	42,457	Gold, barite, copper, tungsten, silver, lead, zinc.
Esmeralda	21,591	22,128	Lithium, diatomite, silver, gold, clays, copper.
Eureka	W	65,277	Gold, iron ore, stone (crushed), silver, mercury, lead, copper, zinc.
Humboldt	12,089	W	Gold, mercury, stone (crushed), copper, silver, clays.
Lander	87,335	W	Barite, gold, copper, silver, lead, zinc.
Lincoln	13,282	W	Tungsten, gold, lime, silver, perlite, clays, copper.
Lyon	27,695	26,403	Cement, stone (crushed), gypsum, diatomite.
Mineral	6,468	W	Silver, gold, tungsten, lead, zinc.
Nye	45,566	58,903	Gold, barite, clays, magnesite, silver, fluorspar, stone (crushed), brucite, lead, zinc, copper.
Pershing	18,495	22,511	Diatomite, gypsum, iron ore, silver, gold, perlite.
Storey	21,043	W	Diatomite, silver, gold, stone (crushed).
Washoe	2,793	W	Clays, copper, gold, silver.
White Pine	W	W	Gold, silver, tungsten, copper, lead, zinc.
Undistributed[3]	83,186	228,286	
Sand and gravel (construction)	XX	e15,770	
Total[4]	394,230	506,659	

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

[1]County distribution for construction sand and gravel not available; total State value shown separately under "Sand and gravel (construction)."

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

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

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

Table 3.—Indicators of Nevada business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	464.0	485.0	+4.5
Unemployment	do	33.0	49.0	+48.5
Employment (nonagricultural):				
Mining[1]	do	7.9	6.8	-13.9
Manufacturing	do	20.1	18.8	-6.5
Contract construction	do	25.4	20.8	-18.1
Transportation and public utilities	do	25.1	24.9	-.8
Wholesale and retail trade	do	83.6	80.7	-3.5
Finance, insurance, real estate	do	18.3	18.0	-1.6
Services	do	173.7	177.6	+2.2
Government	do	57.1	58.1	+1.8
Total nonagricultural employment[1]	do	411.2	405.7	-1.3
Personal income:				
Total	millions	$9,787	$10,348	+5.7
Per capita		$11,582	$11,748	+1.4
Construction activity:				
Number of private and public residential units authorized		10,622	9,011	-15.2
Value of nonresidential construction	millions	$413.8	$298.4	-27.9
Value of State road contract awards	do	$112.6	$77.0	-31.6
Shipments of portland and masonry cement to and within the State	thousand short tons	574	405	-29.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$506.7	$525.9	+3.8
Value per capita, resident population		$630	$597	-5.2
Value per square mile		$4,556	$4,758	+4.4

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.

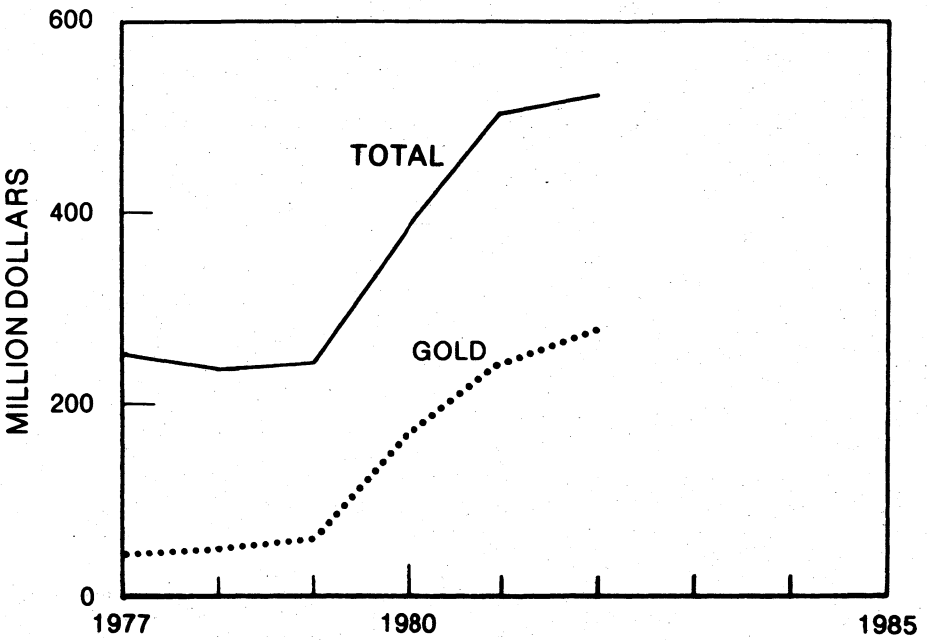

Figure 1.—Value of gold and total value of nonfuel mineral production in Nevada.

Trends and Developments.—The deep collapse of international tungsten markets caused the shutdown of Nevada's three largest tungsten mines. Union Carbide Corp.'s Metals Div. placed its Emerson tungsten mine in western Lincoln County on standby. Thirty-two of the 106 workers were retained for development work. In April, Utah Internatonal Inc. laid off 31 of its 190 employees at the Springer tungsten mine and mill near Mill City, Pershing County, citing the need to cut production because of decreased demand. Later in the year, both the mine and mill were shut down, laying off 140 workers. NRD Mining Ltd.'s Nevada scheelite mine in Mineral County was also shut down.

The Anaconda Minerals Co., a subsidiary of Atlantic Richfield Corp., discontinued molybdenum production in early July at its Nevada molybdenum property, 25 miles north of Tonopah in Nye County. The mine had been the only primary molybdenum producer currently in operation in the United States, and had been producing in excess of 1 million pounds of molybdenum per month. The shutdown was attributed to the greatly decreased demand for steel in which molybdenum is used as an alloy.

Houston International Minerals Corp. suspended operations at its Manhattan Mine at Manhattan in Nye County, on January 31, because of low gold prices and dwindling reserves; the mill was placed on standby. The operation employed 48 persons and 31 were laid off.

Occidental Minerals Corp. announced early in the year that 40 employees had been laid off and 100 placed on a 32-hour workweek at its Candelaria silver mine in Mineral County. The operation tapered off slowly as the price of silver declined. By yearend, monthly production was less than 10% of the full production achieved earlier in the year.

Silver King Mines Inc. resumed full operations on September 20 at the Taylor open pit silver mine, 18 miles southeast of Ely, in White Pine County. About 75 employees that were laid off when the mine closed in June were recalled. Over 1 million ounces of silver were produced during the mine's first year of continuous operation. Duval Corp. developed its Fortitude gold mine deposit next to its Copper Canyon open pit mine, 13 miles south of Battle Mountain, in Lander County. Over 100 holes were drilled. Drilling and development work has shown re-

serves of 14.5 million metric tons averaging 0.165 ounce of gold and 0.63 ounce of silver per metric ton.

AMAX Inc. applied for permits to drill a number of wells sufficient to provide water for an 86,000-ton-per-day mill at its molybdenum deposit at Buckingham, 7 miles south of Battle Mountain, in Lander County.

United Mining Corp. suspended underground development at the New Savage Mine, in Storey County, halting plans for the first underground production in 40 years from the historic Comstock Lode.

Sunshine Mining Co. began production in April at the 16-to-1 Mine and mill near Silver Peak, Esmeralda County. Extraction from the wide, low-grade argentite vein was by trackless haulage up inclined ramps.

Exxon Minerals Co. continued to develop its Mount Hope molybdenum deposit north of Eureka, in Eureka County. Pinson Mining Co. began development of a heap leaching operation at the Preble Mine, 12 miles south of its Pinson open pit, in southeastern Humboldt County. Higher grade ore from the Preble Mine was trucked to the Pinson mill.

Newmont Mining Corp. acquired the 223,000-acre Key Lazy S Ranch in Elko and Eureka Counties. The ranch encompasses the company's Carlin, Bootstrap, Blue Star, and Maggie Mines containing reserves of approximately 8 million ounces in gold.

Carlin Gold Mining Co. announced a new gold discovery at Rain, Elko County, with blocked out reserves estimated to contain 8.3 million tons of ore averaging 0.147 ounce per ton.

Asamera Inc. purchased the Gooseberry Mine in Storey County from Scurry Rainbow Co. A shaft sunk to the 1450 level earlier in the year confirmed the presence of ore at that level.

Industrial mineral production in 1982 totaled $166 million, down 15% from the record high of 1981. Barite, diatomite, cement, and lithium carbonate were the industrial mineral commodities with the highest value produced in Nevada during the year. Commodities closely related to the construction industry—sand and gravel, gypsum, and cement—generally did poorly in 1982. All major barite producers continued to operate, but generally at decreased annual rates. Some small producers that had been active in previous years during the "barite boom" were inactive in 1982.

Exploration Activities.—Exploration for ore deposits continued in Nevada but at a much lower level than in 1981. Many companies closed their exploration offices and laid off entire staffs; others made deep cuts in staff and operating budgets. However, because of the interest in and potential for finding gold, considerable exploration was still undertaken. The U.S. Bureau of Land Management (BLM) reported that more claims were recorded in Nevada in 1982 than in any other Western State.

Bethex, Brazos Metals Inc., Coastal Mining, Energex Minerals, Energy Resources, Hecla Mining Co., Inspiration Mining Co., Molycorp Inc., Patino Mines, Phillips Mineral, Pathfinders, Seremin Inc., Tech Resources, T.R.V., Union Carbide, and Western Nuclear Inc. were reported to have closed their Nevada exploration offices. Cutbacks were also reported by Anaconda Minerals, Gulf Mineral Resources Co., Homestake Mining Co., Noranda Exploration Inc., Phelps Dodge Corp., and Utah International.

Conoco Inc. closed its Reno exploration office and stopped exploration activities for copper at Pumpkin Hollow, east of Yerington, Lyon County, and for gold at the Getchel Mine, north of Golconda, in eastern Humboldt County.

ASARCO Incorporated placed its Rochester property on hold owing to cutbacks in its exploration program.

Energex Minerals reportedly did some drilling for gold and silver in the Eagle Valley district of Carson City (County), and at the Ashby Prospect in the Pimlico district of Mineral County.

Utah International explored for tungsten near the Springer Mine in Pershing County. Houston International conducted exploratory drilling for gold in the Manhattan area of Nye County. Hecla continued gold-silver exploration at Cherry Creek in White Pine County. Additional exploration for gold was undertaken by Newmont in Elko County, Pan Cana Resources in the Lynn district of Eureka County, Westley Mines in the Santa Fe district of Mineral County, and New Beginning Resources in the Kingston district of Lander County.

American Pyramid Resources Inc. announced discovery of a new mineralized zone on its Bell Mountain gold and silver property in Churchill County.

Industrial mineral exploration in the State was also at a lower level in 1982. Exploration for barite, which has dominated industrial mineral exploration in Nevada for the past decade, was at a much lower

level in 1982 because of sharply decreased domestic drilling for oil and gas. The market for barite used in drilling mud was softened at the same time by increased imports of barite at delivered prices well below those for Nevada material.

Employment.—Mine shutdowns and closures during 1982 resulted in a 32% reduction in Nevada's mining industry work force to an estimated 6,620 employees. The Nevada Employment Security Department reported an annual average of 4,223 employees in metal mining and 2,397 in other mining categories. The annual payroll for the mining industry in the State was approximately $167.5 million.

Legislation and Government Programs.—The Nevada State Legislature did not convene in 1982. A precedent-setting mining case was decided by the Nevada Supreme Court when the court ruled that one mining company (Eisenmann Chemical Co.) cannot use the State eminent domain law to condemn and extract ore reserves of another barite company (NL Industries Inc.). The U.S. Bureau of Mines approved a $1 million grant to the Mackay School of Mines, University of Nevada, to establish a mineral industry waste treatment and recovery center to perform research in the treatment of mineral industry waste for the recovery of critical metals and minerals. This center is one of four generic mineral technology centers established by the Bureau's Advisory Committee on Mining and Mineral Research.

The Nevada Bureau of Mines and Geology published 12 reports and maps on mineral resources during the year and reprinted 3 others. Thirty-one projects were underway at yearend, including aeromagnetic maps, gravity maps, geologic maps of the Reno and Walker Lake Army Map Service sheets, a bibliography of Nevada geology and mineral resources, geologic quadrangle maps, and publications on mercury, tungsten, zinc, and barite in Nevada. In addition, several grants and contracts from the U.S. Geological Survey (USGS), the U.S. Department of Energy, and BLM were underway. Work continued on the cooperative agreement with the USGS to complete topographic map coverage of Nevada at a scale of 1:100,000.

The BLM paid $12,381,103 to the State of Nevada in 1982 as its share of Federal mineral leasing receipts. Each State receives semiannual payment equal to 50% of bonuses, rentals, and royalties collected from mineral leasing activities on federally owned public lands within that State.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Copper.—Although copper production was reported from 10 mines, Duval Corp.'s Battle Mountain copper operation in Lander County and Anaconda Minerals' Nevada Moly operation in Mineral County accounted for most of the output. Additional production was reported from Elko, Esmeralda, Humboldt, Lincoln, and White Pine Counties. Lode mine production increased 23% from that reported in 1981. Two copper heap leach operations were reported active in Elko and Humboldt Counties.

Gold.—Nevada remained the leading gold producing State for the third successive year, with 51% of the total primary gold production in the Nation in 1982. Value of gold produced was more than $277 million. Production was more than 738,000 troy ounces, a 41% increase over that of 1981.

Gold production was reported from 40 of the 45 producing lode mines in the State. Of these, 16 mines each recovered gold with a reported value exceeding $1 million.

Freeport Gold Co. was the largest producer in the State from its Enfield Bell Mine—the Nation's leading gold producer. Carlin Gold Mining was the State's second largest producer, recovering gold from three open pit mines—the Carlin, Maggie Creek, and Blue Star pits—in Eureka County, and from the Boot Strap Mine in Elko County.

Iron Ore.—Three producers shipped iron ore in 1982. Output decreased 22% from an already low level, and value decreased 25% from that reported in 1981. Nevada-Barth Corp. in Eureka County was the State's largest shipper. Other shipments were made from Churchill and Pershing Counties.

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

County	Mines producing		Material sold or treated[1] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1980, total	24	1	9,752,286	278,495	$170,594,898	939,997	$19,401,540
1981, total	49	1	[r]12,834,421	524,802	241,219,994	3,039,480	31,970,377
1982:							
Churchill	2	--	W	W	W	W	W
Clark	2	--	W	W	W	W	W
Douglas	1	--	W	W	W	W	W
Elko	4	--	W	W	W	W	W
Esmeralda	3	--	243,296	6,252	2,350,190	867,821	8,899,177
Eureka	6	--	W	W	W	W	W
Humboldt	3	--	450,924	64,659	24,305,964	W	W
Lander	8	1	W	W	W	W	W
Lincoln	2	--	W	W	W	W	W
Lyon	1	--	W	W	W	W	W
Mineral	3	1	W	W	W	W	W
Nye	5	--	3,576,955	111,115	41,769,240	88,011	699,688
Pershing	1	1	90,718	397	149,237	40,767	324,098
Storey	1	--	W	W	W	W	W
White Pine	3	--	990,627	61,993	23,303,789	760,400	6,045,180
Total	45	3	[2]11,541,462	[2]738,321	[2]277,542,250	[2]3,142,263	[2]24,980,993

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1980, total	W	W	26	$24,016	2	$1,848	W
1981, total	W	W	W	W	W	W	$283,796,079
1982:							
Churchill	--	--	W	W	--	--	W
Clark	--	--	W	W	--	--	W
Douglas	--	--	W	W	--	--	W
Elko	W	W	W	W	--	--	W
Esmeralda	W	W	--	--	--	--	W
Eureka	--	--	--	--	--	--	W
Humboldt	W	W	--	--	--	--	W
Lander	W	W	W	W	--	--	W
Lincoln	W	W	--	--	--	--	W
Lyon	--	--	--	--	--	--	W
Mineral	--	--	W	W	--	--	W
Nye	W	W	--	--	--	--	473,335
Pershing	--	--	--	--	--	--	W
Storey	--	--	--	--	--	--	W
White Pine	W	W	--	--	--	--	
Total	W	W	W	W	--	--	[2]313,810,802

[r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Does not include gravel washed.
[2]Includes items indicated by symbol W.

Table 5.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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:[3]							
Dry gold	25	10,049,472	721,851	298,795	W	--	--
Gold-silver	6	320,538	W	718,638	W	W	--
Silver	10	1,050,651	W	1,852,470	W	W	--
Total	42	11,420,661	[4]736,301	2,869,903	W	W	--
Copper	3	W	--	--	W	--	--
Total	45	W	736,301	2,869,903	W	W	--
Other lode material:							
Gold tailings	1	W	W	W	--	--	--
Gold-silver tailings	--	W	W	W	--	--	--
Copper precipitates	1	W	--	--	W	--	--
Molybdenum ore	--	--	W	W	W	--	--
Total lode	45	[4]11,541,462	[4]738,164	[4]3,142,263	W	W	--
Placer	3	--	157	--	--	--	--
Grand total	48	11,541,462	738,321	3,142,263	W	W	--

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 1982, 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]736,713	[1]2,329,609	--	--	--
Acid leaching (vat, tank, heap)	--	--	W	--	--
Smelting of concentrates	[1]1,426	[1]807,103	W	W	--
Direct smelting of:					
Ore	25	5,551	W	W	--
Precipitates	--	--	W	--	--
Total lode material	738,164	3,142,263	W	W	--
Placer	157	--	--	--	--
Grand total	738,321	3,142,263	W	W	--

W Withheld to avoid disclosing company proprietary data.
[1]Includes recovery from retreated tailings.

Lead.—Lower lead prices resulted in a 58% decrease in lead output and a 71% decrease in value for 1982. Small amounts of lead production were reported from seven mines in six Nevada counties. The Diamond Jim Mine (Elko County), operated by Gold Creek Silver Mines, was the largest producer, followed by the Klondike Mine, operated by Brazos Metals, and the Smokey Valley Mine, operated by Gold Dome Mining, both in Lander County.

Mercury.—Placer Amex Inc.'s McDermitt Mine, in Humboldt County, was the Nation's largest mercury producer in 1982, accounting for nearly all of the national production reported. Small quantities were also shipped from the Carlin Mine in Eureka County and the Pinson Mine in Humboldt County as a byproduct from gold mining operations. Total production was nearly 26,000 flasks, a decrease of 7% from that reported in 1981.

Molybdenum.—Anaconda Minerals began shipments of molybdenum concentrate recovered from molybdenum-copper ores at its Nevada Moly Project in Nye County. No material was produced from Kennecott Corp.'s McGill operation in White Pine County.

Silver.—Nevada ranked fifth among the Nation's silver producers in 1982. Production of more than 3 million ounces of silver

was slightly higher than that of 1981, but value dropped 22% because of lower silver prices in the first half of the year. Nevada's largest producing silver mine, the Candelaria in Mineral County, ranked 11th among the Nation's 25 leading silver producing mines in 1982. Two other important Nevada producers—the Taylor Mine in White Pine County and the 16-to-1 Mine in Esmeralda County—ranked 15th and 19th, respectively. Production was started early in the year at the 16-to-1 Mine and mill operated by Sunshine Mining.

Tungsten.—The Emerson Mine and mill in Lincoln County, near Tempiute, was closed early in the year, and Utah International's Springer Mine and mill near Imlay, in Pershing County, produced at reduced levels after its initial opening in April until its closure in October. Intermittent tungsten shipments were reported from Churchill, Elko, Mineral, Nye, Storey, and White Pine Counties. Nevada ranked third among the five States reporting tungsten production in 1982.

NONMETALS

Barite.—Nevada remained the Nation's leading producer of primary barite despite output declining 37% from that reported in 1981 and value reportedly down 34%. Production, principally in Lander and Elko Counties, was reported from 14 open pit mines and 4 beneficiation plants. American Chemical and Energy Co. closed its operations in Lander County. Several mining and grinding operations were either suspended or on minimal operations at year-end, as the downturn in oil and gas drilling left many barite producers with excess inventories.

Cement.—Cement output declined 7% and value declined almost 20% from that of 1981. Production was derived entirely from the Fernley plant of Centex Corp. in Lyon County. Finished portland cement from the Fernley plant was used principally by building material dealers, concrete products manufacturers, ready-mix companies, and highway contractors.

Clays.—Total clay production in Nevada increased 41% for the year despite the decline in demand for bentonite. Production was recorded from nine mines in Esmeralda, Humboldt, Lincoln, Nye, Pershing, and Washoe Counties; four of these were bentonite producers. Kaolin, fuller's earth, and common clay were the other varieties produced from the additional five mines. Industrial Mineral Ventures Inc. was the State's largest producer from its Armagosa facility in Nye County, which reported production of bentonite, fuller's earth, and common clay (shale).

Diatomite.—Production of diatomite declined 12% and value dropped 3% from that reported in 1981. Eagle-Picher Industries Inc. was the State's largest producer from properties in Lyon, Pershing, and Storey Counties. The bulk of the company's production came from Pershing County and was used as a filtration medium. Smaller amounts were used as fillers and in insulation. Production was also recorded from Amoco Minerals Co. in Churchill County and from Grefco Inc. in Esmeralda County.

Fluorspar.—The Daisy Mine in Nye County was Nevada's only fluorspar producer in 1982. Output and value were nearly 80% below that of 1981. The metallurgical-grade fluorspar was shipped to steel plants in California.

Gem Stones.—Individual collectors accounted for the estimated $1.2 million value of gem stones produced. Jasper, agate, turquoise, and opals were the most sought after gems.

Gypsum.—Output and value both decreased for the fourth straight year, as the construction industry remained depressed. Production was reported during the year by four operators, two in Clark County and one each in Lyon and Pershing Counties. Clark County's Pacific Coast Building Products Inc. and Genstar Building Materials were the State's largest producers.

Lime.—Output and value both declined slightly in 1982. Genstar Cement & 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 Corp., was the State's sole producer of lithium compounds from brines near Silver Peak, Esmeralda County. According to Foote's 10K reports, output and value were nearly 20% lower than reported in 1981.

Magnesite.—Basic Inc. operated the only magnesite mine in the United States at Gabbs, Nye County. Output and value declined 26% from that reported in 1981.

Perlite.—Delamar Perlite Co. and United States Gypsum Co. were the only perlite producers in Nevada for 1982. Delamar Perlite produced crude perlite from the Mackie claims in Lincoln County. Addition-

al crude perlite output was reported by United States Gypsum from its Pearl Hill quarry near Lovelock in Pershing County. Expanded perlite was produced at the Empire plant of United States Gypsum in Washoe County.

Salt.—Output and value doubled from that of 1981 at the Huck Salt Co. operation in Churchill County. Owned by Leslie Salt Co., it was the only reported salt producer in the State.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of contruction sand and gravel production in 1981 were generated and are given in table 1.

Sand and gravel for construction, used primarily in concrete aggregate, asphaltic concrete aggregate, road base and coverings, and as fill, decreased 29% in quantity produced and 36% in value from that of 1980, the last year statistically available. Production in 1982 was reported from 51 operations throughout the State, with 3 operations reporting more than 600,000 tons and 24 operations reporting less than 25,000 tons. The major portion of the production was from Clark County. Washoe and Lincoln Counties also had production of better than 300,000 tons.

Industrial.—Simplot Silica Products and Reynolds Electric & Engineering Co. operations, both in Clark County, were the only producers of industrial sand in the State. Production of industrial sand and gravel more than doubled from that of 1981, although the 1982 value of production only increased 14%.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	1,525	$4,006	$2.63
Gravel	NA	NA	NA	3,335	6,331	1.90
Sand and gravel (unprocessed)	NA	NA	NA	1,167	1,388	1.19
Total or average	e7,065	e$15,770	e$2.23	6,027	[1]11,724	1.95
Industrial:						
Sand	W	W	13.92	410	5,117	12.49
Gravel	--	--	--	W	W	2.53
Total or average	W	W	13.92	W	W	7.14
Grand total or average	W	W	e2.86	W	W	2.61

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

Table 8.—Nevada: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,325	$5,192	$2.23
Plaster and gunite sands	26	109	4.19
Concrete products	102	215	2.08
Asphaltic concrete	1,411	2,747	1.95
Road base and coverings	1,651	2,432	1.47
Fill	461	903	1.96
Snow and ice control	24	53	2.24
Other	26	72	2.77
Total[1] or average	6,027	11,724	1.95

[1]Data may not add to totals shown because of independent rounding.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

The value of crushed stone produced in Nevada during 1982 was estimated to have dropped 21%, although the output remained nearly the same as that of 1981.

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[1]State Liaison Officer, Bureau of Mines, Spokane, Wash.
[2]Director and State geologist, Nevada Bureau of Mines and Geology, Reno, Nev.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
Eisenmann Chemical Co	312 East 16th St. Greeley, CO 80631	Surface mine and mill	Elko.
IMCO Services Inc	Box 861 Battle Mountain, NV 89820	____do	Lander.
Milchem Inc	Box 272 Battle Mountain, NV 89820	____do	Do.
NL Industries Inc., Baroid Div	Box 414 Battle Mountain, NV 89820	____do	Do.
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	555 17th St. Denver, CO 80217	____do	Do.
Duval Corp	Box 451 Battle Mountain, NV 89820	____do	Lander.
Diatomite:			
Eagle-Picher Industries Inc	Box 12130 Reno, NV 89510	Surface mine and plants.	Pershing and Storey.
Grefco Inc	3450 Wilshire Blvd. Los Angeles, CA 90010	Surface mine and plant	Esmeralda.
Fluorspar:			
J. Irving Crowell, Jr	Box 96 Beatty, NV 89003	Underground mine	Nye.
Gold:			
Carlin Gold Mining Co	Box 979 Carlin, NV 89822	Surface mine and mill	Elko and Eureka.
Duval Corp	Box 451 Battle Mountain, NV 89820	Surface mine, mill, and refinery.	Lander.
Freeport Gold Co., Joint Venture	Box 1132 Elko, NV 89801	Surface mine and mill	Elko.
Pinson Mining Co	Box 587 Winnemucca, NV 89445	____do	Humboldt.
Gypsum:			
Genstar Building Materials	Star Route 89031 Las Vegas, NV 89101	____do	Clark.
Pacific Coast Building Products Inc	Box 43327 Las Vegas, NV 89104	____do	Do.
Iron Ore:			
Cooney Mining Co	Box 568 Lovelock, NV 89419	____do	Pershing.
Iron Mine	Box 1160 Carson City, NV 89701	____do	Churchill.
Lead:			
Brazos Metals Inc	1325 Airmotive Reno, NV 89515	Surface mine	Lander.
Gold Creek Silver Mines	301 South 11th St. Las Vegas, NV 89101	____do	Elko.
Lime:			
Genstar Cement & Lime Co	215 Market St., Suite 1000 San Francisco, CA 94105	Surface mine and plant	Clark.
Lithium:			
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 Amex Inc, McDermitt JV	Box 497 McDermitt, NV 89421	____do	Humboldt.
Molybdenum:			
The Anaconda Minerals Co	555 17th St. Denver, CO 80217	____do	Nye.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Perlite:			
Delamar Perlite Co	Box 217 Pioche, NV 89043	Underground mine	Lincoln.
Salt:			
Huck Salt Co	895 Harringan Rd. Fallon, NV 89406	Solar evaporation plant.	Churchill.
Sand and gravel:			
ARC Materials Corp., WMK Transit Mix.	Box 14697 Las Vegas, NV 89114	Pits	Clark.
Bonanza Materials Inc	565 Lalif Rd. Henderson, NV 89015	Pit	Do.
Rilite Aggregates Co	Box 11767 Reno, NV 89510	Pit and mill	Washoe.
Southern Nevada Paving Inc	3555 Polaris St. Las Vegas, NV 89103	Pits and mill	Clark.
Stewart Bros. Co	Box 42755 Las Vegas, NV 89116	Pit and mill	Do.
Wells Cargo Inc	Box 14037 Las Vegas, NV 89114	Pit	Do.
Silver:			
Occidental Minerals Corp	777 South Wadsworth Lakewood, CO 80226	Surface mine and mill	Mineral.
Silver King Mines Inc	Box 324 East Ely, NV 89315	____do	White Pine.
Sunshine Mining Co	Box 1080 Kellogg, ID 83837	Underground mine	Esmeralda.
Tungsten:			
Union Carbide Corp., Metals Div	Box 307 Alamo, NV 89001	Underground mine and mill.	Lincoln.
Utah International Inc	Box 642 Winnemucca, NV 89445	____do	Pershing.

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, Jr.,[1] and Robert I. Davis[2]

The value of nonfuel mineral production in New Hampshire in 1982 was $23.3 million, a $700,000 increase compared with that of 1981. Sand and gravel, stone, and clays were mined in-State. Among the six New England States, the Granite State ranked fifth in the value of mineral production.

Nationally, New Hampshire ranked fourth in output of dimension stone and was one of only four States that produced more than 100,000 tons. The State ranked second in dimension granite output and annually produces about 16% of the U.S. total.

Trends and Developments.—In the 1970's, sand and gravel and stone accounted for the bulk of the State's mineral production. In the 1980's, these commodities remained the major components of New Hampshire's mining industry, although output has declined. From 1973 through 1979, an average of 1 million tons of crushed stone and 6.7 million tons of sand and gravel were mined. From 1980 through 1982, an average of 618,000 tons of stone and 5.1 million tons of sand and gravel were mined.

Exploration activity in New Hampshire, which was revitalized in the late 1970's by the discovery of a massive sulfide deposit in northern Maine, was on the decline in 1982 as the result of depressed metal prices. However, some limited investigations reportedly continued for base metals around Warren and Littleton, Grafton County, and Errol, Coos County. Also, in the White Mountains tin and tungsten were discovered in stream sediment samples according to a preliminary report published by the U.S. Geological Survey in 1982. The samples

Table 1.—Nonfuel mineral production in New Hampshire[1]

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel (construction) thousand short tons	e4,528	e$12,990	4,332	$12,593
Stone:				
Crushed do.	665	2,599	p600	p3,100
Dimension do.	89	6,889	p107	p7,500
Combined value of other nonmetals	XX	122	XX	101
Total	XX	r22,600	XX	23,294

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

indicated the potential of economically recoverable deposits, particularly tin, but additional investigations were recommended. Except for a tin prospect near Jackson, which was discovered in 1840, no other occurrences of tin are known in the State.[3]

Table 2.—Value of nonfuel mineral production in New Hampshire, by county

(Thousands)

County	1980	1981[1]	Minerals produced in 1981 in order of value
Belknap	$589	(2)	
Carroll	2,420	(2)	
Cheshire	1,042	W	Stone (crushed).
Coos	582	(2)	
Grafton	W	W	Stone (crushed).
Hillsborough	W	W	Stone (dimension).
Merrimack	5,182	W	Stone (crushed), stone (dimension).
Rockingham	W	W	Stone (crushed).
Strafford	W	W	Clays.
Sullivan	991	(2)	
Undistributed[3]	14,597	$9,609	
Sand and gravel (construction)	XX	e12,990	
Total[4]	25,406	22,600	

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

[1]County distribution for construction sand and gravel is not available; total State value shown separately under "Sand and gravel (construction)."

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

[3]Includes gem stones and values indicated by symbol W.

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

Table 3.—Indicators of New Hampshire business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	482.0	487.0	+1.0
Unemployment	do	24.0	36.0	+50.0
Employment (nonagricultural):				
Mining	do	(1)	(1)	--
Manufacturing	do	116.6	112.1	-3.9
Contract construction[2]	do	20.7	22.9	+10.6
Transportation and public utilities	do	14.4	14.6	+1.4
Wholesale and retail trade	do	88.8	88.0	-.9
Finance, insurance, real estate	do	20.6	20.9	+1.4
Services	do	76.8	78.8	+2.6
Government	do	56.7	55.8	-1.6
Total nonagricultural employment	do	394.6	393.1	-.4
Personal income:				
Total	millions	$9,367	$10,184	+8.7
Per capita		$10,013	$10,710	+7.0
Construction activity:				
Number of private and public residential units authorized		4,443	4,167	-6.2
Value of nonresidential construction	millions	$87.9	$69.8	-20.6
Value of State road contract awards	do	$58.1	$51.4	-11.5
Shipments of portland and masonry cement to and within the State	thousand short tons	252	297	+17.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$22.6	$23.3	+3.1
Value per capita, resident population		$28	$24	-14.3
Value per square mile		$2,742	$2,504	-8.7

pPreliminary.

[1]Included with "Contract construction."

[2]Includes mining.

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.—During the year, the U.S. Supreme Court ruled that New Hampshire Public Utilities Commission cannot restrict the exporting of hydroelectric power. The unanimous court opinion stated that the exporting ban was "precisely the sort of protectionist regulation that (the Constitution)

declares off-limits to the States."[4]

In another legal action, the New Hampshire Supreme Court overturned a lower court decision that gave local government jurisdiction on siting hazardous waste facilities. The court ruled that the State, not towns, should determine the location of hazardous waste operations. The issue began in 1980 when Stablex Corp., a British-based firm, announced intentions to build a hazardous waste processing plant in Hooksett, Merrimack County. Shortly after the company announcement at a special town meeting, three ordinances were adopted that essentially banned construction of a hazardous waste facility in Hooksett, unless approved by popular vote.[5]

Traditionally, forest products have contributed to the stability of the State's economy. Approximately 85% of New Hampshire's 9,304 square miles is forested. A Forest Resources Plan, published in 1982 by the Division of Forests and Lands, Department of Resources and Economic Development (DRED), identified policy and direction goals for the 1980's. Included under the section on environmental quality was the recommendation that New Hampshire's mining laws RSA155-E and RSA12-E should be strictly enforced. The section stated that "Mining and mineral extraction should be recognized as a potentially competing land use that may not be compatible with forest resource management.... The New Hampshire DRED and Water Supply and Pollution Control Commission should develop reasonable and effective rules and regulations covering field enforcement of these laws."

New Hampshire continued cooperative programs, through the Office of the State Geologist, with two U.S. Department of the Interior agencies, the Bureau of Mines and the Geological Survey. Both programs were related to the minerals and geology of the State. During the year, a report on mineral investigations of the Great Gulf wilderness area in Coos County was published.[6]

Among other activities, the Office of the State Geologist served as a source of information for mining companies considering exploration programs and State agencies involved in land use planning and resource management. State budget limitations again reduced funding for the office in 1982.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—New Hampshire was one of four New England States that produced clay in 1982. Kane-Gonic Brick Corp., the State's only operator, mined common clay in Strafford County in the southeastern part of the State. About 80% of the brick manufactured by Kane-Gonic was shipped to the Boston market, a distance of approximately 65 miles.

Gypsum.—National Gypsum Co., Portsmouth, Rockingham County, imported crude gypsum from company-owned mines in Nova Scotia, Canada, for the manufacture of gypsum wallboard. A small quantity of vermiculite was also used by National Gypsum in the production of a fire-resistant wallboard. The company was one of two active gypsum calciners in New England; the other, United States Gypsum Co., operated a plant in Massachusetts.

Sand and Gravel.—New Hampshire's sand and gravel industry in 1982 consisted of 29 companies operating 39 pits in all 10 of the State's counties.

Construction.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Output in 1982 of 4.3 million tons was the lowest reported since 1958 when 3.9 million tons was produced. Sand and gravel mining operations in Carroll, Hillsborough, and Merrimack Counties accounted for about three-fifths of the total tonnage mined in the State.

Table 4.—New Hampshire: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,416	$4,658	$3.29
Plaster and gunite sands	28	84	3.03
Concrete products	122	377	3.09
Asphaltic concrete	902	2,849	3.16
Road base and coverings	1,114	3,123	2.80
Fill	327	616	1.89
Snow and ice control	239	384	1.61
Railroad ballast	10	22	2.23
Other	175	477	2.73
Total[1] or average	4,332	12,593	2.91

[1]Data may not add to totals shown because of independent rounding.

Table 5.—New Hampshire: Construction sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	NA	NA	NA	1,869	$5,404	$2.89
Gravel	NA	NA	NA	2,158	6,686	3.10
Sand and gravel (unprocessed)	NA	NA	NA	305	503	1.65
Total or average	e4,528	e$12,990	e$2.87	4,332	12,593	2.91

eEstimated. NA Not available.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be finalized the following year.

Crushed.—Output of crushed stone decreased to 600,000 tons in 1982 compared with 665,000 tons in 1981. In the past 10 years, New Hampshire's crushed stone production has averaged about 890,000 tons annually. A record high of 1.8 million tons was mined in 1973 during construction of a segment of the interstate highway system. Federal funding of $50 million for completion of the final three links of New Hampshire's 225 miles of interstate highway beginning in 1983 was expected to once again boost aggregate sales during the 5-year life of the project, although not to the production level of 1973.

Dimension.—Production reached a record high of 107,000 tons (1.3 million cubic feet) in 1982. New Hampshire ranked fourth nationally in dimension stone output and also was one of only four States that mined more than 100,000 tons. Granite was the only type of dimension stone mined in the State.

Dimension granite was quarried at three operations—two in Hillsborough County and one in Merrimack County. Curbing, dressed architectural, construction, and monumental stone were the primary uses. The State ranked second to Georgia in output of dimension granite.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.

[2]State geologist, New Hampshire Department of Resources and Economic Development, Durham, N.H.

[3]Domenico, J. A., F. H. Howd, P. A. Hall-Santala, and W. J. Gerstel. Spectrographic Analyses and Statistical Summaries of Nonmagnetic-Heavy-Mineral Concentrate Samples From North-Central New Hampshire. U.S. Geol. Survey, OFR 82-10886, October 1982, 36 pp.

[4]Knoxville (Tennessee) News Sentinel. Feb. 27, 1982, p. 3.

[5]Boston Globe. Jan. 2, 1983, pp. 28-29.

[6]Girol, V. P., and T. M. Crandall. Mineral Investigation of Great Gulf Wilderness Area, Coos County, New Hampshire. BuMines MLA 115-82, 1982, 15 pp.

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 1st 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:			
Boston S&G Cook Concrete Co	Hooksett, NH 03106	Quarry	Merrimack.
Iafolla Industries Inc	Peverly Hill Rd. Portsmouth, NH 03801	do	Rockingham.
Kitledge Granite Corp	Armory Rd. Milford, NH 03055	do	Hillsborough.
Lebanon Crushed Stone Inc	Plainfield Rd. West Lebanon, NH 03784	do	Grafton.

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 William Kebblish[1]

The value of nonfuel mineral production in New Jersey was $132.4 million in 1982, a decrease of $16.3 million compared with 1981 figures. The reason for the decline was lower demand for nearly all minerals produced. Nationally, New Jersey ranked 35th in value of total nonfuel mineral output. The State ranked second in refinery production of tellurium, third in ilmenite concentrate, and sixth in magnesium compounds produced from seawater and well and lake brine; it was the only State in which greensand was produced. In terms of value, stone, sand and gravel, and zinc accounted for 95% of the total nonfuel mineral production.

Table 1.—Nonfuel mineral production in New Jersey[1]

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	62	$563	63	$566
Gem stones	NA	1	NA	1
Peat thousand short tons	26	1,476	W	W
Sand and gravel:				
Construction do	e9,756	e26,050	7,940	25,722
Industrial do	2,305	26,438	2,140	28,151
Stone (crushed) do	10,434	57,819	p10,700	p57,800
Zinc (recoverable content of ores, etc.) metric tons	16,198	15,911	16,800	14,248
Combined value of iron ore (1981), magnesium compounds, marl (greensand), stone (dimension), titanium concentrate (ilmenite), and value indicated by symbol W	XX	20,404	XX	5,922
Total	XX	r148,662	XX	132,410

eEstimated. pPreliminary. 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 New Jersey, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Atlantic	$626	W	Sand and gravel (industrial).
Bergen	750	(3)	
Burlington	25	(3)	
Camden	3,121	W	Sand and gravel (industrial).
Cape May	W	W	Magnesium compounds.
Cumberland	W	W	Sand and gravel (industrial), clays.
Essex	W	W	Stone (crushed).
Gloucester	W	W	Greensand marl, sand and gravel (industrial).
Hudson	147	$158	Stone (crushed).
Hunterdon	W	W	Stone (crushed), stone (dimension).
Mercer	W	W	Stone (crushed).
Middlesex	W	W	Sand and gravel (industrial), clays.
Monmouth	527	(3)	
Morris	W	W	Stone (crushed), iron ore.
Ocean	W	W	Ilmenite.
Passaic	W	7,050	Stone (crushed).
Somerset	26,749	24,829	Stone (crushed), clays.
Sussex	W	W	Zinc, stone (crushed), peat.
Warren	W	W	Peat.
Undistributed[4]	117,505	90,575	
Sand and gravel (construction)	XX	e26,050	
Total	[5]149,448	148,662	

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

[1]Salem and Union Counties are not listed because no nonfuel mineral production was reported.

[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 values indicated by symbol W.

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

Table 3.—Indicators of New Jersey business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	3,587.0	3,624.0	+1.0
Unemployment	do	262.0	325.0	+24.0
Employment (nonagricultural):				
Mining	do	2.3	2.2	-4.4
Manufacturing	do	770.7	727.7	-5.6
Contract construction	do	108.7	107.2	-1.4
Transportation and public utilities	do	196.5	195.9	-.3
Wholesale and retail trade	do	690.6	698.2	+1.1
Finance, insurance, real estate	do	161.8	166.7	+3.0
Services	do	638.5	661.5	+3.6
Government	do	529.0	525.8	-.6
Total nonagricultural employment	do	3,098.1	3,085.2	-.4
Personal income:				
Total	millions	$90,001	$96,898	+7.7
Per capita		$12,156	$13,027	+7.2
Construction activity:				
Number of private and public residential units authorized		20,746	23,647	+14.0
Value of nonresidential construction	millions	$916.6	$1,030.3	+12.4
Value of State road contract awards	do	$190.0	$188.0	-1.0
Shipments of portland and masonry cement to and within the State	thousand short tons	1,324	1,288	-2.7
Nonfuel mineral production value:				
Total crude mineral value	millions	$148.7	$132.4	-11.0
Value per capita, resident population		$19	$18	-5.3
Value per square mile		$18,123	$16,898	-6.8

pPreliminary.

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

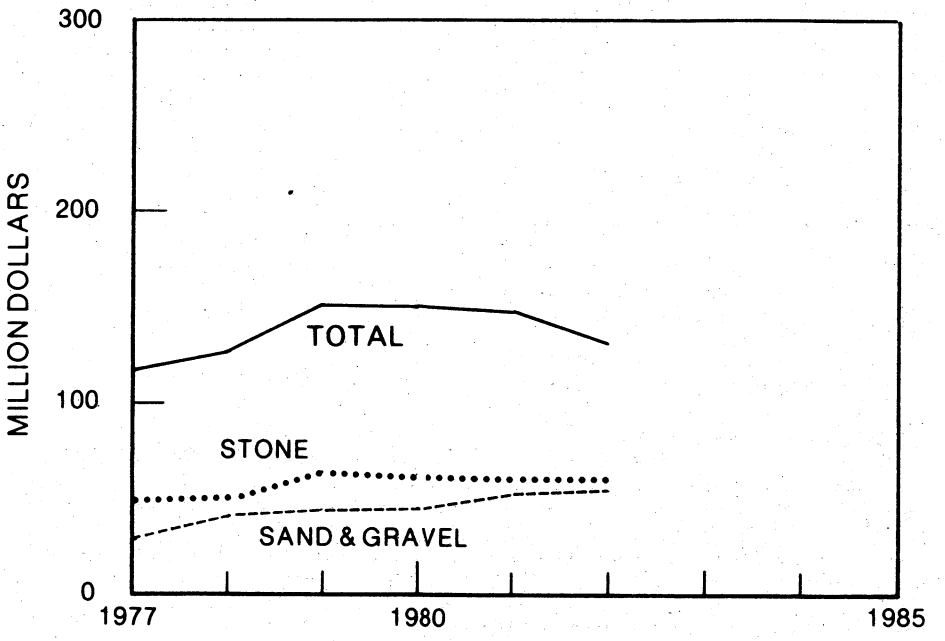

Figure 1.—Value of sand and gravel and stone, and total value of nonfuel mineral production in New Jersey.

Trends and Developments.—At yearend, there were signs that the Nation's eighth post-World War II business recession was ending. In 1982, nearly 3.1 million of the State's 7.4 million people were employed. Of this total, slightly more than 2,000 workers were employed in the mining industry. Housing starts increased to an average 1,970 per month, compared with 1,729 in 1981. The slight increase in housing starts, coupled with a 1% increase in population from 1980 to 1982, provided a basis for future increase in mineral demand.

Also during the year, the State moved from a manufacturing base to a service-related economy. The largest service-related employers included New Jersey Bell Telephone, Bell Telephone Laboratories, American Telephone & Telegraph Co., and Prudential Insurance Co. Manufacturing consumers reducing employment in New Jersey during the past decade include Ford Motor Co., Westinghouse Electric Corp., and E. I. du Pont de Nemours & Co. Inc. The slight change in the type of employment base could influence future mineral needs.

The water quality of New Jersey's lakes and streams concerns many agencies. The New Jersey Department of Environmental Protection (DEP) has been measuring acid rain precipitation at three locations throughout the State—Chester, Washington Crossing, and Rutgers University—with the help of university personnel. Rutgers officials are also studying acid precipitation in the Pinelands, while a Cook College pathologist is studying effects on vegetation. Various Federal agencies are also conducting studies on acid rain in the Northeast.

Legislation and Government Programs.—In 1982, the Governor appointed members to the Hazardous Waste Siting Commission. This commission has responsibilities for siting and determining the number of hazardous waste disposal facilities to be built, including operational procedures. The Governor also signed into law regulations allowing State officials to close hazardous waste facilities during cleanup operations and providing for prosecution of illegal waste handlers. Permit regulations were also included in the bill.

At yearend, five major chemical and petrochemical producers lost their appeal when the U.S. Supreme Court refused to overrule a lower court ruling requiring

payment into the New Jersey Spill Compensation Fund in addition to the Federal "Superfund." The State compensation fund raises money for pollution cleanup by taxing chemical and petrochemical producers with plants in the State.

In addition to chemical producers, the State's metal-reclaiming companies were ordered by DEP to prepare plans for cleanup of hazardous chemical spills, which could affect ground water. In many rural areas, wells are the only source of potable water, and quality must be assured. To further ensure water quality, the Environmental Protection Agency (EPA) sent letters to 3,000 generators of hazardous waste in New Jersey to determine locations and types of waste discarded in landfills. At yearend, EPA continued its effort to locate, identify, and eliminate these waste areas, 65 of which are eligible for Federal cleanup funds.

DEP approved new air pollution rules designed to reduce sulfur dioxide emissions while encouraging industry to use less expensive fuels with more efficient air pollution controls.

Another problem involves dredging of shoaled inlets. Previously, cities paid a part of dredging costs, which depleted funds. In mid-1982, DEP adopted regulations assuming total cost for approved projects.

Mine operators, manufacturing industries, private landowners, and others may be adversely affected by New Jersey's claim to land covered at one time by ocean tides. Affected areas, known as riparian lands, belong to the State, according to early English law. As a result of this right, a State agency prepared maps identifying lands being used by parties other than the State for which compensation is required. At yearend, the riparian land problem remained controversial and unresolved.

The State's "Shore Protection Master Plan" provided for maintenance or modification of existing beach erosion control structures. Six shore protection projects were identified in the plan.

New Jersey's proposed bottle bill requiring a deposit on bottles and beverage containers may have an adverse effect on the State's bottle industry. Currently, Cumberland County has much of the State's industrial sand production, which is used by local companies to manufacture a broad variety of glass products.

In the central part of the State, the Pinelands Commission finalized land use measures, which were adopted by 28 of the 52 towns located within the Pinelands. Land use measures also pertain to the extractive mineral industry.

During the year, the State's Coastal Management Program continued management of coastal areas. In 1982, program changes included a memorandum of agreement with the Port Authority of New York and New Jersey, shore protection program rules, and amendments to rules on coastal resource and development policies pertaining to limited growth areas and low-density development. The Coastal Management Program also includes regulations for extraction of minerals.

State Activities.—In late 1982, the State Geological Survey merged with the Bureau of Ground Water Management to form the New Jersey Geological Survey Element. Objectives of the new group include ground water studies, mapping of acquifers, waste areas, geologic mapping, resource studies, and providing information to the public and government agencies.

During 1982, ground water studies in Warren County indicated adequate water supplies resulting in construction of the $15 million Pequest Fish Hatchery. Other studies were completed on use of ground water in the northern part of the State to supplement reservoir capacity to prevent water shortages in the metropolitan areas.

An open file report was nearing completion on adequacy of ground water for rural inhabitants. Other publications nearing completion include asbestiform minerals in northern New Jersey, sand and gravel and stone operations, inventory of uranium-thorium occurrences, the Woodbury clay project, and geologic mapping of many parts of New Jersey.

A proposed project concerned drilling of a 3,340-foot well near Warren Grove, Ocean County, for possible storage of natural gas. The project was discontinued owing to environmental concerns.

In 1982, the Federal Government paid $62,789 to eight local governing authorities in New Jersey for services pertaining to 45,790 acres of tax-exempt Federal lands located near these municipalities. Services included those for fire and police and protection of natural resources. Payments are generally known as payments in lieu of taxes.

During fiscal year 1982, 17 U.S. Bureau of Mines contracts and grants totaling $795,000 were awarded to New Jersey orga-

nizations. The largest award of $353,000 went to Ingersoll-Rand Research Inc., Princeton, for a remote drill-bolting system for metal and nonmetal mines. The second largest award, $282,000 to Engelhard Corp., was for control of diesel emissions in underground mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—Clay production in New Jersey in 1982 totaled 62,703 tons valued at $566,160. This represents a slight increase in both quantity and value compared with those of 1981. Principal producers were New Jersey Shale Brick & Tile Corp. (common clay), Almasi Clay Co. (common and fire clays), and Jessie S. Morie & Son Inc. (fire clay). Common clay was used for face brick and sewer pipe; fire clay, for firebrick and block, cement, refractory mortar, and sealing.

An additional use of clay is for construction of waste disposal areas. Impermeable clay is used to seal landfills and toxic refuse areas to prevent seepage into the water table. In Middlesex County, south of Perth Amboy, B & J Warren & Sons Inc. had clay operations temporarily suspended by the Monroe Township Council owing to mining operations below permitted depths. Clay was shipped to Browning Ferris Industries for sealing landfills in Monroe and South Brunswick.

In southwestern New Jersey, Standard Minerals Corp. applied for a township permit to mine clay from a site in Alloway, Salem County. At yearend, no decision was made on the application.

Fluorspar.—Although no fluorspar was produced in the State, New Jersey was the eighth leading consumer in the Nation. In 1982, 13,396 tons was brought into the State, a 31% decrease compared with 1981 levels. The decline was due to the economic recession, resulting in reduced demand for manufactured products. Fluorspar was used by the ceramic industry as a flux and opacifier in the manufacture of glass products; it was also used as a flux in steelmaking, for hydrofluoric acid, and in other manufacturing processes.

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 1982.

The Kiwanis Franklin Museum and the Gerstmann Franklin Museum are popular tourist attractions, displaying mineral specimens from local mining areas. More than 180 minerals are associated with the abandoned zinc mine that operated for many years in Franklin, Sussex County. Some of these specimens are found by collectors scouring waste rock areas of abandoned mining operations. In southern New Jersey, quartz pebbles are collected by amateurs in various parts of Cape May County.

A recent publication, "Three Hundred Years of Mining in Sussex County" by John L. Baum, is available in Franklin. The book covers early exploration for minerals and mining of economical deposits in northern New Jersey.

Also in Sussex County, Limestone Products Corp. permits collection of mineral specimens, twice yearly, from an operating limestone quarry in Sparta Township. Specimens usually found include chondrodite, graphite, mica, spinel, hornblende, and fluorite.

Greensand.—Inversand Co., a subsidiary of Hungerford & Terry Inc., near Clayton, Gloucester County, was the only producer of greensand in the United States in 1982. Deposits of greensand, also known as glauconite, occur from Sandy Hook south to Delaware Bay near Salem. Greensand was sold for use mainly as a water purifier and as a fertilizer. Glauconite is a hydrous iron potassium silicate containing various amounts of aluminum, magnesium, sodium, and trace elements.

Gypsum (Calcined).—Crude gypsum, imported from Nova Scotia, Canada, was calcined by National Gypsum Co., Burlington County, and Genstar Building Materials, Camden County. Production increased slightly in both quantity and value from 1981 to 1982. Calcined gypsum was used mainly in the manufacture of wallboard and industrial and building plasters.

Iodine.—Crude iodine was shipped into New Jersey and used by six chemical and pharmaceutical companies to manufacture various iodine-containing compounds. Iodine compounds produced were used as catalysts, food supplements, stabilizers, in inks and colorants, in pharmaceuticals, and for sanitary purposes. Leading producers of iodine compounds were J. T. Baker Chemical Co., Warren County; Cooper Chemical Co., Morris County; GAF Corp., Union County; and Troy Chemical Corp., Essex County.

Magnesium Compounds.—New Jersey ranked sixth of seven States that produced magnesium compounds in 1982. Harbison-Walker Refractories Co., the only producer

in the State, extracted magnesium compounds from seawater in Cape May County in southern New Jersey. From 1981 to 1982, both production and value dropped 60% owing to economic conditions, which reduced demand for magnesium-contained products. At yearend, management considered closing the plant. Magnesium compounds were used mainly in refractories, fertilizers, and pharmaceuticals.

Peat.—Peat sales in New Jersey in 1982 were nearly the same as the 26,000 tons sold in 1981. Peat was produced at five plants in two counties and sold in bulk and packaged form. Types of peat produced were reed-sedge and humus. Peat was used for soil improvement and as an ingredient in potting soil.

Perlite (Expanded).—Grefco Inc., Jamesburg, and The Schundler Co., Edison, both in Middlesex County, expanded processed perlite shipped from out of State. Expanded perlite was used in roof insulation board, plaster aggregates, insulation masonry, and as a soil conditioner.

Quartz Crystal.—James M. Ronan Associates Inc., Wayside, Monmouth County, used cultured quartz crystal during 1982. Major use was in the manufacture of electronic products.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Production of construction sand and gravel in New Jersey totaled 7.9 million tons valued at $25.7 million in 1982, a decrease in both quantity and value compared with 1981 estimated figures. Ocean and Morris Counties, located close to markets, led in production. Principal producers were Clayton Sand Co., New Jersey Pulverizing Co., Saxon Falls Sand & Gravel Co. Inc., and Stavola Construction Materials Inc. Unit value was $3.24, an increase of $0.57 over 1981 estimated levels. Approximately 88% of the construction sand and gravel was trucked to market, with the remainder transported by other means. Principal use was for concrete aggregate.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	4,931	$15,647	$3.17
Gravel	NA	NA	NA	1,927	7,052	3.66
Sand and gravel (unprocessed)	NA	NA	NA	1,081	3,023	2.80
Total or average	e9,756	e$26,050	e$2.67	[1]7,940	25,722	3.24
Industrial sand and gravel	2,305	26,438	11.47	2,140	28,151	13.15
Grand total or average	e12,061	e52,488	e4.35	10,080	[1]53,874	5.34

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

Table 5.—New Jersey: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,767	$10,205	$3.69
Plaster and gunite sands	762	2,618	3.44
Concrete products	471	1,591	3.38
Asphaltic concrete	1,242	3,554	2.86
Road base and coverings	949	2,798	2.95
Fill	1,399	3,577	2.56
Snow and ice control	242	897	3.70
Other	107	483	4.51
Total[1] or average	7,940	25,722	3.24

[1]Data may not add to totals shown because of independent rounding.

Industrial.—New Jersey ranked fifth in industrial sand production in 1982, with production amounting to 2.1 million tons valued at $28.2 million, compared with 2.3 million tons valued at $26.4 million in 1981. Industrial sand was produced mainly in Cumberland County, which accounted for 98% of total State output. Other producing counties were Gloucester and Middlesex. Principal producers were New Jersey Silica Sand Co., Pennsylvania Glass Sand Corp., and Whitehead Bros. Co.

Principal uses of industrial sand were in the manufacture of glass products, foundry molds and cores, refractories, and in sandblasting and filtration.

Unit price of industrial sand was $13.15 per ton in 1982, compared with $11.47 in 1981. Approximately 61% of the industrial sand was shipped to market by truck, the remainder by rail.

Cumberland County producers accounted for more than 98% of New Jersey's industrial sand output, resulting in a concentration of glass-producing companies in the southern part of the State. The Glass Packaging Institute, Washington, D.C., listed New Jersey in fourth place behind California, Pennsylvania, and Indiana in number of glassmaking plants.[2] Owing to the weak economy, many glass plants reduced their work force. At yearend, the State's seven remaining glass-container plants employed approximately 7,500 workers. Reductions in work force occurred at the Kerr Glass Manufacturing Co. plant at Millville, Cumberland County; the Owens-Illinois Inc. plant at Vineland, Cumberland County; the Wheaton Industries Vineland plant, the largest glass producer in South Jersey; and the Anchor Hocking Corp. plant at Salem, Salem County.

Also during the year, Owens-Illinois purchased Kontes Glass Co. and modernized its Bridgeton plant also located in the same county. Durand Glass Manufacturing Co. Inc. opened a new glass plant in Millville, while Driver-Harris Co. installed a new melting furnace in Hudson County.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Crushed.—Estimated crushed stone production totaled 10.7 million tons valued at $57.8 million, approximately the same quantity and value compared with 1981 figures. Crushed stone was produced in eight counties, all in the northern part of the State. Leading producing counties were Passaic, Somerset, and Sussex; these three counties accounted for more than 75% of New Jersey's total crushed stone output.

Anthony Ferrante & Sons Inc. and Tri-County Asphalt Corp. produced crushed granite, while Trap Rock Industries Inc. and Stavola produced crushed traprock. Most of the stone was transported to market by truck. Major uses of crushed stone were for concrete aggregate, road base, and bituminous aggregate.

During the year, Trap Rock reopened its Moores Station Quarry in Hopewell Township, Mercer County. Newly installed equipment included crushers and screens. Crushed stone was used primarily for road base.

Hess Bros. Inc. purchased Burlington Asphalt Corp., Burlington County, which included a sand plant near Newark and a quarry in Pennsylvania. A Hess Bros. subsidiary, Riverdale Quarry Co., Morris County, supplied specialty stone sizes for public projects. Stones weighing up to 8 tons each were shipped to Central Park in New York City.

The U.S. Army Corps of Engineers considered a Carney's Point quarry as a disposal site for approximately 15 million cubic yards of dredged material from the Marcus Hook Shoal. Residents in Salem County objected to the plan and expressed concern over possible contamination of the water table. At yearend, Corps of Engineers officials continued environmental studies on feasibility of the plan.

Dimension.—Estimated dimension stone production was higher in 1982 than in the previous year. Only one company quarried dimension stone throughout the State. Delaware Quarries produced dimension sandstone in Hunterdon County for use as cut stone.

Sulfur (Recovered).—Sulfur was recovered as a byproduct in oil refining at four plants. Shipments of elemental sulfur totaled 103,000 metric tons valued at $12 million, a drop of 14% in quantity and 11% in value compared with 1981 figures. The decrease in shipments was the result of reduced demand for oil-related products. Less oil was refined at the State's four oil plants, two located in Gloucester County

and one each in Middlesex and Union Counties. Sulfur was used in the manufacture of sulfuric acid, fertilizers, plastics, and other products.

Talc.—Talc mined in other States was shipped into New Jersey and processed by Amoco Minerals Co. at a plant in South Plainfield, Middlesex County. Talc was used mainly in the production of ceramics.

Vermiculite (Exfoliated).—Crude vermiculite was shipped into New Jersey and exfoliated by W. R. Grace & Co., Trenton, Mercer County, and The Schundler Co., Edison, Middlesex County. Both output and value declined from that of 1981. The product was used for agricultural purposes, loose fill insulation, fireproofing, and lightweight aggregate.

METALS

Aluminum.—Although New Jersey does not produce primary aluminum, vast amounts of aluminum cans are collected for recycling. During the first year of operation, the Aluminum Co. of America can-recycling plant at Fairview, Bergen County, collected and processed more than 300 million cans, equivalent to 7.5 million pounds of aluminum. The cans are pressed into 800-pound bales and shipped to Tennessee where can sheet is produced. Reynolds Aluminum Co. also collects and recycles aluminum cans.

Copper.—United States Metals Refining Co., a subsidiary of AMAX Inc., Carteret, Middlesex County, the Nation's largest secondary smelter and refiner of copper, reduced production of refined copper at its Carteret plant to 81,000 tons annually, a decrease of approximately 54,000 tons compared with 1981 levels.[3] The reduced production resulted in idling of nearly 400 workers. A large volume of copper scrap originates from the New York metropolitan area.

Ferroalloys.—Ferroalloy shipments decreased 45% and value decreased 41% in 1982 compared with those of 1981. Reason for the sharp decline of ferroalloy shipments was due to weak economic conditions in the country coupled with low-priced imports. Principal producer of ferroalloys is Shieldalloy Corp., Newfield, Gloucester County, a division of Metallurg Inc. Ferroalloys of columbium, titanium, and vanadium were produced and used by other companies in the manufacture of cast iron products, auto parts, tool steel, and other products.

Iron Oxide Pigments.—Shipments of finished iron oxide pigments in New Jersey in 1982 totaled 5,176 tons valued at $5.7 million, representing a decrease in both quantity and value of 34% and 25%, respectively, compared with those of 1981. Producers were Combustion Engineering Inc., CE Minerals Div., Camden County; Du Pont, Essex County; and Columbian Chemicals Co., a subsidiary of Cities Service Co., Mercer and Middlesex Counties. At yearend, Columbian Chemicals closed its Trenton plant, transferring all employees to the Monmouth Junction facility. Iron oxide pigments were used mainly in paint manufacture.

Selenium and Tellurium.—During 1982, New Jersey was one of three States in which selenium was recovered, and one of two States in which tellurium was produced. United States Metals Refining Co., Carteret, recovered selenium and tellurium from anode slimes generated in the electrolytic refining of copper. Selenium was sold for use in electronic and photocopier components, glass manufacturing, and chemicals and pigments; tellurium was sold as an alloying material in the production of free-machining steels.

Steel.—Two small minimills operated profitably, using scrap to produce steel. Raritan River Steel Co., Perth Amboy, is owned by Co-Steel International Ltd., Whitby, Ontario, Canada. In 1982, Raritan supplied wire rod, accounting for approximately 20% of the Nation's needs.[4] At another minimill, Roebling Steel Co., Roebling, Burlington County, competed in the wire and wire rod markets but required a $1.8 million loan from the U.S. Economic Development Administration to purchase additional equipment for continued operation. New Jersey Economic Development Agency also provided funds for a worker retraining program.[5]

Associated Metals & Minerals Corp. closed its ferrous scrap export terminal in Port Newark; the nonferrous section of the yard remained open. Earlier in the year, Luria Bros. & Co. Inc. closed owing to low ferrous scrap prices.

Schiavone Chase Corp. began operation of a steel-shearing operation mounted on a floating barge. In 1982, the barge was located at Port Newark and will be moved to other locations according to market conditions.

Swepco Tube Corp., Clifton, Passaic County, a division of Superior Tube Corp., continued plant modernization for production of pipe with wall thicknesses up to 4 inches and heavy wall pipe up to 20 feet in length.

Other industry-related events are listed in table 6.

Table 6.—New Jersey: Selected developments in manufacturing in 1982

Company	Location	Event
Allied Corp	Morristown	Development of metglass family of amorphous metals used for transformers and electromagnetic products.
Joseph Dixon Crucible Co	Jersey City	Plant consolidations: Jersey City plant closed, and operations moved to Lakehurst.
Driver Harris Co	Franklin Township.	$3 million modernization program; new melting furnace to be completed in 1983; wire rod produced.
E. I. du Pont de Nemours & Co., Inc.	Deepwater	Development of a fiber called KEVLAR used for aerospace products; fiber ingredients produced at the Deepwater plant.
Engelhard Corp	East Newark	Development of a substitute for acid hard gold; alloy uses palladium and nickel.
Do	Iselin	Development of a catalytic converter to reduce air pollution.
Do	Menlo Park	Construction of a collection and pretreatment facility for precious metals.
General Magnaplate Corp	Linden	Received a Federal contract to improve resistance to wear of steel, aluminum, copper, and magnesium products.
Haber Inc	Towaco	New process to recover silver from low-grade ores.
Hyatt Clark Industries Inc	Clark	Employees purchased a plant from General Motors Inc. producing bearings; new equipment being installed.
Johnson Matthey Inc	West Deptford.	Modernization of plant for increased platinum recovery.
Louis Usdin Co. Inc	Newark	Alloy plant sold to Steelmet Inc.
M & T Chemicals Inc	Rahway	Marketing of a catalytic nickel-plating process, which was developed in the United Kingdom.
NL Industries Inc	Pedricktown	Secondary lead plant sold to National Smelting of New Jersey.
Northbrook Metals Inc	Pennsauken	Secondary base metal plant opened.

Titanium.—During the year, ASARCO Incorporated closed its dredging operation at Lakehurst, Ocean County, owing to escalating costs, a worldwide oversupply of ilmenite, and poor market conditions. The operation began in 1973 producing ilmenite concentrate that was sold exclusively to Du Pont for the manufacture of titanium dioxide pigments for use in paper, plastics, and other applications.

Additionally, NL Industries Inc. ceased production of titanium dioxide pigments at its plant in Sayreville, Middlesex County. Shutdown of the plant was expected to affect operations of the company's ilmenite-magnetite mine in central New York, output of which had been sent to Sayreville for processing.

Zinc.—New Jersey ranked fifth of 10 States in zinc production in 1982. Output amounted to 16,800 metric tons valued at $14.2 million, representing a slight increase in quantity but an 11% decrease in value, compared with 1981 figures. Zinc was used mainly for galvanizing, brass products, and zinc-base alloys.

When New Jersey Zinc Co. closed the underground zinc mine in Franklin on September 30, 1954, the company transferred ownership of the 38.5-acre surface complex to the city. Currently, an apartment complex is being planned on part of the city-owned property. During its operating life, total zinc ore extracted from underground operations at the Franklin Mine totaled approximately 22 million tons with a 19% average zinc content. More than 180 minerals were associated with the ore deposit, making the town of Franklin, according to residents, the "mineral capital of the world." Today, mineral collectors visit the area in an effort to find many of the mineral specimens.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.
[2]Philadelphia Inquirer. Funds To Promote Use of Glass. Dec. 21, 1982.
[3]American Metal Market. Nonferrous Output Cuts Continue. June 10, 1982, p. 1.
[4]Silvestri, F. Raritan Captures 20% of Wire Rod Mart in 3 Yrs. Am. Met. Market, Jan. 19, 1983.
[5]Chase, M. EDA Criticized for $1.8M Loan to Roebling. Am. Met. Market, Feb. 11, 1982, pp. 1, 16.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Almasi Clay Co	Metuchen Ave. Woodbridge, NJ 07095	Pit	Middlesex.
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.	226 Atlantic Ave. Clayton, NJ 08312	Pit	Gloucester.
Gypsum (calcined):			
National Gypsum Co	4100 First International Bldg. Dallas, TX 75270	Plant	Burlington.
Ilmenite:			
ASARCO Incorporated	Route 70, Mile 41 Lakehurst, NJ 08733	Dredge and plant.	Ocean.
Iron oxide pigments:			
Columbian Chemicals Co	Box 37 Tulsa, OK 74102	Plants	Mercer and Middlesex.
Combustion Engineering Inc., CE Minerals Div.	901 East 8th Ave. King of Prussia, PA 19406	Plant	Camden.
E. I. du Pont de Nemours & Co. Inc	Pigments Dept. Wilmington, DE 19898	do	Essex.
Magnesium compounds:			
Harbison-Walker Refractories Co	2 Gateway Center Pittsburgh, PA 15222	do	Cape May.
Peat:			
Hyper-Humus Co	Lafayette Rd., Box 267 Newton, NJ 07860	Bog	Sussex.
Mount Bethel Humus Co. Inc	315 West 57th St. New York, NY 10019	Bog	Do.
Netcong Natural Products	738 Route 10 Randolph, NJ 07801	Bog	Do.
Perlite (expanded):			
Grefco Inc	3450 Wilshire Blvd. Los Angeles, CA 90010	Plant	Middlesex.
The Schundler Co.[2]	Box 251 Metuchen, NJ 08840	do	Do.
Sand and gravel:			
Construction:			
New Jersey Pulverizing Co	115 Hickory Lane Bayville, NJ 08721	Pit	Ocean.
Saxon Falls Sand & Gravel Co. Inc	R.D. 3 Stanhope, NJ 07874	Pit	Morris.
Industrial:			
New Jersey Silica Sand Co	Millville, NJ 08332	Dredge	Cumberland.
Pennsylvania Glass Sand Corp	Berkeley Springs, WV 25411	Pit	Do.
Whitehead Bros. Co	64 River Rd. East Hanover, NJ 07936	Pit and dredge.	Do.
Stone:			
Granite (crushed and broken):			
Anthony Ferrante & Sons Inc	Route 202, Mine Brook Rd. Bernardsville, NJ 07924	Quarry	Hunterdon.
Tri-County Asphalt Corp	Route 15 Hopatcong, NJ 07843	do	Sussex.
Traprock (basalt, crushed):			
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.
Union Building & Construction Corp	1111 Clifton Ave. Clifton, NJ 07013	Quarry	Passaic.
Sulfur:			
Chevron U.S.A. Inc	1200 State St. Perth Amboy, NJ 08861	Refinery	Middlesex.
Exxon Co. U.S.A	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 Department of Energy and Minerals, for collecting information on all nonfuel minerals.

By Albert E. Ward[1] and Robert W. Eveleth[2]

Total value of nonfuel minerals declined in 1982 to $432 million from $696 million in 1981. Potassium salts surpassed copper in value in 1982, reversing the usual positions of these two commodities; together they constituted about 75% of the State's nonfuel mineral output value. Other leading minerals included gold, perlite, sand and gravel, silver, and stone. In 1982, New Mexico was the Nation's leading producer of perlite and potassium salts, second in mica and pumice output, and third in copper.

Because of the cutback in copper mining and the lack of molybdenum output, metals accounted for only 35% of nonfuel mineral value in 1982, down from 51% in 1981. Weak national agricultural markets also were reflected in reduced output of potassium salts. Attributed largely to high interest rates, demand for most construction minerals declined for the third consecutive year.

Table 1.—Nonfuel mineral production in New Mexico[1]

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
Clays[2] thousand short tons	64	$119	60	$112
Copper (recoverable content of ores, etc.) metric tons	154,114	289,204	W	W
Gem stones	NA	200	NA	200
Gold (recoverable content of ores, etc.) troy ounces	65,749	30,221	W	W
Gypsum thousand short tons	166	2,256	198	887
Manganiferous ore (5% to 35% Mn) short tons	12,741	W	--	--
Perlite thousand short tons	489	14,983	408	13,355
Potassium salts thousand metric tons	1,601	261,200	1,497	204,600
Pumice thousand short tons	93	919	97	809
Sand and gravel (construction) do.	e6,496	e19,780	5,616	17,670
Silver (recoverable content of ores, etc.) thousand troy ounces	1,632	17,170	805	6,397
Stone:				
Crushed thousand short tons	4,162	12,485	p2,800	p13,700
Dimension do.	26	173	p18	p138
Combined value of carbon dioxide, cement, clays (fire clay), helium (Grade-A), lead, lime, mica (scrap), molybdenum, salt, sand and gravel (industrial, 1982), vanadium (1981), zinc (1981), and values indicated by symbol W	XX	r47,697	XX	173,945
Total	XX	r696,407	XX	431,813

eEstimated. pPreliminary. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Bernalillo	$25,020	W	Cement, stone (crushed), clays.
Catron	74	(3)	
Chaves	535	—	
Curry	W	W	Stone (crushed).
De Baca	W	(3)	
Dona Ana	W	W	Stone (crushed), stone (dimension), clays.
Eddy	W	W	Potassium salts, salt, stone (crushed).
Grant	377,080	$320,466	Copper, silver, gold, lime, manganiferous ore, stone (crushed), zinc, lead.
Harding	W	W	Carbon dioxide.
Hidalgo	1,171	889	Silver, stone (crushed), gold, clays, copper, lead, zinc.
Lea	W	W	Potassium salts, salt, stone (crushed).
Lincoln	W	(3)	
Luna	W	W	Silver, gold, lead, clays, copper, zinc.
McKinley	W	W	Stone (crushed), molybdenum.
Otero	1,177	(3)	
Quay	257	(3)	
Rio Arriba	W	W	Stone (crushed), pumice.
Sandoval	1,453	W	Gypsum, pumice.
San Juan	4,889	W	Helium (Grade-A), stone (crushed), clays.
San Miguel	73	(3)	
Santa Fe	W	20,648	Gold, pumice, stone (crushed), gypsum, silver, copper, lead.
Sierra	W	(3)	
Socorro	2,215	2,171	Perlite, stone (dimension), lead, stone (crushed), silver.
Taos	45,181	W	Perlite, mica, stone (crushed), molybdenum.
Torrance	13	W	Stone (crushed).
Union	W	W	Do.
Valencia	W	W	Perlite, stone (dimension), stone (crushed).
Undistributed[4]	306,473	332,450	
Sand and gravel (construction)	XX	e19,780	
Total[5]	765,609	696,407	

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

[1]Colfax, Guadalupe, Los Alamos, Mora, and Roosevelt Counties not listed because no nonfuel mineral production was reported.

[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 some gem stones and vanadium that cannot be assigned to specific counties and values indicated by symbol W.

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

Table 3.—Indicators of New Mexico business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	578.0	592.0	+2.4
Unemployment	do	42.0	54.0	+28.6
Employment (nonagricultural):				
Mining[1]	do	31.2	26.7	-14.4
Manufacturing	do	34.3	34.0	-.9
Contract construction	do	33.3	31.9	-4.2
Transportation and public utilities	do	29.2	29.8	+2.0
Wholesale and retail trade	do	106.0	109.4	+3.2
Finance, insurance, real estate	do	21.5	21.8	+1.4
Services	do	94.1	94.9	+.8
Government	do	125.8	125.4	-.3
Total nonagricultural employment[1]	do	[2]475.5	473.9	-.3
Personal income:				
Total	millions	$11,298	$12,230	+8.2
Per capita		$8,509	$8,997	+5.7

See footnotes at end of table.

Table 3.—Indicators of New Mexico business activity —Continued

	1981	1982[P]	Change, percent
Construction activity:			
Number of private and public residential units authorized	7,952	7,927	-0.3
Value of nonresidential construction millions	$282.0	$295.9	+4.9
Value of State road contract awards do	$98.3	$150.3	+52.9
Shipments of portland and masonry cement to and within the State thousand short tons	672	553	-17.7
Nonfuel mineral production value:			
Total crude mineral value millions	$696.4	$431.8	-38.0
Value per capita, resident population	$534	$318	-40.4
Value per square mile	$5,710	$3,549	-37.8

[P]Preliminary.
[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.

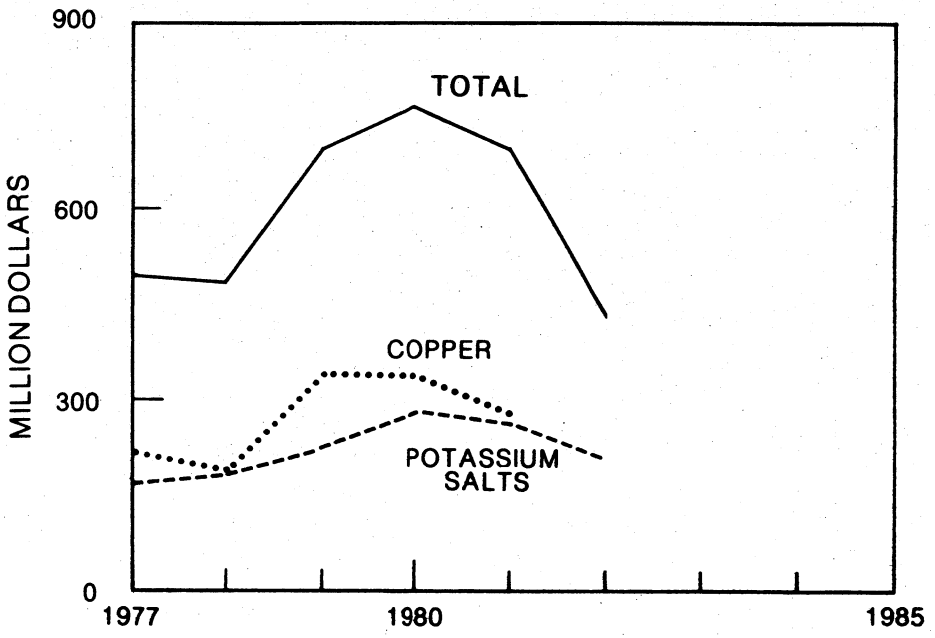

Figure 1.—Value of potassium salts, copper, and total value of nonfuel mineral production in New Mexico.

Trends and Developments.—Several State agencies and coal-mining interests in New Mexico agreed upon a voluntary program to identify, assess, and preserve valuable fossils found during coal exploration and mining. A national pacesetter, the program may set guidelines for similar efforts in other coal-mining States and for paleontological resources in other bedded mineral deposits. Paleontological resources, unlike archaeological and historic sites, have no mandated protection in New Mexico. Agencies participating include the Mining and Minerals Division of the Energy and Minerals Department, the New Mexico Bureau of Mines and Mineral Resources, the State Land Office, and the New Mexico Natural History Museum. The program comprises

three distinct parts: a premining attempt to identify surface indications of fossils; if fossils are present, an examination and evaluation period by State agencies to determine their value; and a provision for quick removal of valuable fossils discovered during the mining process without unduly disrupting mining operations.

New Mexico's Economic Development Division, at midyear, began a new approach for attracting industry to several one-industry mining districts in the State. The concept, called "regionalism," bands together small communities in a unified effort to attract light industry. Initially targeting the Silver City copper district and the Grants uranium district for assistance, the State will provide advice and guidance. Several thousand copper-industry workers were idled in the Silver City area, raising unemployment to over 20% in the area. Most of these workers remained there, in contrast to the transient nature of uranium workers in the northwest part of the State.

An offshoot of the copper industry curtailment was a dominolike attempt to shift westward electrical power generated in southern New Mexico and western Texas that had been used for copper production. Texas-New Mexico Power Co. serves the area and had lost more than one-half its power demand owing to the curtailment or shutdown of three major copper mining operations in the area. Collectively, the three copper operations continued to pay the utility a monthly minimum of $317,000; however, their demand for power was negligible. Claiming substantial losses, Texas-New Mexico attempted to eliminate or reduce its obligation to buy electricity from Public Service Co. of New Mexico and El Paso Electric Co. With more than ample supplies, Public Service and El Paso attempted to market their surplus electricity on the west coast.

Exploration Activities.—Most exploration programs in the State were aimed at the precious metals. Gold and silver prices continued their 1981 downtrends through June 1982; however, by yearend, gold had risen 50% from a low near $300 to $460, and silver had moved up from $5 to $10. Moreover, gold and silver prices were about 10 times their price levels of almost two decades ago, whereas base metals have fallen to and below their price levels of the 1960's. Volatility now appears to be a hallmark of most metal prices, but the price range of precious metals is much more attractive than the price range of most base and ferrous metals.

Phelps Dodge Corp. continued its program of examining precious metals prospects; New Mexico activity has centered on its Tyrone copper operation. Gold Fields Mining Corp. had 36,000 acres under long-term lease surrounding its Ortiz open pit gold mine and had a long-term exploration program underway. Conoco Inc. conducted gold exploration south of the Ortiz leased area, particularly in the Gypsy Queen-Candelaria Mine area. However, after E. I. du Pont de Nemours & Co. Inc. took over Conoco in September 1981, Conoco's Minerals Department and the exploration project were scheduled to be terminated in July 1983. Goldfield Corp.'s successful new St. Cloud silver mine spurred interest in old mines and new prospects in the Hermosa and other mining districts.

Exxon Corp. reached an agreement with Boliden Minerals Inc. whereby Boliden would acquire the Pinos Altos copper prospect and conduct a 3-year exploration and development program. Exxon will retain a production royalty if and when the property goes into production. Elsewhere, Exxon continued investigating some 300 copper claims in the Flying A Ranch area, Burro Mountain district. Superior Oil Co.'s mineral division continued evaluating their molybdenum prospect in the White Mountains in Lincoln County.

Legislation and Government Programs.—The Urgent Supplemental Appropriations Act, signed into Federal law in July, included an amendment that prevents the Mine Safety and Health Administration (MSHA) from classifying potash mines as "gassy" without going through formal rulemaking proceedings. The amendment, a result of suggestions by Carlsbad-area potash industry officials, changes "gassy" mine regulations to regulations that apply specifically to the hazards and safety requirements of potash mines; coal-related standards will no longer be used as had been done previously. Adoption of the coal-related standards would have required an $80 million investment in the Carlsbad mines despite the 500 million tons of production in 51 years without a single incident or ignition involving methane. In 1981, under a new interpretation of existing regulations, MSHA designated the Kerr-McGee Corp. and Mississippi Chemical Corp. mines "gassy." Management and labor representatives noted that under the new policy, the

four other Carlsbad mines would be classified "gassy," because of methane traces existing underground near pressure-relief holes that were drilled to relieve air pressure and to prevent roof collapse. The primary source of methane traces in the Carlsbad mines is from these pressure-relief holes; the methane is mixed with high percentages of nitrogen.

For 1982, New Mexico received a record $146.8 million payment in mineral-leasing receipts from the Federal Bureau of Land Management, second only to the payment received by Wyoming and up from $128 million in 1981. The receipts represent one-half of all mineral-leasing rents, royalties, and bonuses the Federal Government collected within the State. Oil and gas leasing accounted for most of the receipts; however, coal, geothermal, phosphate, potash, sodium, sulfur, and other minerals were included. High semiannual payments the last half of 1981 and first half of 1982 indicate the timing of the latest peak in oil and gas exploration in the State.

In December, the Secretary of the Interior ordered the transfer of mineral-leasing activities for Indian lands from the Minerals Management Service to the Bureau of Indian Affairs; implementation was to be completed by June 1, 1983. The move is intended to achieve a more integrated management of Indian lands and to afford the tribes increased control over the development and use of mineral resources on tribal lands.

In January, the U.S. Supreme Court by a six to three vote upheld the sovereign right of the Jicarilla Apache Tribe to impose a severance tax on nonmembers for resources produced on Indian land. The landmark decision was the result of objections by two major oil companies that pay royalties to the small Indian tribe in northwestern New Mexico and a severance tax to the State. The ruling is expected to reopen the oil companies' issue that the State cannot charge a severance tax if the tribes do. Suits filed against the State years ago over the question of double taxation have been inactive pending the outcome of litigation between the oil companies and the Jicarilla Apaches. Legal authorities visualize a prolonged period of litigation and another Supreme Court ruling before the suits are settled.

The New Mexico Bureau of Mines and Mineral Resources completed and published Resource Map 14, showing active mines and processing plants in the State. It also published geologic maps on the Florida Gap, Massacre Peak, and Regina quadrangles, and circulars on the western extent of the Ogallala Formation in New Mexico, Quaternary geology of Lake Animas in Hidalgo County, industrial rocks and minerals of the southwest, and adobe bricks in New Mexico. It also participated in projects on disposal sites for low-level radioactive waste, high-level radioactive waste, and sites for toxic waste. New Mexico Bureau personnel served on various State commissions and boards such as the Coal Surface Mining Commission, Water Quality Control Commission, and Mine Safety Advisory. The New Mexico Mining and Mineral Resources and Research Institute at the New Mexico Institute of Mining and Technology in Socorro, which was created under title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—Although no barite was produced in New Mexico during 1982, Barite of America Co. processed some lead-silver-gold ore in its refitted barite mill near Deming. Lack of lead ore closed the operation in September. Western General Resources Co. abandoned an uneconomic barite-lead-fluorspar mill operation at Hansonburg.

Carbon Dioxide.—Three carbon dioxide pipelines, originating in southwest Colorado, will enter the southeast New Mexico part of the Permian Basin to enhance the oil and gas recovery by secondary recovery methods and assure continued vitality of the region's oil and gas industry for another 10 to 20 years. Two pipelines were under construction, and a third is scheduled for the mid-1980's.

Cement.—Ideal Basic Industries Inc.'s cement division continued manufacturing cement at its Tijeras plant in Bernalillo County; production, however, declined in 1982—portland cement fell about one-eighth, masonry cement was off about one-seventh. Prices were firm—portland cement up about one-tenth, masonry cement up one-eighth. Cement inventories, up considerably in 1981, moved up only moderately in 1982.

Ideal Basic's substantial energy-saving investments, largely completed in 1980, effected greater fuel savings in 1982 than in 1981. Reported coal and electrical energy consumption were off about 20% and natural gas needs, still the primary source of energy, were reduced by more than 50%. On an estimated British thermal unit basis for combined natural gas and coal consumption per ton of cement produced, fuel savings were about halved in 1982 compared with reported 1981 fuel consumption.

Portland cement markets were virtually unchanged in 1982. As in 1981, ready-mix companies took about 60% of the cement, followed by nonhighway contractors with about one-fifth, and building materials dealers demand for one-eighth of the output. Concrete product manufacturers, highway contractors, and government agencies took the remaining 8%.

Clays.—Common clay and shale output declined about 6% in 1982 as construction industry demands for clay products remained slack for the second consecutive year. Fire clay production also decreased as demand for refractory products in smelters turned weak in 1982. As in 1981, three different operators mined common clay in Bernalillo, Dona Ana, and San Juan Counties. Phelps Dodge in Hidalgo County and Mathis & Mathis Mining & Exploration Co. in Luna County continued to mine fire clay.

United Desiccants Inc., a division of United Catalysts Inc. of Louisville, Ky., began constructing a 30,000-square-foot building on 10.4 acres in the Rio Grande Industrial Park of Tierra Del Sol, about 3 miles east of Belen. Clay the company mined in Sanders, Ariz., will be shipped to the plant, which employs 30 people, solar dried from a moisture content of about 35% down to 16%, then placed in a gas-fired industrial drier for further moisture reduction and subsequent processing. Packaged desiccating clay will be shipped to Galveston, Tex., for marketing worldwide.

Gem Stones.—Indian silversmiths welcomed the declining price of silver in early 1982; however, largely owing to the cutback in surface copper mining in New Mexico and Arizona, turquoise became increasingly scarce. In particular, top-quality spider-web turquoise, in tight supply, soared to $5,000 per pound, up from about $800 since 1978. Other types of high-quality turquoise also were in short supply and costly, whereas lower quality material generally remained plentiful. Most turquoise, some of high quality, is recovered as a byproduct of open pit copper mining in Arizona. Several mines in Colorado, Nevada, and New Mexico produce turquoise only intermittently; these mines, however, generally were not responsive to market demands in 1982, possibly because of recent oversupply of turquoise.

By act of Congress, the famous Harding Pegmatite, 10 miles east of Dixon in Taos County, became the legal property of the University of New Mexico. Discovered at the turn of the century, the deposit was mined for lepidolite used in the ceramic industry from 1918 to about 1930. During World War II, the mine was reopened to ship rare microlite and tantalite-columbite ores, and, later, spodumene and lepidolite also were handpicked at the quarry. Because of U.S. Bureau of Mines drilling and exploration, the Harding became the first domestic pegmatite mine with blocked-out ore reserves; these reserves still remain. From 1949 to 1958, beryl was mined at the deposit. The property is now to be preserved as a mineral-collecting locality as well as an outdoor laboratory. Permission to visit the area must be obtained from the Chairman, Department of Geology, University of New Mexico at Albuquerque.

Gypsum.—Output of gypsum in New Mexico reversed a 3-year downtrend in 1982 and moved up about 20% from that of 1981. White Mesa Gypsum Co. (later, Pomeroy Inc.) and Ernest Teeter mined gypsum at operations in Sandoval County, and Western Gypsum Co. quarried gypsum in Santa Fe County. Western Gypsum continued to calcine its gypsum, and American Gypsum Co. in Bernalillo County calcined the White Mesa output. Calcined gypsum output moved up about in step with crude gypsum production. The Ideal Basic cement plant at Tijeras bought Ernest Teeter's San Felipe gypsum output for use as a set retarder in portland cement.

Lime.—Output plunged more than 50% in 1982 largely because of reduced demand for lime in the Hurley copper concentrator at Kennecott Corp.'s Chino Mines Div. in Grant County. Average price, however, rose about one-third. All quicklime production was at the Grant County operations of Kennecott and Mathis & Mathis.

Mica.—Mineral Industrial Commodities of America Inc. (MICA) increased moderately the output of scrap and flake mica at its Tojo Mine in Taos County. Price per ton

declined about one-sixth owing to weak markets during the year.

Rio Arriba County commissioners in November endorsed a $1 million revenue bond for a proposed flotation muscovite mica mill to be built in Velarde. The commissioners' interest was in creating 30 to 50 mill jobs for unemployed residents in Velarde and southeast Rio Arriba County. If the project proceeds, the mill is expected to be completed in 1984; MICA would be the operator.

Perlite (Expanded).—New Mexico continued to produce most of the Nation's processed perlite ore with 83% of the total, unchanged from that of 1981. Ore sales to out-of-State consumers fell about one-sixth in 1982, approximately in step with the nationwide decline in sales, as weakened demand for perlite from the construction industry appeared to bottom out toward yearend. Price per ton for marketed New Mexico perlite was $33.22, up from the $30.64 in 1981.

Potash.—Because of slack demand for potassium salts from the agricultural sector throughout 1982, New Mexico potash output declined 15%, and sales fell 6.5%. New Mexico continued to produce most of the domestic potassium salts, 85% in 1982, compared with 83% in 1981. Average price of potassium salts was about $137 per metric ton, down from $163 in 1981.

During the year, extended vacation periods, temporary mine and plant shutdowns, and layoffs occurred as operators cut back production to bring record-high midyear inventories under control. National Potash Co. suspended production at its Carlsbad operation in February. AMAX Chemical Corp. had its usual 3-week vacation shutdown at midyear and a short unscheduled shutdown because of power loss following a severe ice storm in December, but no general layoff during 1982. Mississippi Chemical had its first 2-week vacation shutdown at midyear. International Minerals & Chemical Corp. (IMC), Kerr-McGee Chemical Corp., and Potash Co. of America (PCA) had midyear vacation shutdowns. Duval Corp. and PCA had major layoffs, and Kerr-McGee reduced its work force by attrition during the last half of the year.

IMC began sinking a fifth shaft at its mine near Carlsbad. Site preparation and pregrouting of the collar began in midsummer for the 18-foot-diameter, 875-foot-deep, conventionally excavated, $10.5 million shaft; shaft sinking began in late December. When completed in late 1983, the shaft will provide additional ventilation and improved efficiencies in operations during the development and initial mining of the southern ore reserves. Mining of the northern ore reserves will continue for several years; however, as the southern reserves are developed, ore increasingly will be recovered from the area the new shaft will service. The new shaft will permit the mine to maintain its current annual output of about 5.5 million metric tons. Since initial production in 1940, IMC has extracted more than 130 million metric tons of potash ore, and at recent production rates, estimated reserves are sufficient for more than 25 years. IMC planned in late 1982 to spend about $1 million in early 1983 for expanding its compaction-plant operations to produce a more granular potash product, currently in demand.

Mississippi Chemical in September announced plans for a $17.5 million compaction plant at its Carlsbad facility. Plant construction was to begin in January 1983 and completion is expected in about 18 months. The planned 15-employee compaction unit will be capable of converting all the 400,000-ton mine output from a standard to a granular product. With the scheduled completion of the compaction plant in mid-1984, the company will have the flexibility to meet any combination of demand for standard and coarse potash.

Announced at yearend was the consolidation of AMAX Phosphate Inc. into a single operating company, AMAX Chemical Corp., to serve the fertilizer industry. AMAX Chemical, to be headquartered in Lakeland, Fla., will remain a wholly owned subsidiary of AMAX Inc., a diversified minerals and energy company based in Greenwich, Conn. The AMAX potash mine and mill in Carlsbad will be under jurisdiction of the Lakeland office. The consolidation was part of streamlining AMAX corporate activities announced in October to reduce costs and increase operating efficiencies.

Waste Isolation Pilot Project (WIPP) continued excavation work near Carlsbad under U.S. Department of Energy supervision. WIPP is to provide a research and development facility to demonstrate safe disposal of radioactive wastes from defense and some energy programs in the United States. Transuranic wastes would be placed in thick-bedded salts about 2,150 feet below the surface. WIPP has a land area of 18,960 acres the Federal Bureau of Land Management administers and about 1,600 acres of

State-owned land. The site, about 6 miles in diameter, was divided into four concentric zones. Zone one, 100 acres at the site center, would contain most of the surface facilities. Zone two, about 1,800 acres, overlies most of the foreseen underground development. Zone three, 89,340 acres, would provide a 1-mile buffer zone around zone two. Recovery of natural gas, oil, and potash would be permitted in zone four, the outermost control zone at the WIPP site, which comprises about 8,720 acres.

The Santa Fe Railroad cut back its daily potash train in Carlsbad to three trains per week at midyear and made some minor staff reductions because of slack potash demand. Carlsbad was the number five revenue-producing point for the railway in 1982, including $120 million in potash income. At yearend, the State Legislative Energy Resources Transportation Committee endorsed four bills for introduction to the 1983 legislature. These measures included a bill to provide State money for a railroad line from the potash mines near Carlsbad in Eddy County, east through the Climax Chemical Corp. facility at Monument in Lea County, then north to connect with the Missouri-Pacific Railroad north of Hobbs. The Lea County Industrial Development Corp. initially proposed the rail line.

Table 4.—New Mexico: Production and sales of potash

(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]
1981:							
January-June	9,129	1,186	1,786	904	1,732	881	r147,600
July-December	9,361	1,234	1,726	894	1,386	720	113,700
Total[3]	18,490	2,420	3,513	1,798	3,118	1,601	r261,200
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

rRevised.
[1]Sylvinite and langbeinite.
[2]F.o.b. mine.
[3]Data may not add to totals shown because of independent rounding.

Pumice.—With 23% of U.S. production, New Mexico was the second largest pumice producer in 1982, up from third place in 1981. Although mine output increased moderately, average price eased down to $8.34 per ton from $9.88 in 1981 largely because of weak demand from the construction industry.

Salt.—Production of salt, up about one-fourth in 1981, eased downward about 10% in 1982; however, the average price of salt was up about 8%. United Salt Corp. continued to produce salt by solar evaporation in Eddy County. SPN Dismantling Inc. again was a major producer of bulk rock salt in the county, and Duval recovered a small quantity of salt in 1982. In Lea County, Williams Brine Service and Pioneer Water Co. produced brine.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. Construction sand and gravel output fell about one-seventh in 1982 as the lingering economic recession restricted construction throughout the State. Revised construction sand and gravel figures for 1981 show that production was about 800,000 tons less than the preliminary estimate, but average value per ton was up substantially to $3.04 in 1981. Average value inched up to $3.15 in 1982, even though sand and gravel demands were unusually weak.

Santa Ana Sand and Gravel Products completed its first year of operation on Santa Ana Pueblo land in Sandoval County. Gravel, quartzite rock, ready-mix concrete, and washed sand were marketed largely in southern Sandoval County and in metropolitan Albuquerque in nearby Bernalillo County. The operation shelved expansion plans until commercial and residential construction markets improve. Manufacture of adobe brick at the site also was foreseen.

Industrial.—Springer Building Materials Corp. mined a small quantity of industrial sand and gravel in Bernalillo County.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	1,688	$5,608	$3.32
Gravel	NA	NA	NA	3,003	10,372	3.45
Sand and gravel (unprocessed)	NA	NA	NA	925	1,690	1.83
Total or average	e6,496	e$19,780	e$3.04	5,616	17,670	3.15
Industrial sand	--	--	--	W	W	7.50

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

Table 6.—New Mexico: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,049	$7,534	$3.68
Plaster and gunite sands	99	423	4.28
Concrete products	245	609	2.48
Asphaltic concrete	427	1,734	4.06
Road base and coverings	2,204	5,839	2.65
Fill	481	1,135	2.36
Railroad ballast	4	14	3.70
Other	107	382	3.57
Total or average	5,616	17,670	3.15

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and completed the following year.

Crushed.—Estimated crushed stone production declined about one-third in 1982 as the construction industry sharply reduced its demands. Construction-related stone needs were particularly slack in the northwest part of the State where mineral fuel developments have been curtailed and in the southeast where potash production and oil and gas exploration have been reduced.

Dimension.—Dimension stone quarried in the State during 1982 also was estimated down by one-third.

Sulfur (Recovered).—Eight companies recovered sulfur from natural gas and crude oil at 11 operations in four counties—Eddy, Lea, Roosevelt, and San Juan—unchanged from that of 1981. Most of the 10% increase in 1981 was lost in 1982 as sulfur recovery eased down about 9%. The small 1,500-ton beginning stockpile was reduced to 800 tons at yearend. Price held firm in the weak sulfur marketplace, declining to about $85 per metric ton in 1982, from $87 in 1981.

METALS

Copper.—Production of copper was slashed by more than one-half and total value plummeted by almost 60% as all mines cut back or were closed down during the year. Copper demand was weak throughout the

year. Most foreign copper producers continued to mine copper ore at or near capacity levels to maintain employment at home and to acquire overseas hard currency. Copper inventories rose, and domestic operators, generally faced with higher costs than foreign producers, were forced to curtail their operations. The price of copper declined from about 80 cents per pound in January to a 66-cent low in June, then irregularly upward to about 73 cents at yearend.

Kennecott's Chino Mines Div. shut down its concentrator in March, closed the smelter in May, and ceased stripping waste in the pit in June—its first closure owing to slack demand since the depression. Early in the year, Phelps Dodge reduced output at Tyrone by one-fifth, then shut the mine and concentrator down in mid-April. The company's smelter in Hidalgo County continued to process leach-dump precipitates and toll ore mostly from operating mines in Arizona.

Quintana Minerals Corp. in January began shakedown operations at its new Copper Flat project, went into full production in March, and shut down the new mine and mill in June. The low-cost, 15,000-ton-per-day operation, with state-of-the-art autogenous milling, could not be operated economically because of the low copper price. Sharon Steel Corp., which operates an underground and open pit mine at Tierro, began a series of cutbacks in mid-1981, reduced operations to maintenance and stripping overburden in early 1982, and ceased operations in May.

Compounding the problem of slack demand for copper through 1982 was the collapse in demand for byproduct molybdenum. Also, byproduct precious metals declined in price through June—gold troughing at about $300 and silver at $5. Unemployment in Grant County peaked at 38% in late 1982, substantially higher than the 25% recorded during the depression.

Kennecott's new concentrator at Chino underwent shakedown tests in the summer and was in full operation at yearend. In September, Kennecott announced it would proceed with a $100 million smelter modernization program at Hurley. An INCO flash furnace will replace the existing reverberatory furnace. Because the INCO process requires oxygen injection into the furnace, the company will build an oxygen plant at the site. The smelter project is to be completed early in 1985.

Table 7.—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	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1980, total	7	1	22,239,228	15,847	$9,707,239	W	W
1981, total	12	--	23,375,862	65,749	30,220,871	1,632,346	$17,169,618
1982:							
Grant	8	--	8,402,419	1,927	724,379	W	W
Hidalgo	1	--	W	W	W	W	W
Santa Fe	2	--	W	W	W	W	W
Sierra	4	--	W	W	W	W	W
Total	15	--	[1]10,341,336	W	W	[1]804,594	[1]6,396,523

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1980, total	149,394	$337,228,102	--	--	W	W	$373,011,033
1981, total	154,114	289,203,720	W	W	W	W	336,815,343
1982:							
Grant	W	W	W	W	--	--	[1]120,462,893
Hidalgo	W	W	--	--	--	--	W
Santa Fe	W	W	W	W	--	--	W
Sierra	W	W	W	W	--	--	W
Total	W	W	W	W	--	--	[1]150,797,306

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

Table 8.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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	W	W	W	--	--	--
Gold-silver	5	13,546	W	58,971	W	W	--
Silver	5	W	W	W	W	W	--
Copper	4	W	W	W	W	W	--
Total	15	W	W	[2]804,594	W	W	--
Other lode material:							
Copper precipitates	1	W	--	--	W	--	--
Grand total	15	[2]10,341,336	W	804,594	W	W	--

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.
[2]Includes items indicated by symbol W.

Table 9.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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	12,628	--	--	--
Smelting of concentrates	W	733,786	W	W	--
Direct smelting of:					
Ore	W	58,180	W	W	--
Precipitates	--	--	W	--	--
Total	W	804,594	W	W	--

W Withheld to avoid disclosing company proprietary data.

Gold.—Owing to reduced copper mining in the State, byproduct gold recovery was down substantially in 1982.

Gold Fields mined and processed 830,000 tons of ore that yielded $19 million. Gold Fields uses the cyanide-heap-leaching process the U.S. Bureau of Mines pioneered. Ongoing metallurgical research conducted by the company has improved precious metal recovery rates to about 90%. Innovations include the use of a gantry arrangement that selectively stacks the ore for optimum cyanide percolation and aeration of the heap. Leached gold is recovered by activated carbon and then precipitated as a metallic gold. An electrolytically deposited precious metal foil is produced at the plant as opposed to the precious metal plated steel wool produced at similar operations.

Goldfield produced a small amount of byproduct gold at its St. Cloud silver mine in the Black Range mining district. Gold also was produced at Goldfield's San Pedro Mine and at several small properties owned by other companies.

Lead.—Lead produced in New Mexico during 1982 was substantially less than output for most years in the 1970's. The price of lead fell by almost one-third. The Groundhog Mine at Vanadium remained closed. Byproduct lead from major copper mines was off sharply, and only four companies produced byproduct lead concentrate.

Manganese.—No manganiferous ore was mined in New Mexico during 1982. Ore production at the Boston Hill Mine near Silver City ceased in late 1981 as demand from the CF&I Steel Corp. in Pueblo, Colo., evaporated because of sharply reduced steel operations.

Molybdenum.—Kerr-McGee Corp. produced a small quantity of molybdenum as a byproduct of its uranium operations near Grants. No other molybdenum production was reported in the State. The 1982 output was one-twentieth that of 1981, and 1981 production was one-half of 1980 output. Huge molybdenum inventories at the start of 1982 resulted in price declines and cutbacks or closures of domestic molybdenum mines. Foreign producers continued to recover substantial quantities of byproduct molybdenum from copper mining operations; demand was weak throughout the

year, and large molybdenum inventories remained at yearend.

Molycorp Inc. closed its mill at Questa in August 1981, as it ceased open pit mining of its ore body and made final preparations to mine its deep ore by underground block caving. Initial mining of the deep ore was planned for the summer of 1983. Virtually completed in 1982, the mill was expected to reach full capacity in mid-1984. The 124-million-ton ore body, with a grade of 0.29% MoS_2, was scheduled to be mined at 18,000 tons per day to produce about 20 million pounds of MoS_2 annually for 20 years. The Questa ore body is reached by two 1,300-foot shafts for service and ventilation. Ore is moved by rail underground. A conveyor transports crushed ore to the surface.

Silver.—Production of silver was cut by one-half in 1982 because of the widespread reductions in base metals output. Total value of mined silver fell by almost two-thirds owing to the drop in price early in the year to the $5 trough in June. By yearend, the price of silver had risen to about $11; however, by the second half of the year, all base metal operators had curtailed or closed their mines. As in 1981, New Mexico ranked eighth in silver output among 16 States that reported production in 1982.

Goldfield of Florida began producing silver ore on a limited basis in January but went into full production in March at its St. Cloud Mine in the Black Range district near Chloride. Initial mining was from a 68,000-ton block of ore that contained 18.08 ounces of silver per ton, 2.15% copper, and 0.03 ounce of gold. Ore was shipped to the 250-ton-per-day mill at the company's San Pedro Mine northeast of Albuquerque, a 240-mile haul. Goldfield now plans to erect a 400-ton mill in the Winston-Chloride area. The $3 million facility is to come onstream in mid-1983. The company planned to expand its mine output and also was considering the purchase of custom ore from nearby mining districts. When the new mill is in operation, the company foresees annual savings of about $1 million in haulage costs, including the shorter haul of concentrates to the ASARCO Incorporated El Paso smelter.

Silver was produced at Goldfield's San Pedro Mine and at several other small operations, mostly as a byproduct of gold or base metal mining.

Vanadium.—For the first time in 27 years, no byproduct vanadium recovery was recorded in New Mexico as the number of uranium producers fell to 2 in 1982, down from 15 in 1980.

Zinc.—No zinc was produced in New Mexico in 1982.

[1]State Liaison Officer, Bureau of Mines, Denver, Colo.
[2]Mining engineer, New Mexico Bureau of Mines and Mineral Resources, Socorro, N. Mex.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
Ranger Industries Inc	Box 602 Socorro, NM 87801	Open pit mine and processing plant.	Socorro.
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	Box 12336 El Paso, TX 79912	Open pit mine	Dona Ana.
Kinney Brick Co. Inc	100 Prosperity Ave. Box 1804 Albuquerque, NM 87102	do	Bernalillo.
Copper:			
Kennecott Minerals Co., a subsidiary of Kennecott Corp., Chino Mines Div.[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.
Sharon Steel Corp.[4]	Box 406 Hanover, NM 88041	Underground mine, open pit mine, 2 flotation mills.	Do.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
American Gypsum Co	Box 6345 Albuquerque, NM 87197	Processing and wallboard plant.	Bernalillo.
Pomeroy Inc	10147 North 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 & Mathis Mining & Exploration Co.	1101 Santa Rita Box 2577 Silver City, NM 88061	Quarry and open pit mine.	Grant.
Manganese:			
Luck Mining Co	Box 29 Silver City, NM 88061	Open pit mine and plant.	Do.
Mica:			
Mineral Industrial Commodities of America Inc.	Box 2403 Santa Fe, NM 87501	Open pit mine	Taos.
Molybdenum:			
Molycorp Inc., a division of Union Oil Co. of California.	Box 760 Los Angeles, CA 90051	Open pit mine and flotation mill.	Do.
Perlite:			
Grefco Inc., a subsidiary of General Refractories Co.	Box 308 Antonito, CO 81120	Open pit mine; crushing, screening, air separation.	Socorro and Taos.
Manville Sales Corp., a division of Manville 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.	Valencia.
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.
Mississippi Chemical Corp	Box 101 Carlsbad, NM 88220	do	Do.
National Potash Co., a subsidiary of Freeport Minerals Co.	Box 731 Carlsbad, NM 88220	do	Lea.
Potash Co. of America, a subsidiary of Ideal Basic Industries Inc.[5]	Box 31 Carlsbad, NM 88220	do	Eddy.
Pumice:			
American Pumice Co., a division of Beatrice Foods Co.	Box 4305 Santa Fe, NM 87502	Processing plant	Santa Fe.
Copar Pumice Co	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	Lea.
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:			
Concrete Sales and Equipment Rentals.	Box 2547 Milan, NM 87021	Open pit mine and crusher.	McKinley.

[1]Also clays and stone.
[2]Also silver and lime.
[3]Also silver, gold, and sandstone.
[4]Also gold, silver, zinc, and iron.
[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, Geological Survey, for collecting information on all nonfuel minerals.

By William Kebblish[1]

The value of nonfuel mineral production in New York was $500.4 million in 1982, an increase of $19.1 million over that of 1981. Cement, lime, salt, sand and gravel, stone, and zinc were the principal commodities produced, for more than 95% of the total value of mineral production in the State. Nationally, New York ranked first in value of garnet and salt, third in zinc, and fourth in talc. New York was the only State that mined emery and accounted for most of the Nation's wollastonite production.

Other mineral commodities produced were clays, gypsum, ilmenite, magnetite, and peat. Silver and lead were recovered as byproducts of zinc mining. Slag was produced at steelmaking operations, while byproduct sulfur was recovered from oil refining.

New York also ranked high in the production of synthetic minerals, leading the Nation in sodium carbonate, calcium chloride, and graphite and ranking fourth in mullite. The State ranked second in output of primary aluminum based on estimated data.

Table 1.—Nonfuel mineral production in New York[1]

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
Clays[2] thousand short tons	597	$2,310	352	$897
Gem stones	NA	30	NA	30
Lead (recoverable content of ores, etc.) metric tons	968	780	974	549
Peat thousand short tons	39	811	W	W
Salt do.	5,597	103,668	6,205	117,718
Sand and gravel:				
Construction do.	e18,280	e45,560	17,524	47,799
Industrial do.	55	W	45	512
Silver (recoverable content of ores, etc.) thousand troy ounces	29	303	27	212
Stone:				
Crushed thousand short tons	30,681	117,689	p28,700	p132,800
Dimension do.	21	2,291	p22	p2,293
Zinc (recoverable content of ores, etc.) metric tons	36,889	36,235	49,351	41,855
Combined value of cement, clays (ball clay), emery, garnet (abrasive), gypsum, iron ore, lime, talc, titanium concentrate (ilmenite), wollastonite, and values indicated by symbol W	XX	171,554	XX	155,688
Total	XX	r481,231	XX	500,353

eEstimated. pPreliminary. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Albany	W	W	Cement, stone (crushed), clays, stone (dimension).
Allegany	$1,263	(3)	
Broome	W	W	Clays, peat.
Cattaraugus	5,251	$175	Peat.
Cayuga	W	(3)	
Chautauqua	919	(3)	
Chemung	W	(3)	
Chenango	723	(3)	
Clinton	W	W	Stone (crushed).
Columbia	W	W	Do.
Cortland	720	(3)	
Delaware	W	W	Stone (dimension), stone (crushed).
Dutchess	W	W	Stone (crushed), peat.
Erie	W	W	Stone (crushed), lime, clays.
Essex	16,894	16,586	Wollastonite, ilmenite, iron ore, stone (crushed), stone (dimension), garnet.
Franklin	154	100	Stone (dimension), stone (crushed).
Fulton	478	(3)	
Genesee	W	W	Gypsum, stone (crushed).
Greene	W	W	Cement, stone (crushed).
Herkimer	W	W	Stone (crushed).
Jefferson	2,902	1,784	Do.
Lewis	W	W	Wollastonite, stone (crushed).
Livingston	W	W	Salt, stone (crushed).
Madison	1,740	1,340	Stone (crushed).
Monroe	W	W	Do.
Montgomery	W	2,263	Do.
Nassau	W	(3)	
Niagara	4,729	W	Stone (crushed).
Oneida	4,304	W	Stone (crushed), sand and gravel (industrial).
Onondaga	59,026	48,664	Lime, stone (crushed), salt, cement, clays.
Ontario	W	W	Stone (crushed).
Orange	W	W	Stone (crushed), clays.
Orleans	W	914	Stone (crushed).
Oswego	1,501	(3)	
Otsego	231	(3)	
Putnam	W	W	Stone (crushed).
Rensselaer	W	880	Do.
Rockland	W	17,639	Do.
St. Lawrence	34,596	W	Zinc, talc, stone (crushed), lead, silver.
Saratoga	2,545	W	Stone (crushed), sand and gravel (industrial).
Schenectady	W	(3)	
Schoharie	W	W	Cement, stone (crushed).
Schuyler	W	W	Salt.
Seneca	W	W	Stone (crushed), peat.
Steuben	W	W	Stone (crushed).
Suffolk	3,904	(3)	
Sullivan	W	W	Stone (crushed).
Tioga	1,156	(3)	
Tompkins	W	W	Salt, stone (crushed), stone (dimension).
Ulster	W	W	Stone (crushed), clays.
Warren	13,722	W	Cement, garnet, stone (crushed).
Washington	W	W	Stone (crushed), stone (dimension).
Wayne	W	W	Stone (crushed).
Westchester	185	W	Emery, peat, stone.
Wyoming	W	W	Salt.
Yates	162	(3)	
Undistributed[4]	338,680	345,327	
Sand and gravel (construction)	XX	e45,560	
Total[5]	495,788	481,231	

e Estimated. 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.

[2] County distribution for construction sand and gravel is not available; total State value is shown separately under "Sand and gravel (construction)."

[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 may not add to totals shown because of independent rounding.

Table 3.—Indicators of New York business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	8,023.0	8,026.0	+0.4
Unemployment	do.	613.0	687.0	+12.1
Employment (nonagricultural):				
Mining[1]	do.	6.4	6.4	--
Manufacturing	do.	1,433.3	1,361.8	-5
Contract construction	do.	213.2	213.8	+.3
Transportation and public utilities	do.	429.7	421.9	-1.8
Wholesale and retail trade	do.	1,465.7	1,454.3	-.8
Finance, insurance, real estate	do.	654.9	670.5	+2.4
Services	do.	1,783.8	1,815.8	+1.8
Government	do.	1,300.3	1,289.7	-.8
Total nonagricultural employment[1]	do.	7,287.3	[2]7,234.1	-.7
Personal income:				
Total	millions	$201,707	$217,695	+7.9
Per capita		$11,460	$12,328	+7.6
Construction activity:				
Number of private and public residential units authorized		26,409	24,290	-8.0
Value of nonresidential construction	millions	$1,316.3	$1,781.4	+35.3
Value of State road contract awards	do.	$550.0	$561.0	+2.0
Shipments of portland and masonry cement to and within the State	thousand short tons	2,506	2,362	-5.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$481.2	$500.4	+4.0
Value per capita, resident population		$28	$28	--
Value per square mile		$9,924	$10,093	+1.7

[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.

Trends and Developments.—New York attracted more investment by foreign firms than second place New Jersey. In 1982, there were 36 foreign firms investing in New York, compared with 21 in New Jersey. Canadian firms led the list of countries investing in New York.

The number of private and public housing units continued to decline, falling from 26,409 units in 1981 to 24,290 units in 1982. The continual decline in housing starts during the past 5 years has reduced demand for construction and mineral-related products such as wallboard and insulation materials.

The subject of acid rain continued to be discussed throughout New York during 1982. Environmentalists, outdoor enthusiasts, and government officials were told of increasing acidity in the State's streams and lakes. The problem was being investigated by Federal, State, and local research agencies. To counteract immediate effects attributed to acid rain, interested citizens, with the assistance of State officials, used lime to reduce lakewater acidity. At year-end, researchers were continuing efforts to determine the cause of acid rain and possible remedial actions.

Water transportation continued to play a vital function in the State's mineral economy. Operating costs pertaining to navigation, channel maintenance, dredging, lock construction, and maintenance remain the responsibility of the Federal Government. To offset costs, the Federal Government proposed legislation whereby users of the transportation facilities would be charged a user fee. Also proposed was a congestion fee, imposed when excessive traffic causes delays at operating locks, especially on the St. Lawrence River. The Barge Canal (formerly the Erie Canal), a 524-mile waterway linking Lake Erie with the Hudson River and operated by the Federal Government, faced the possibility of closure. Such action would affect many industries, especially quarries in the Lockport vicinity, which supply stone for restoration areas in the Buffalo area.

Legislation and Government Programs.—Legislation was introduced that, if enacted, would prohibit all exploration and mining of uranium and other radioactive materials within New York for 7 years. A similar bill was passed in New Jersey during the year.

In midyear, the Governor signed into law a "minisuperfund" bill pertaining to hazardous waste dumps. Fees will be paid by hazardous waste generators, with monies used for cleanup of abandoned waste sites when owners of such sites cannot be located. Federal funds are also available for cleanup purposes.

The Governor also signed into law a bottle bill designed to eliminate litter and conserve resources by recycling glass and metal beverage containers. Officials of the New York Department of Environmental Resources planned oversight hearings on the bill prior to the July 1, 1983, effective date.

The New York Geological Survey continued investigations throughout the year, many of which were published or being prepared for publication.[2] State geologic publications consisted of eight reports—three related to the geology of Albany County, one to petroleum exploration, and the remaining four to other geologic investigations throughout New York. Seven doctoral theses also were finalized by students at New York universities dealing with various aspects of the State's complex geologic structures.

Investigations by Federal, State, and local governing entities, as well as the academic community and others, continued on various research topics. Eight projects pertained to hydrology; 14 to economic, environmental, and engineering geology; 8 to geophysics and seismology; 18 to surficial geology; 39 to sedimentary geology; and 15 to igneous and metamorphic geology.

At yearend, State survey geologists were finalizing a demonstration project to determine the characteristics of glacial soils in the Albany area. The project will enable engineers and land use developers to predict soil behavior with regard to construction activity.

Of interest to tourists, as well as the general public, was a survey report describing different stone used in construction of the Empire State Plaza in Albany.[3] Some of the dimension stone was produced in New York, but most of it originated in Alabama, Georgia, and Vermont, as well as overseas. The Empire State Plaza constitutes the major part of New York State office buildings in the capital district.

The New York Geological Survey acquired a mineral rock collection of the Adirondack region that belonged to a deceased professor emeritus of the Department of Geology, Princeton University. The collection is to be made available at the State Museum in Albany for use by students, researchers, and others.

During fiscal year 1982, the U.S. Bureau of Mines had 18 active contracts and grants totaling approximately $331,000 with various research agencies throughout New York. The largest contract ($129,000) was awarded to Hispotronics Inc. at Brewster for electrical research studies. Educational institutions participating in research programs included Alfred University, Columbia University, and New York University.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives (Manufactured).—Artificial abrasives manufacturers in New York experienced a distressing year, with production and value both dropping approximately 40% compared with 1981 levels. High-purity aluminum oxide was produced in Niagara County by The Carborundum Co., a division of SOHIO Co. and General Abrasives Div. of Dresser Industries Inc. Carborundum ceased production of silicon carbide in late 1981; General Abrasives began producing a small quantity of aluminum-zirconium oxide in 1982. Pellets Inc. in Erie County, the State's lone metallic abrasives producer, reported a drop in quantity and value for 1982 when compared with that of 1981. The company produced cut wire shot for abrasive purposes.

Calcium Chloride (Synthetic).—New York ranked first of three States in the production of synthetic calcium chloride in 1982. Allied Chemical Corp. recovered synthetic calcium chloride as a byproduct of soda ash production at its plant near Syr-

acuse. Although output increased slightly compared with 1981 levels, value decreased owing to a lower unit price. Calcium chloride was used for ice and snow removal and as a dust suppressant. In 1982, Allied Chemical officials expected to use the equivalent of approximately 600,000 gallons of 34% liquid calcium chloride in flake and liquid form for ice and dust control and quarry roads.[4]

Cement.—Nationally, New York ranked 6th in portland cement shipments and 18th in masonry cement shipments. From 1981 to 1982, portland cement shipments decreased 9% in quantity and 8% in value mainly owing to the weak national economy, which reduced construction projects. New York's cement industry is concentrated in the capital area, namely Albany, Greene, and Schoharie Counties. These three counties account for nearly 90% of the State's output. The principal producer of portland cement is Atlantic Cement Co. Inc. at Ravena, south of Albany.

Shipments of masonry cement in New York declined nearly 17% in quantity and 4% in value from 1981 to 1982. Three companies shipping portland cement also shipped masonry cement. One masonry cement plant was located in Greene County, a second plant in Warren County, and a third plant, owned by Lehigh Portland Cement Co., only sold masonry cement from inventory. The other producers were Lone Star Industries Inc. and Moore McCormack Resources Inc.

In May, Lehigh Portland purchased the Alpha Portland Cement Co. plant at Cementon and closed its nearby Alsen plant. The newly aquired plant, which has State approval to burn waste solvents mixed with coal to fuel cement kilns, will undergo modernization resulting in an estimated 750,000-ton annual cement capacity.

Alpha Portland ceased cement-producing operations during the year, selling or preparing to sell existing plants to reduce short-term bank debt. The company's portland cement plant at Jamesville, near Syracuse, remained idle.

Lone Star purchased the Gulf + Western Industries Inc. Marquette Co. cement operations nationwide. Included in the sale was the Catskill cement plant in Greene County, with an annual rated capacity of 600,000 tons of portland cement. The plant is fueled by coal and uses the wet process for cement production.[5]

In June, Atlantic Cement launched the *Maria T*, a self-unloading barge. Cement is to be transported from the Ravena plant on the Hudson River to markets on the east coast. The barge is 420 feet long with a nearly 23,000-ton capacity and a self-unloading discharge rate of 800 tons per hour.

Independent Cement Corp. planned to triple capacity of their cement distribution terminal at Oswego on Lake Ontario. Other company-owned terminals are located in Buffalo and in Saugerties, on the Hudson River.

Clays.—Production of clay and shale in New York, excluding ball clay, decreased from 1981 to 1982 owing to the weak economy, which reduced demand for construction and ceramic products. Clay and shale was produced by nine companies in six counties. Leading producing companies were Atlantic Cement and Northeast Solite Corp. Albany County led in production with 55% of the State's total, followed by Ulster, Broome, Onondaga, Orange, and Erie Counties.

Slip clay (statistically tallied as ball clay) was produced by Industrial Mineral Products Inc., Albany County, from the Imp pit. The slip clay was used principally for ceramic glazes and bonding.

Emery.—The entire U.S. production of emery was produced from two open pits in Westchester County operated by De Luca Emery Mine Inc. and John Leardi. From 1981 to 1982, output remained essentially the same, but value increased slightly. Emery was used mainly as a nonslip application for floors, pavements, and stair treads.

Garnet.—Of the three States that produced garnet in 1982, New York ranked second in output and first in value. From 1981 to 1982, production decreased approximately 10%, but value increased nearly 2%. Garnet was produced by Barton Mines Corp., Warren County, from a surface mine near North Creek. The NYCO Div. of Processed Minerals Inc., Essex County, recovered garnet as a byproduct of wollastonite mining and processing. Garnet was used in coated abrasives, glass grinding and polishing, and metal lapping.

Gem Stones.—The value of gem stones and mineral specimens collected by mineral dealers and amateur collectors in New York was estimated at $30,000 in 1982. Clear quartz crystals are found east of Utica in the vicinity of Herkimer and Middleville. In parts of St. Lawrence County, gem stone occurrences include hexagonite, chrome tourmalite, uvite, and diopside. On the bor-

der between Orange and Rockland Counties, monazite, allanite, davidite, and other mineral specimens have been found.

Graphite (Manufactured).—New York again ranked first among the States in the production of manufactured graphite in 1982, accounting for nearly 37% of the national total (excluding Puerto Rico). Output amounted to 68,444 tons valued at $113.6 million, a 40% decrease in quantity and 48% in value compared with those of 1981. Leading producers were Airco Carbon, a division of BOC International Group Co. (England), Great Lakes Carbon Corp., Carborundum, and Union Carbide Corp., all located in Niagara Falls. Manufactured graphite was sold principally for electrodes; other uses included anodes, electric motor brushes, crucibles and vessels, powders, and lubricants.

Gypsum.—United States Gypsum Co., Oakfield, Genesee County, was the only producer of crude gypsum in New York, although three other companies shipped gypsum into the State. Output from the United States Gypsum underground mine increased nearly 13% in quantity and 18% in value compared with 1981 figures. The crude gypsum, together with purchased rock, was calcined at company-owned plants in Genesee and Rockland Counties. At the Rockland plant, officials were concerned with power failures, which deenergize pollution control equipment, increasing fugitive dust emissions.

National Gypsum Co., Rensselaer County, and Georgia-Pacific Corp., Westchester County, calcined out-of-State gypsum for use in wallboard and various plasters. In western New York, National Gypsum officials planned a reclamation project, which would eliminate mounds of waste gypsum at the Clarence Center plant, Erie County, closed since early 1982.

Iodine.—Crude iodine was brought into the State by Sterling Organics, Rensselaer County, for use in the manufacture of pharmaceuticals, catalysts, and sanitation products. During 1982, RSA Corp., Westchester County, also sold iodine products.

Iron Slag.—Iron slag was the only type of slag sold in New York in 1982. Output and value declined 58% and 48%, respectively, compared with those of 1981, owing to reduction in ironmaking, mainly in the Buffalo area. Slag was used for road base, asphaltic concrete aggregate, fill, and railroad ballast.

Lime.—Lime production in New York dropped considerably from 1981 to 1982 owing to reduced steel output at the Bethlehem Steel Corp.'s Buffalo plant and cessation of lime production by Bethlehem Steel. The remaining lime-producing company, Allied Chemical, Syracuse, produced 7% less quicklime than in 1981. Quicklime was produced by calcining calcium carbonate; the product was used in alkalies and for steelmaking.

Mullite (Synthetic).—Carborundum, Niagara Falls, was the only producer of synthetic mullite in New York. Synthetic mullite was produced from aluminum silicate materials and used in furnace linings and refractories. Demand for synthetic mullite declined owing to the depressed national iron and steel industry.

Peat.—New York ranked seventh of 20 States in peat sales in 1982. Peat was produced by Anderson Peat Co. (Dutchess County), Bob Murphy Inc. (Broome County), Finger Lakes Peat Moss Co. (Seneca County), and Stone Age Humus Corp. (Westchester County). Peat was used for soil improvement and potting soil.

At yearend, Adirondack Sod & Peat Farm Inc. applied for permits to mine peat near the Warren County Airport. Applications were being reviewed by the New York Department of Environmental Conservation.

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), United States Gypsum (Genesee County), and Scolite International Corp. (Rensselaer County). Sales amounted to 4,100 tons valued at $782,000, representing a drop of 27% in quantity and 22% in value from 1981 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 salt production in 1982 but first in value. Output amounted to 6.2 million tons valued at $117.7 million, an increase of 11% in quantity and nearly 14% in value compared with those of 1981. Salt was produced by five companies with seven operations in five counties. Cargill Inc. operated an underground rock salt mine in Tompkins County, and International Salt Co. operated the Retsof underground mine in Livingston County. These two mines accounted for most of New York's total production. Additionally, salt was produced from brines and evaporation methods by Allied Chemical in

Onondaga County, International Salt in Schuyler County, and Morton-Norwich Products Inc. and Hooker Chemical & Plastics Corp., both in Wyoming County. Rock salt was used mainly for snow and ice removal; salt in brine was used for the manufacture of soda ash, chlorine, and other chemicals.

Late in the year, Morton Salt Co. officials and local residents near the company's abandoned Himrod salt mine agreed to a settlement regarding salt runoff from a mine waste area onto adjacent property. The Himrod Mine is located on the west shore of Seneca Lake in Yates County and was officially closed in 1976.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Production of construction sand and gravel in New York in 1982 totaled 17.5 million tons valued at $47.8 million, a decrease of 4% in quantity but a 5% increase in value compared with those of 1981. Construction sand and gravel was produced close to markets to reduce transportation costs and increase operators' profitability; most markets were located in urban areas. Principal producers, in descending order, were Koppers Co. Inc., Valente Gravel Inc., and Roanoke Marbro Sand & Gravel Corp. Counties leading in output, in descending order, were Cattaraugus, Suffolk, Dutchess, and Rensselaer. 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 in 1982. The company operated one pit in Oneida County and another in Saratoga County. Major sales were in moldings and foundry use.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	7,014	$19,385	$2.76
Gravel	NA	NA	NA	7,928	23,961	3.02
Sand and gravel (unprocessed)	NA	NA	NA	2,582	4,454	1.72
Total or average	e18,280	e$45,560	e$2.49	17,524	[1]47,799	2.73
Industrial sand	55	W	W	45	512	11.45
Grand total or average	e18,335	W	W	17,569	48,311	2.75

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

Table 5.—New York: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,193	$14,829	$3.54
Plaster and gunite sands	157	595	3.79
Concrete products	800	2,377	2.97
Asphaltic concrete	2,696	9,334	3.46
Road base and coverings[1]	5,044	11,688	2.32
Fill	2,801	4,731	1.69
Snow and ice control	1,373	2,886	2.10
Railroad ballast	46	153	3.33
Other	413	1,206	2.92
Total or average	[2]17,524	47,799	2.73

[1]Includes road and other stabilization (cement and lime).
[2]Data do not add to total shown because of independent rounding.

Sodium Carbonate (Synthetic).—New York was the only State in which synthetic sodium carbonate was produced in 1982. Allied Chemical produced a chemical-grade limestone from its Jamesville quarry south of Syracuse. The limestone was trucked 6 miles to its chemical plant in Solvay. The limestone, when mixed with salt and an ammonia catalyst, produced a synthetic sodium carbonate used in the manufacture of glass, chemicals, paper, and for leather tanning and water treatment purposes.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and finalized the following year.

Crushed.—Crushed stone production in New York was estimated at 28.7 million tons valued at $132.8 million, reflecting a slight decrease in quantity but an increase in value compared with those of 1981. During the past 5 years, crushed stone output has fluctuated between 28 and 37 million tons annually, peaking in 1979 and declining thereafter, generally following national economic patterns. In 1982, an estimated 68 companies produced crushed stone from 81 quarries in 36 of the State's 62 counties. Principal producers were Allied Chemical; Atlantic Cement; Fitzgerald Bros. Construction Co.; The General Crushed Stone Co., a subsidiary of Koppers; Lone Star; and Tilcon Inc. Counties leading in output, in descending order, were Onondaga, Albany, Rockland, Dutchess, Erie, and Greene, all comprising highly populated areas resulting in high consumption of construction materials. Limestone was the leading type of crushed stone mined; other types were sandstone, traprock, and slate. Main uses included bituminous aggregate, road base, and cement manufacture.

Dimension.—Dimension stone production in New York amounted to 21,530 tons valued at $2.3 million in 1982, nearly the same as 1981 figures. A total of 12 quarries were located in Washington County; 3 each were in Albany and Delaware Counties; and 1 each was in Essex, Franklin, Tompkins, and Westchester Counties. Producers included Heldeberg Bluestone & Marble Co., Johnson & Rhodes Bluestone Co., Darius Slate Products Inc., and Hilltop Slate Co. Types of dimension stone quarried were granite, sandstone, and slate. Sales were for cut stone and flagging.

Sulfur (Recovered).—Elemental sulfur was recovered as a byproduct from oil refinery operations at Ashland Oil Inc., Buffalo, for use in chemicals and various synthetic products. From 1981 to 1982, shipments decreased in both quantity and value owing to less consumption of oil-related products.

Talc.—New York ranked fourth of 11 States in talc production in 1982. Production decreased nearly 19% in quantity and 15% in value compared with those of 1981. All production originated from two mines operated by Gouverneur Talc Co. Inc. near Fowler, St. Lawrence County. The ore was ground and processed at the company-owned mill and used mainly in ceramics and paints. Another company, Clark Minerals Inc., Natural Bridge, Jefferson County, purchased talc, which was ground and processed for use in cosmetics.

Vermiculite (Exfoliated).—W. R. Grace & Co. shipped vermiculite into the State for exfoliation at its plant in Weedsport, Cayuga County. Both output and value declined from 1981 to 1982. The product was used for loose fill insulation, soil conditioning, lightweight concrete aggregate, and building plaster aggregate.

Wollastonite.—New York accounted for virtually all of the Nation's wollastonite output in 1982, with a minor amount produced in California. Shipments remained approximately the same from 1981 to 1982. NYCO operated the underground Willsboro Mine and the Lewis surface operation, both in Essex County. R. T. Vanderbilt Co. Inc. operated the underground Valentine Mine in Lewis County. Wollastonite is a calcium silicate found in metamorphic rocks; major markets were in ceramics, coatings, and plastics.

An application by NYCO to test drill for wollastonite on adjacent forest preserve land was being considered by the State Department of Environmental Conservation. Without additional reserves, company officials have indicated possible closure of the underground mine due to depletion of the ore body.

METALS

Aluminum.—In 1982, New York ranked second behind Washington in primary aluminum production. Both output and value

increased slightly compared with those of 1981. Aluminum Co. of America (Alcoa) and Reynolds Metals Co. operated plants at Massena on the St. Lawrence River, where hydroelectric power is less expensive than in other parts of the State. By yearend, both companies were operating at capacity, Alcoa at 226,000 tons annually, and Reynolds at 126,000 tons annually.[6]

Ferroalloys.—New York ranked ninth of 18 States in shipments of ferroalloys in 1982. Shipments continued to decline owing to the weak economy both in this Nation and abroad. Producers were Elkem Metals Co., SKW Alloys Inc., and Union Carbide Metals Div., all in Niagara Falls. SKW Alloys idled its ferrosilicon furnace on October 1.

Iron Ore.—In late 1982, production from the NL Industries Inc. open pit MacIntyre Mine in Essex County ceased, but shipments of magnetite concentrate from inventory continued. The company is the last remaining producer of iron ore in New York. The magnetic concentrate is used mainly for heavy media separation in the coal industry. Associated with the iron ore is ilmenite, which is recovered as a separate concentrate.

Iron and Steel.—New York's iron and steel industry was severely affected by the national economic decline, which resulted in slumping automobile sales and poor markets for steel. In 1982, pig iron shipments in New York amounted to 1.1 million tons valued at nearly $230 million, a decline of approximately 58% in quantity and value compared with those of 1981. To counteract economic effects, steel companies reduced work forces, closed operations, and one filed for bankruptcy. Employment at the Republic Steel Corp. plant at South Buffalo totaled 2,500 at one time; in early 1982, only 20 maintenance workers remained at the idle plant. Bethlehem Steel employed nearly 8,600 workers at its Lackawanna plant, but owing to reductions in output, only 1,300 remain. All facilities at Bethlehem Steel's Lackawanna plant were expected to close in 1983 except the galvanizing line and 13-inch bar mill. Late in the year, Guterl Specialty Steel Corp., Lockport, filed for protection under Chapter 11 of the Federal Bankruptcy Code.

Lead and Silver.—Lead was recovered as a byproduct from zinc ore processed from mines in St. Lawrence County. Lead production in 1982 increased slightly to 974 metric tons, but value dropped considerably (30%) owing to poor markets for lead. Silver, in turn, was recovered during lead processing; output and value decreased 7% and 30%, respectively, compared with 1981 figures.

Titanium Concentrate (Ilmenite).—Ilmenite concentrate was produced by NL Industries, Essex County, as the major product from the MacIntyre ilmenite-magnetite mine operations. Shipments decreased in both quantity and value from 1981 to 1982 because of the closure in September 1982 of the company's 100,000-ton-per-year titanium dioxide pigment plant at Sayreville, N.J., where nearly all of the MacIntire ilmenite was processed.

Zinc.—New York ranked third behind Tennessee and Missouri in zinc production in 1982. Output totaled 49,351 metric tons valued at $41.9 million, an increase of 34% in quantity and 15% in value compared with those of 1981. All production originated from St. Lawrence County in the northwestern part of the State.

During the year, St. Joe Minerals Corp. developed its zinc deposit at Pierrepont, with production commencing in April. The ore, which averages approximately 15% zinc, was trucked to a company-owned mill at Balmat for concentrating and eventually shipped to a smelter in Monaca in western Pennsylvania. The zinc was used mainly for galvanizing steel.[7]

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[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.
[2]Rickard, L. V. (ed.). Empire State Geogram. NY Geol. Survey, v. 19, No. 1, 1983, 37 pp.
[3]Szydlik, F. P. Stoned on the Plaza. Knickerbocker News (Albany, NY), July 21, 1982, p. 1B.
[4]Pit and Quarry. Calcium Chloride Puts Damper on Dust at Allied Quarry. April 1983, p. 80.
[5]Lone Star Industries Inc. 1982 Annual Report. P. 18.
[6]American Metal Market. July 6, 1983.
[7]Donnelly, J. R. St. Joe Confident of Future. Watertown (NY) Daily Times, Jan. 15, 1982.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives (manfactured):			
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 (primary):			
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:			
Alpha Portland Cement Co.[2]	15 South 3d St. Easton, PA 18042	Quarry and plant.	Greene.
Atlantic Cement Co. Inc., a subsidiary of Newmont Mining Corp.[3]	Box 30 Stamford, CT 06904	do	Albany.
The Glens Falls Portland Cement Co. Inc., a subsidiary of Moore McCormack Resources Inc.[3]	Box 440 Glens Falls, NY 12801	do	Warren.
Lehigh Portland Cement Co.[3]	718 Hamilton Mall Allentown, PA 18105	do	Greene.
Marquette Co., a subsidiary of Lone Star Industries Inc.[2 3]	1 Commerce Pl. Nashville, TN 37239	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.
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 mine and plant.	Genesee and Rockland.
Iron ore:			
NL Industries Inc.[5]	Tahawus, NY 12879	Pit	Essex.
Iron slag:			
Buffalo Slag Co., a subsidiary of Koppers Co. Inc.[2 6]	111 Great Arrow Ave. Buffalo, NY 14216	Plants	Allegany, Cattaraugus, Steuben.
Lime:			
Allied Chemical Corp.[2 7]	Box 70 Morristown, NJ 07960	Quarry and plant.	Onondaga.
Peat:			
Anderson Peat Co	Pleasant Hill Rd. Wingdale, NY 12594	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 Salt Co	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.
Stone:			
Crushed:			
The General Crushed Stone Co., a subsidiary of Koppers Co. Inc.	712 Drake Bldg. Easton, PA 18042	Quarry	Herkimer, Jefferson, Livingston, Onondaga, Ontario, Wayne.
New York Trap Rock Corp., a subsidiary of Lone Star Industries Inc.	162 Old Mill Rd. West Nyack, NY 10994	do	Rockland.
Dimension:			
Darius Slate Products Inc	Box 4 Middle Granville, NY 12849	do	Washington.
Heldeberg Bluestone & Marble Co	East Berne, NY 12059	Quarries	Albany and Delaware.
Hilltop Slate Co	Middle Granville, NY 12849	Quarry	Washington.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Dimension —Continued			
Johnson & Rhodes Bluestone Co	East Branch, NY 13756	Quarry	Delaware.
Sulfur (recovered):			
Ashland Oil Inc.[2]	Tonawanda, NY 14150	Refinery	Erie.
Talc:			
Gouverneur Talc Co. Inc., a subsidiary of R. T. Vanderbilt Co. Inc.	Gouverneur, NY 13642	Underground mine.	St. Lawrence.
Wollastonite:			
NYCO, a division of Processed Minerals Inc.[6]	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 Minerals Corp.[9]	250 Park Ave. New York, NY 10017	Mine	St. Lawrence.

[1]Also synthetic mullite and synthetic graphite.
[2]Also stone.
[3]Also clays.
[4]Also expanded perlite.
[5]Also ilmenite.
[6]Also sand and gravel.
[7]Also salt.
[8]Also garnet.
[9]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 1982 was $257.3 million, compared with the record $380 million in 1980. Although the State's mineral industry endured a second year of declining demand and reduced sales, North Carolina continued to lead the world in the production of lithium minerals and was first in the Nation in the sales of feldspar, scrap mica, olivine, and pyrophyllite. The State ranked second in the output of common clay and shale and crushed granite and third in phosphate rock.

Table 1.—Nonfuel mineral production in North Carolina[1]

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2]	thousand short tons	2,110	$6,838	1,573	$5,243
Feldspar	short tons	462,864	13,517	428,755	12,255
Gem stones		NA	50	NA	50
Mica, scrap	thousand short tons	92	6,398	67	4,793
Sand and gravel:					
Construction	do	e6,294	e18,330	5,198	15,395
Industrial	do	1,236	10,440	716	4,878
Stone:					
Crushed	do	28,833	117,092	p27,500	p117,600
Dimension	do	30	2,773	p30	p2,814
Talc and pyrophyllite	do	3104	3825	83	1,266
Combined value of cement, clays (kaolin), lithium compounds, olivine, peat (1982), phosphate rock, and talc (1981)		XX	196,397	XX	92,964
Total		XX	r372,660	XX	257,258

eEstimated. pPreliminary. 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.
[3]Excludes talc; value included with "Combined value" figure.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Alamance	W	W	Stone, clays.
Anson	$8,126	$4,129	Sand and gravel (industrial), stone.
Ashe	W	W	Stone.
Avery	r1,852	2,928	Mica, clays, stone, olivine.
Beaufort	W	W	Phosphate rock.
Bertie	21	(3)	
Bladen	71	(3)	
Brunswick	25	(3)	
Buncombe	W	W	Stone, clays.
Burke	W	305	Sand and gravel (industrial).
Cabarrus	W	W	Clays, stone.
Caldwell	W	489	Stone.
Camden	4	(3)	
Caswell	W	W	Stone.
Catawba	W	W	Do.
Chatham	2,157	869	Clays.
Cherokee	W	905	Stone, talc.
Chowan	4	(3)	
Cleveland	16,129	17,476	Lithium, stone, feldspar, mica, sand and gravel (industrial), clays.
Craven	W	W	Stone.
Cumberland	660	(3)	
Currituck	W	(3)	
Dare	W	(3)	
Davidson	W	W	Stone, clays.
Davie	W	W	Stone.
Duplin	W	W	Do.
Durham	W	W	Stone, clays.
Edgecombe	W	W	Stone.
Forsyth	W	W	Do.
Franklin	W	(3)	
Gaston	14,719	16,979	Lithium, stone, mica, feldspar.
Granville	W	--	
Greene	49	(3)	
Guilford	W	W	Stone, clays.
Halifax	W	125	Clays.
Harnett	W	W	Sand and gravel (industrial), stone, clays.
Haywood	2,216	1,073	Stone.
Henderson	W	W	Stone, clays.
Hertford	318	(3)	
Hyde	4	(3)	
Iredell	W	2,128	Stone, clays.
Jackson	3,919	W	Olivine, stone.
Johnston	W	W	Stone.
Jones	71	98	Do.
Lee	W	W	Stone, clays.
Lenoir	W	(3)	
McDowell	880	W	Stone.
Macon	1,386	1,406	Do.
Martin	12	(3)	
Mecklenburg	W	W	Stone.
Mitchell	14,819	W	Feldspar, stone, mica, olivine.
Montgomery	W	99	Clays, stone.
Moore	W	W	Pyrophyllite, clays.
New Hanover	29,527	W	Cement, stone, clays.
Northampton	332	(3)	
Onslow	W	W	Stone.
Orange	W	W	Stone, pyrophyllite.
Pasquotank	W	(3)	
Pender	W	572	Stone.
Person	W	--	
Pitt	W	W	Do.
Polk	W	--	
Randolph	W	W	Do.
Richmond	3,206	W	Sand and gravel (industrial), stone.
Rockingham	W	W	Stone, clays.
Rowan	W	W	Do.
Rutherford	W	W	Stone.
Sampson	132	122	Clays.
Scotland	W	(3)	
Stanly	506	1,330	Clays.
Stokes	235	158	Clays, stone.
Surry	W	3,473	Stone.
Swain	W	367	Do.
Transylvania	W	W	Do.
Tyrrell	7	(3)	
Union	W	W	Stone, clays.
Vance	W	W	Stone.

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Wake	W	$10,775	Stone, clays.
Washington	W	(3)	
Watauga	W	1,079	Stone.
Wayne	$152	(3)	
Wilkes	W	W	Stone.
Wilson	W	W	Do.
Yadkin	W	(3)	
Yancey	2,632	W	Olivine, mica.
Undistributed[4]	276,163	287,445	
Sand and gravel (construction)	XX	e18,330	
Total	[5]380,333	372,660	

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: Alexander, Alleghany, Carteret, Clay, Columbus, Gates, Graham, Hoke, Lincoln, Madison, Nash, Pamlico, Perquimans, Robeson, and Warren.

[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 sand and gravel 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

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,919.0	2,944.0	+0.9
Unemployment	do	188.0	266.0	+41.5
Employment (nonagricultural):				
Mining	do	4.9	4.7	-4.1
Manufacturing	do	820.7	781.3	-4.8
Contract construction	do	115.6	104.0	-10.0
Transportation and public utilities	do	116.8	115.6	-1.0
Wholesale and retail trade	do	478.8	477.4	-.3
Finance, insurance, real estate	do	98.1	97.7	-.4
Services	do	353.0	359.2	+1.8
Government	do	403.7	398.5	-1.3
Total nonagricultural employment	do	2,391.6	2,338.4	-2.2
Personal income:				
Total	millions	$51,534	$54,357	+5.5
Per capita		$8,656	$9,032	+4.3
Construction activity:				
Number of private and public residential units authorized		35,217	31,614	-10.2
Value of nonresidential construction	millions	$615.5	$515.0	-16.3
Value of State road contract awards	do	$136.0	$145.6	+7.1
Shipments of portland and masonry cement to and within the State	thousand short tons	1,628	1,532	-5.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$372.7	$257.3	-31.0
Value per capita, resident population		$64	$43	-32.8
Value per square mile		$7,160	$4,892	-31.7

pPreliminary.

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

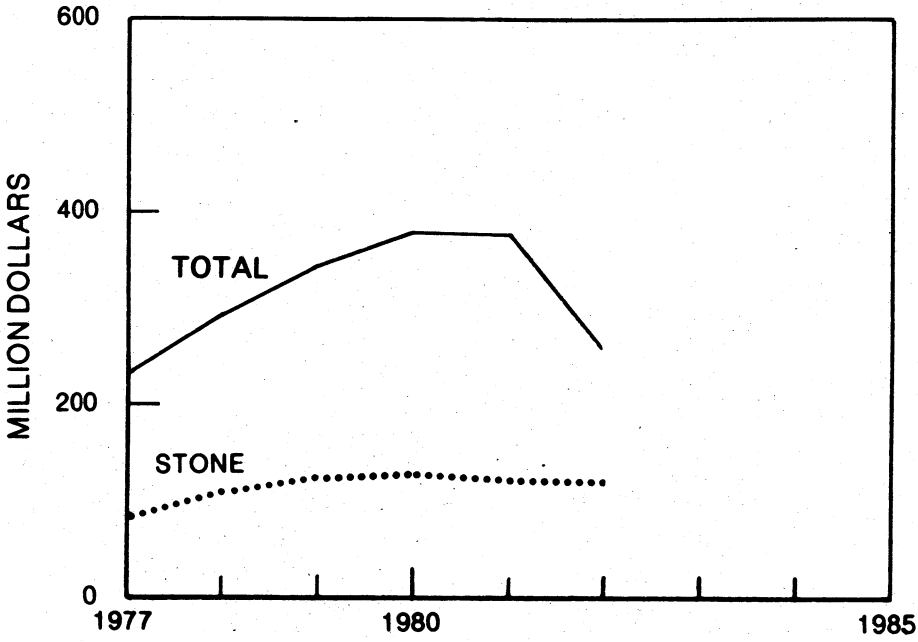

Figure 1.—Value of stone and total value of nonfuel mineral production in North Carolina.

Trends and Developments.—The longest recession since the end of World War II reduced the demand for mineral commodities and slowed industrial development. The record for the construction of new industry facilities and the expansion of existing plants in North Carolina was set in 1980 when the value of construction totaled approximately $2.2 billion; in 1981, it fell to $2.1 billion, and in 1982, the value slumped 38% to approximately $1.3 billion.[3] The prosperity of the State's mineral industry, geared to the production of industrial minerals, paralleled the depressed economy, which curtailed demand for most mineral commodities. Mineral sales plummeted $115.4 million below those reported in 1981, and the tonnage of individual mineral commodities listed in table 1 fell to the pre-1976 levels.

Sales of construction aggregate (sand and gravel and crushed stone), which during healthy economic times have accounted for approximately 45% of the State's mineral value, fell almost $21 million below the 1979 record as high interest rates discouraged new construction. Reduced Federal funding for highway construction was also a key factor in the slump in aggregate demand, although funds from a State gasoline tax passed in 1981 helped to resurface 300 miles of State highways, which aided local aggregate producers. Other producers of mineral commodities directly related to the construction industry—cement, clay for brick, and feldspar used in glassmaking—also experienced a slowdown in sales.

Nonconstruction-related sectors of the State's mineral industry also felt the effects of the continuing recession. Several producers of lithium, phosphate rock, and talc terminated mining or processing operations for part of the year as inventory buildup outgained sales, while producers of kaolin and olivine reported a further decrease in sales from those of the previous year. North Carolina Phosphate Corp., which was developing the State's second phosphate mine, deferred initial production from 1983 to at least 1987 because of the worldwide slump in phosphate rock demand. Plans for a new potline at the Aluminum Co. of America (Alcoa) Badin plant have been deferred indefinitely because of the weak aluminum market.

In many of North Carolina's industries, raw mineral commodities are the basic

material or are a major ingredient in the manufacturing process. Although few industries in the State were unaffected by the recession, the demand for selected mineral raw materials obtained from out-of-State sources remained strong. Colemanite, imported from Turkey and processed in South Carolina, was used in glass fiber manufacture by a North Carolina firm. Gypsum was imported from Nova Scotia, Canada, for use in wallboard and cement manufacture. Iodine, from Japan, was used to manufacture X-ray contrast media. Block mica, imported from India and other sources, was processed into products used by the electrical industry. Perlite, shipped from New Mexico, was expanded for use in concrete and plaster, and South Carolina vermiculite was exfoliated for insulation uses. Petroleum coke and pitch, shipped from out-of-State suppliers, was used in the manufacture of synthetic graphite. Sulfur was barged from the gulf coast to the Texasgulf Inc. fertilizer facility at Lee Creek for use in sulfuric acid manufacture.

Exploration Activities.—Despite poor economic conditions prevalent throughout 1982, a number of mining companies viewed the State's mineral potential and national economic recovery optimistically and were active in exploration in many areas of the State. Although mining companies normally keep exploration activity confidential to avoid competition, limited activity was reported by trade journals during the year.

Gold was one of the minerals targeted for exploration throughout the slate belt in the central part of the State. In March, the Engineering and Mining Journal reported that Questor Surveys Inc. of Toronto, Canada, conducted unspecified airborne surveys over Union County where gold was produced in the late 1800's. Yellowknife Bear Resources, another Canadian firm, acquired a one-half interest in a former gold-producing property, the Howie Mine, near Charlotte. The company expects to spend $600,000 to assess the gold potential of the property and begin a dewatering and shaft rehabilitation program according to the Northern Miner, a Canadian technical newspaper. The article stated that it would be mid-1983 before a decision on production could be reached.

Skillings' Mining Review, February 6, 1982, reported that American Copper & Nickel "is said to be examining massive sulfide ground in western North Carolina."

Sulfide mineralization was not the only target for exploration. At least three companies: Texasgulf; Billiton, a subsidiary of Royal Dutch/Shell; and ASARCO Incorporated were active in southern Rutherford County exploring for commercial concentrations of cassiterite, a tin mineral.

Although the occurrence of cassiterite in part of the area has long been known, recent work by the U.S. Geological Survey (USGS) revealed that the tin ore has a much wider distribution than hitherto realized, thus sparking commercial interest in the region.

Legislation and Government Programs.—The North Carolina Division of Land Resources is the principal State agency involved in investigating the potential of the State's mineral resources. As structured, the Division is subdivided into the following sections: (1) Geological Survey; (2) Geodetic Survey; (3) Land Quality; (4) Early Resources Planning; and (5) Land Resources Information Services.

During 1982, the North Carolina Geological Survey continued work on 7 1/2-minute geologic quadrangle maps in the western part of the State and various types of maps for regional planning purposes in other areas of North Carolina. As part of a cooperative program with the USGS, preparation of 7 1/2-minute topographic maps continued and is scheduled for completion in 1985.

The North Carolina State Mineral Laboratory at Asheville continued developing and improving beneficiation techniques for ores from North Carolina, other States, and foreign countries. The laboratory, which completed its 36th year of operation, is one of the top-ranked, university-affiliated minerals testing laboratories in the Nation and has a worldwide reputation for excellence in the field of mineral beneficiation.

The U.S. Bureau of Mines completed a study on the Lost Cove and Harper Creek Roadless Area Review and Evaluation (RARE II) areas in the Pisgah National Forest in Avery and Caldwell Counties. The study identified speculative uranium resources in the Wilson Creek Gneiss and Grandfather Mountain Formation totaling 5 million to 10 million pounds of uranium oxide. The study was placed on open file by the Bureau of Mines and also published as a joint report with the USGS.

During the year, the USGS completed investigations of mineralized areas in the Charlotte Quadrangle. These investigations were part of an ongoing mineral resource assessment program designed to update and increase the knowledge of U.S. mineral

resources. The Charlotte Quadrangle work identified areas where cassiterite is widespread in stream gravels.

A cooperative project aimed at stabilizing orphan mined lands to prevent offsite siltation resulted in reclaiming more than 100 acres during 1982 in Mitchell, Yancey, and Avery Counties. The abandoned mines were worked for scrap mica and kaolin nearly 50 years ago and are not under provisions of the State's Mining Act of 1971. Present landowners (none of whom were engaged in the original mining), the North Carolina Land Quality Section, Tennessee Valley Authority (TVA), and local soil and water conservation districts contributed to the project. Of special concern was reduction of siltation in downstream reservoirs of TVA, which are used for flood control, power generation, municipal water supplies, and recreation.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Traditional markets for most mineral commodites mined in-State remained depressed as the effects of the recession were evident throughout the year. Demand for North Carolina's mineral output, the raw material for many of the State's manufacturing industries, paralleled the demand for finished goods. Output of all of the 11 mineral commodities produced in-State fell below the 1981 levels, and sales declined approximately $115.4 million.

Cement.—Ideal Basic Industries Inc., Denver, Colo., produced portland and masonry cement at a plant at Castle Hayne in New Hanover County. The company used wet grinding to produce feed for the plant's two kilns. Most raw material for cement manufacture was mined in the immediate area; however, gypsum was imported from Nova Scotia, Canada, and iron, in the form of mill scale, was purchased from Georgia sources. Sales fell below the 1981 level, and the company terminated production twice during the year to allow inventories to recede to normal levels.

Clays.—The record year for clay production in North Carolina was 1978 when 3.5 million tons valued at $9 million was mined. Since then, producers have reported a decline for each of the following 4 years. In 1982, output and sales had slumped by 1.9 million tons and nearly $4 million below the record.

Table 4.—North Carolina: Common clay and shale sold or used by producers, by county

County	1981			1982		
	Number of mines	Quantity (short tons)	Value	Number of mines	Quantity (short tons)	Value
Alamance	1	49,934	$110,454	1	42,591	$103,581
Cabarrus and Durham	3	240,554	974,835	3	192,792	838,846
Chatham	3	225,180	869,082	3	170,841	939,580
Iredell and Rockingham	4	262,475	431,900	3	241,420	429,458
Lee and Stanly	6	538,287	1,833,140	6	351,416	884,524
Montgomery and New Hanover	4	152,972	555,157	3	91,648	458,395
Rowan	3	150,715	912,407	4	121,723	740,183
Sampson	1	30,000	121,500	--	--	--
Stokes	1	35,538	89,911	1	35,538	98,796
Undistributed[1]	11	424,725	940,034	14	325,399	749,653
Total	37	2,110,380	6,838,420	38	1,573,368	5,243,016

[1]Includes Avery, Buncombe, Cleveland, Davidson, Guilford, Halifax, Harnett, Henderson, Moore, Union, and Wake Counties.

During the year, the State's clay industry consisted of 22 companies mining 38 pits. Raw material for brick manufacture was mined by 19 companies operating 35 pits; 1 company mined clay as a raw material in the manufacture of cement, and 2 companies produced kaolin at 2 mines.

Most of the brick clay mines were in an area underlain by the Carolina slate belt in 14 counties in central North Carolina. A smaller amount was produced from Triassic shale in Moore and Lee Counties. Other brick clay-producing areas included Buncombe and Henderson Counties in the western part of the State and Halifax County in eastern North Carolina.

Clay for cement manufacture was mined by Ideal Basic in New Hanover County in the southeastern part of the State.

Kaolin was produced by Harris Mining Co. in Avery County near Spruce Pine and Kings Mountain Mica Co. Inc. in Cleveland County as a coproduct of mica mining. The majority of sales were for ceramics and specialty brick manufacture.

During the year, Harris completed a land acquisition program, acquiring 4,300 acres in the Spruce Pine area. The acquisition, along with existing holdings, raised the company's clay-mica reserves substantially.[4]

A consortium of 11 North Carolina brick companies and the U.S. Department of Energy funded the drilling of three natural gas test wells in the Deep River Coalfield in Lee County. The third hole produced "promising" results. A commercial-scale gas well could provide fuel savings of up to 50% to the area's energy-intensive brick companies.[5]

Warren Wilson College, near Asheville, offered an "Appropriate Technology" course teaching students brickmaking. A manual press was used to produce 20-pound, sun-dried brick that were to be used in the construction of an Appropriate Technology workshop. The students are scheduled to spend 8 weeks in Latin American countries teaching the rural population brickmaking skills.[6]

Feldspar.—Historically, North Carolina has led the Nation in the production of feldspar, an important mineral in the manufacture of glass and ceramics. The State retained the first place ranking in 1982, although output fell for the third consecutive year with sales nearly 95,000 tons less than the record set in 1979.

The ongoing slump in the automotive and construction industries, which reduced the demand for glass, was partially responsible for the sluggish feldspar market. In addition, a continuing trend in the soft drink industry of replacing glass bottles with plastic containers further affected feldspar demand. To combat competition from the plastic bottles, glass container manufacturers have developed a lighter bottle using less glass, further reducing feldspar sales. The State's feldspar producers also face strong competition from nepheline syenite imported duty-free from Canada.

Table 5.—North Carolina: Feldspar industry in 1982

Company	Location	Ore type	Comments
Primary producers:			
The Feldspar Corp	Spruce Pine	Alaskite	Byproduct mica and industrial-grade sand.
International Minerals & Chemical Corp.	do	do	Byproduct mica and construction-grade sand.
Lawson-United Feldspar & Minerals Co.	do	do	Byproduct mica and industrial-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.

Three primary feldspar producers in the Spruce Pine area in western North Carolina mined alaskite, an ore that contains approximately 65% feldspar. Run-of-mine ore is trucked from five mines to processing facilities for crushing and grinding, excluding one company that has the primary crusher at the mine. A three-phase flotation process is used to recover mica, iron minerals (mainly garnet), and silica. Feldspar concentrate was dried and shipped in bag or bulk to glass producers. Iron is removed by magnetic separation, and a pottery-grade product is produced by dry grinding.

Two lithium producers in the Kings Mountain-Cherryville area of south-central North Carolina recovered a feldspar-silica product from the flotation of spodumene-bearing pegmatite. One company shipped the material to a plant in South Carolina for further processing, and the second sold the feldspar concentrate, after additional

processing, to glass manufacturers. A mica producer in the Kings Mountain area also recovered a feldspar concentrate as a byproduct of mica processing.

Gem Stones.—North Carolina continued as one of the leading States in the East in gem stone output. Scores of mines in the west-central and southwestern part of the State are open to gem collectors on a fee basis, and expenditures by gem collectors are a major factor in the economy of the areas. The principal gem stones and gem stone areas are listed below:

County	Nearest city	Principal gem stones
Alexander	Hiddenite.	Emeralds and hiddenite.
Macon	Franklin	Rubies, sapphires, garnets.
Mitchell	Spruce Pine.	Emeralds and aquamarine.

During 1982, the North Carolina Mining Museum, near Spruce Pine, completed construction of the museum office building. The museum is at the site of the McKinney Mine, an abandoned underground feldspar operation once worked by the Bon Ami Co. for the abrasive ingredient in its cleaning powder.

Gypsum.—Texasgulf produced gypsum as a waste byproduct of phosphoric acid manufacture at Lee Creek in Beaufort County, a limited amount was used by local farmers for soil conditioning. National Gypsum Co., in Wilmington, imported gypsum from Nova Scotia, Canada, for wallboard manufacture.

Lithium.—Although production dropped, North Carolina continued to lead the world in lithium output. The decrease was due to cutbacks in the aluminum, glass, and ceramics industries.

North Carolina's lithium industry is comprised of two producers, Foote Mineral Co., Kings Mountain, and Lithium Corp. of America Inc. (Lithco), Cherryville, near Gastonia. The Foote mining-processing complex consists of an open pit mine, spodumene beneficiation facilities, and lithium carbonate plants. The beneficiation operation produces several grades of spodumene concentrate, a portion of which was used as feed for the onsite lithium carbonate plant, and some was shipped to the company's lithium chemical plant at Sunbright, Va. During the year, Foote completed a granular lithium carbonate plant at Kings Mountain. The granular material will replace pelletized lithium carbonate as a more efficient means of introducing lithium carbonate into aluminum potlines.

Although the Foote lithium carbonate plant was closed on August 1 and remained closed through yearend, the mine and beneficiation facility remained active. Foote's lithium carbonate production was 19.25 million pounds in 1982, a decrease of 9.55 million pounds from that of the previous year.[7]

Lithco operates a similar mining, beneficiation, and lithium chemical complex at Cherryville. A 3-year, $18 million expansion, completed in 1981, raised Lithco's capacity to 36 million pounds of lithium carbonate equivalent.

Mica.—North Carolina was the major mica-producing State in the Nation, producing approximately 63% of the Nation's total. Production fell because of the slump in demand for oil well drilling mud, a major market for the State's dry-ground mica.

Two companies in the Spruce Pine area recovered mica by open pit mining. The mines are located in areas of high mica concentration associated with major alaskite intrusions. Mica-rich saprolite was mined using dozer-mounted rippers and front-end loaders. Beneficiation includes grinding, gravity separation, and flotation. Three Spruce Pine area feldspar producers marketed mica as a byproduct of feldspar processing.

Table 6.—North Carolina: Ground mica sold or used by producers, by use

Use	1981		1982	
	Quantity (short tons)	Value	Quantity (short tons)	Value
Paint	7,843	r$1,869,730	W	W
Joint cement	26,927	4,106,481	27,156	$4,435,504
Other[1]	r42,033	r7,006,234	34,307	7,349,148
Total	r76,803	r12,982,445	61,463	11,784,652

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes insulation, plastics, roofing, rubber, textile coatings, welding rods, well drilling, other miscellaneous uses, and uses indicated by symbol W.

Table 7.—North Carolina: Mica industry in 1982

Company	Location	Grinding process	Comments
Producers (mica):			
Harris Mining Co	Spruce Pine	Wet	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	Kings Mountain	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.	
Fabricators:			
Spruce Pine Mica Co	Spruce Pine	XX	Mica obtained from foreign sources.
Tar Heel Mica Co	Plumb Tree	XX	Do.

XX Not applicable.

In the Kings Mountain area, one company mined weathered pegmatite and granite to produce mica, and a second recovered mica as a byproduct of lithium beneficiation. A lithium producer at Cherryville, near Gastonia, also recovered mica during lithium beneficiation.

One company in Franklin produced a wet-ground product using mica shipped from Georgia, and a second, Mitchell Mining & Manufacturing Inc. near Spruce Pine, wet-ground scrap obtained from Spruce Pine area mica fabricators and mica obtained from a mica schist. At yearend, Mitchell was purchased by J. M. Huber Corp.

Asheville Mica Co., Asheville, produced a dry-ground product from scrap mica obtained from three North Carolina fabricators.

Olivine.—North Carolina continued as the ranking State in olivine output although production decreased from that reported during 1981. The slump was due to the depressed demand for steel and foundry products.

The olivine industry in North Carolina is in Mitchell, Yancey, and Jackson Counties in the western part of the State. Three companies mined olivine by open pit methods; two firms used wet beneficiation; the third used dry processing.

Appalachian Properties Inc. continued preliminary work on the proposed surface mine in the Buck Creek area of Clay County. When mining commences, olivine is scheduled to be trucked to Dillsboro for processing.

Phosphate Rock.—North Carolina ranked third behind Florida and Idaho in the production of phosphate rock, the principal ingredient in phosphoric acid production necessary for fertilizer manufacture.

The State's phosphate rock output is currently limited to Texasgulf with a mine and fertilizer manufacturing complex at Lee Creek, near Aurora, in Beaufort County along Pamlico Sound. The Texasgulf mine used dredges to remove the upper portion of the 100-foot-thick overburden. Following dredging and pit dewatering, draglines were used to complete overburden removal and mine the ore. An ore-water slurry is pumped to an adjacent beneficiation plant where phosphate rock is separated from the sand-clay matrix for use in acid manufacture. Mined-over land, averaging about 70 acres per year, was reclaimed for silvicultural and agricultural purposes.

In the spring, Texasgulf began operation of the world's largest single train sulfuric acid plant, a 3,100-ton-per-day unit at the Lee Creek complex. In the fall, the mine was temporarily closed to reduce phosphate rock inventories but was reopened before yearend.

The depressed demand for phosphate forced North Carolina Phosphate to defer plans to open a mine adjacent to the Lee Creek Mine. Production is currently scheduled to begin in 1987.

Pyrophyllite.—North Carolina is one of two States reporting the production of pyrophyllite, an anhydrous aluminum silicate used in extender and filler applications and in refractories. Three companies operated surface mines in Moore and Orange Counties in the central and north-central part of the State.

The Moore County operations, Standard Minerals Co. Inc. and Glendon Pyrophyllite Inc., mined pyrophyllite by open pit method. The ore was trucked to processing plants where it was crushed, dried, and milled to consumer specifications. Sales were for an insecticide filler and carrier, wallboard and latex foam filler, and ceramic and refractory applications.

Piedmont Minerals Co., in Orange County, produced an andalusite pyrophyllite concentrate by open pit mining and heavy media concentration. The material was trucked to Greensboro for refractory shape applications. The company also recovered sericite and quartzite during the mining operation. The two materials were marketed for use in brick manufacture and as an aggregate.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981 collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

The Bureau of Mines received production-value reports from 55 construction sand and gravel companies. These producers reported output from 100 operations in 50 of the State's 100 counties. Production was about 1.1 million tons below the 1981 level.

The 10 leading counties, in terms of tonnage, produced over two-thirds of the total output in 1982. These counties were located in four areas comprised of contiguous or single counties. They were (1) Cumberland and Harnett Counties in south-central North Carolina, which accounted for slightly over 39% of the 10-county total; (2) the Anson, Montgomery, Richmond County area in the south-central part of the State, which accounted for approximately 36% of the 10-county output; (3) the Buncome, Haywood, McDowell, and Yancey County area in western North Carolina, which produced approximately 20%; and (4) Wayne County in the east-central part of the State, which produced about 5% of the 10-county total.

Table 8.—North Carolina: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	3,353	$8,633	$2.58
Gravel	NA	NA	NA	1,313	5,943	4.53
Sand and gravel (unprocessed)	NA	NA	NA	533	819	1.54
Total or average	e6,294	e$18,330	e$2.91	[1]5,198	15,395	2.96
Industrial:						
Sand	637	5,593	8.78	425	2,166	5.09
Gravel	599	4,847	8.09	291	2,712	9.33
Total or average	1,236	10,440	8.44	716	4,878	6.81
Grand total or average	e7,530	e28,770	e3.82	5,914	20,273	3.43

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

Table 9.—North Carolina: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,861	$9,101	$3.18
Plaster and gunite sands	205	632	3.09
Concrete products	131	393	3.00
Asphaltic concrete	993	3,094	3.12
Road base and coverings	474	1,252	2.64
Fill	482	750	1.56
Snow and ice control	9	35	4.03
Other	45	136	3.04
Total[1] or average	5,198	15,395	2.96

[1]Data may not add to totals shown because of independent rounding.

Industrial.—Data on production and value were received from six companies mining seven operations in four counties. The bulk of the output, over 75%, came from the Anson-Richmond County contiguous area in the south-central part of North Carolina. The remainder was reported from Mitchell and Cleveland Counties.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and finalized the following year.

Despite the decline in demand for aggregate materials, several factors helped to buoy sales, and two companies whose market studies revealed a growth area for aggregate opened new quarries.

Crushed.—Homebuilding activity was stronger than in most States as North Carolina, on the fringe of the Sun Belt, continued to attract new residents.[8] The State Department of Transportation resurfaced more than 300 miles of road, which aided sales to local aggregate producers. During the year, Wake Stone Co. and Martin Marietta Corp. opened new operations to supply the Raleigh-Durham area.

Dimension.—North Carolina's dimension stone industry quarried granite, sandstone, and argillite from surface mines in the western part of the State. Granite output was centered in the northwestern part of the State. North Carolina Granite Corp. operates the world's largest granite quarry near Mount Airy and produces a myriad of stone products ranging from veneer and curbing to mausoleums and chicken grit. Dimension sandstone operations in the west central part of the State produced stone slabs for building facing and patio walkway applications. One company in Davidson County, Jacob Creek Stone Co., produced dimension argillite for both construction and monument uses. During the past few years, a new market for dimension argillite has developed in the mobile home industry; the stone is used in hearths for prefabricated fireplaces. Production and value data for dimension stone are given in table 1.

Talc.—The Warner Corp., Murphy, the State's only talc producer, operated an underground talc mine in Cherokee County. Talc was milled into a cosmetic material and used for talc pencil manufacture. Processing for the former use included drying, grinding, and bagging, while the latter fabricating process involved the use of a series of diamond saws to produce the pencils from talc slabs. The market for cosmetic-grade talc was adversely affected by the recession, and talc pencil imports from Japan and China have severely affected sales of the North Carolina pencils.

METALS

Aluminum.—Alcoa operated a primary aluminum smelter at Badin in Stanly County. The Alcoa bauxite-alumina facility in Mobile, Ala., provided alumina for the 127,000-ton-per-year-capacity North Carolina facility.

Cobalt.—Carolmet Inc., a subsidiary of Métallurgie Hoboken-Overpelt S.A. of Belgium, processed cobalt "slugs" imported from the Zairian cobalt producer La Générale des Carrières et des Mines (Gécamines). The company produced extra-fine cobalt powder used as the cementing material in carbide cutting tools.

Copper.—The SCM Co., Glidden Metals

Div., produced copper powder from scrap materials. Principal sales were to the bearing and friction products industries.

Lithium Metal.—Foote and Lithco produced lithium metal at facilities in Kings Mountain and Cherryville. Both companies used molten salt electrolysis to produce ingots, rod, wire, shot, and dispersions.

Steel.—Florida Steel Co. operated two electric furnaces and two 2-strand continuous casters at its plant in Charlotte. The Charlotte facility is the only primary steel producer in North Carolina.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, Ala.
[2]Geologist, North Carolina Geological Survey Section, Raleigh, N.C.
[3]North Carolina Commerce Report. V. 4, No. 1, Winter 1983, p. 3.
[4]Ceramic Industry. March 1982, pp. 13-14.
[5]Sandford, North Carolina, Herald. Nov. 18, 1982.
[6]Monroe, North Carolina, Enquirer-Journal. Aug. 11, 1982.
[7]Foote Mineral Co. 1982 Annual Report. P. 3.
[8]Rock Products. December 1982, p. 39.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum, smelter:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Stanly.
Cement:			
Ideal Basic Industries Inc.[1 2]	950 17th St. Denver, CO 80202	do	New Hanover.
Clays:			
Pine Hall Brick & Pipe Co	Box 11044 Winston-Salem, NC 27105	Open pit mines and plant.	Rockingham and Stokes.
Sanford Brick Corp	Drawer 458 Sanford, NC 27330	do	Chatham, Lee, Stanly.
Solite Corp	Box 27211 Richmond, VA 23261	do	Rockingham and Stanly.
Feldspar:			
The Feldspar Corp.[1 2 3]	Box 99 Spruce Pine, NC 28777	Open pit mines and plants.	Mitchell.
International Minerals & Chemical Corp.[3]	666 Garland Place Des Plaines, IL 60016	do	Do.
Lawson-United Feldspar & Minerals Co.[3]	Box 309 Spruce Pine, NC 28777	do	Do.
Lithium:			
Foote Mineral Co.[1]	Box 792 Kings Mountain, NC 28086	Open pit mine and plant.	Cleveland.
Lithium Corp. of America Inc	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.[1 2]	Box 628 Spruce Pine, NC 28777	do	Avery.
Kings Mountain Mica Co. Inc.[4]	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.[5]	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.[3]	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:			
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.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Martin Marietta Corp	Box 30013 Raleigh, NC 27612	Pits	Various.
Nello L. Teer Co	Box 1131 Durham, NC 27702	do	Do.
Vulcan Materials Co., Mideast Div.	Box 7506, Reynolds Station 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 stone.
[2]Also clays.
[3]Also mica.
[4]Also feldspar.
[5]Also gypsum.

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]

The value of nonfuel mineral production in North Dakota during 1982 was $13 million, a 13% decrease compared with that of 1981. Sand and gravel, again the State's leading nonfuel mineral commodity, accounted for nearly 38% of the total value. Other nonfuel mineral commodities produced, in descending order of value, included lime, salt, clays, peat, and gem stones; of these commodities, only lime increased in either quantity or value compared with the output in 1981.

Nationally, North Dakota was ranked 48th in value of nonfuel mineral production, accounting for less than 1% of the U.S. total.

Table 1.—Nonfuel mineral production in North Dakota[1]

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$2	NA	$2
Peat thousand short tons	W	36	W	W
Sand and gravel (construction) do	e3,000	e6,500	2,347	4,873
Combined value of clays, lime, salt, and value indicated by symbol W	XX	r8,310	XX	8,102
Total	XX	r14,848	XX	12,977

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 North Dakota, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Barnes	$71	(3)	
Benson	W	(3)	
Bottineau	W	$36	Peat.
Bowman	W	(3)	
Burke	555	(3)	
Burleigh	3,148	(3)	
Cass	W	(3)	
Divide	79	(3)	
Eddy	777	(3)	
Emmons	111	(3)	
Foster	W	(3)	
Grand Forks	W	(3)	
Kidder	94	(3)	
McHenry	W	(3)	
McKenzie	W	W	Salt.
McLean	622	(3)	
Mercer	205	(3)	
Morton	W	W	Clays.
Mountrail	W	(3)	
Pembina	949	1,037	Lime.
Pierce	W	(3)	
Ramsey	61	(3)	
Ransom	W	(3)	
Renville	W	(3)	
Richland	W	W	Lime.
Rolette	63	(3)	
Stark	1,585	(3)	
Stutsman	909	(3)	
Towner	W	(3)	
Traill	155	(3)	
Walsh	220	(3)	
Ward	2,120	(3)	
Williams	6,290	W	Salt.
Undistributed[4]	4,363	7,275	
Sand and gravel (construction)	XX	e6,500	
Total	[5]22,376	14,848	

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, Dickey, Dunn, Golden Valley, Grant, Griggs, Hettinger, La Moure, Logan, McIntosh, Nelson, Oliver, Sargent, Sheridan, Sioux, Slope, Steele, and Wells.

[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 values indicated by symbol W.

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

The North Dakota State Soil Conservation Committee (NDSSCC), designated by the State legislature to administer the Surface Mining Reports Law (chapter 38-16, North Dakota Century Code), reported that during 1982, surface mining operations for minerals other than coal affected 467 acres from which 4,394,571 cubic yards of minerals was mined and 379,460 cubic yards of overburden was disturbed. The NDSSCC required 53 surface mining operators to report for calendar year 1982 and noted that there were 127 pits ranging in size from 0.125 to 30 acres; clay, gravel, sand, and scoria were reported as the mineral commodities mined.

According to the North Dakota Job Service, employment in the nonfuel mineral sector of the mining industry during 1982 averaged 330 workers, ranging from a high of 480 in August to a low of 160 in February. These workers represented less than 1% of the total average nonagricultural work force in 1982.

During the Federal fiscal year 1982, North Dakota received $7 million from the U.S. Department of the Interior as its 50% share of receipts the Federal Government collected within the State under the Mineral Leasing Act of 1920. The monies were derived from mineral leasing rents and royalties and bonuses involving Federal lands.

Exploration for nonfuel mineral re-

Table 3.—Indicators of North Dakota business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	311.0	315.0	+1.3
Unemployment	do	16.0	18.0	+12.5
Employment (nonagricultural):				
Mining[1]	do	10.9	9.3	-14.7
Manufacturing	do	15.3	14.9	-2.6
Contract construction	do	15.0	15.7	+4.7
Transportation and public utilities	do	17.2	16.8	-2.3
Wholesale and retail trade	do	66.6	67.2	+.9
Finance, insurance, real estate	do	11.7	11.8	+.9
Services	do	52.2	54.1	+3.6
Government	do	60.5	60.7	+.3
Total nonagricultural employment[1]	do	249.4	250.5	+.4
Personal income:				
Total	millions	$6,741	$7,200	+6.8
Per capita		$10,237	$10,746	+5.0
Construction activity:				
Number of private and public residential units authorized		2,163	2,417	+11.7
Value of nonresidential construction	millions	$104.9	$82.4	-21.4
Value of State road contract awards	do	$88.8	$78.7	-11.4
Shipments of portland and masonry cement to and within the State	thousand short tons	324	272	-16.0
Nonfuel mineral production value:				
Total crude mineral value	millions	$14.8	$13.0	-12.2
Value per capita, resident population		$34	$19	-44.1
Value per square mile		$318	$184	-42.1

[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.

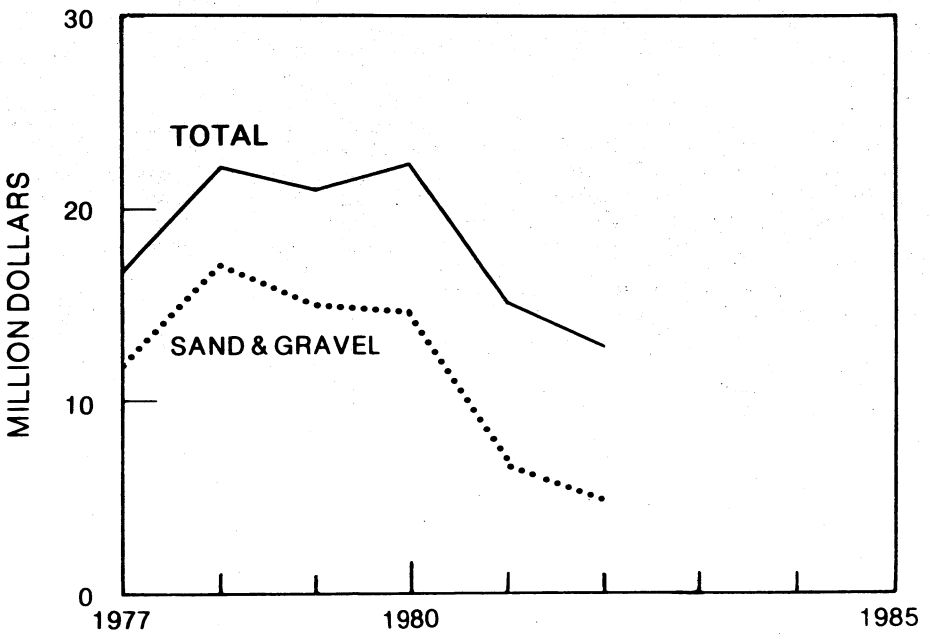

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in North Dakota.

sources was at a standstill during the year. The North Dakota Geological Survey (NDGS) issued no permits for nonfuel minerals exploration within its borders during 1982.

During 1982, geologists and engineers at the NDGS were engaged in a variety of activities that focused on providing the public with a better understanding of the State's geology and mineral and water resources. Included among these projects were the following: (1) NDGS concluded a county ground-water study program that resulted in mapping almost all of the State's geology. The project, which was done in cooperation with the North Dakota State Water Commission and U.S. Geological Survey (USGS), is being concluded with published reports dealing with ground-water basic data, hydrology, and geology on a county basis; (2) NDGS completed a study and issued a technical report on State hydrothermal resources; (3) NDGS published a new bedrock geologic map (1:1,000,000), together with a map of the Pierre Formation structure; (4) the agency began detailed compilation of 1° by 1° maps of the State. The 1° by 1° series will be part of an atlas containing surface geologic maps, a Pleistocene stratigraphic framework, land use planning derivative maps, mineral-resource maps, landfill-suitability maps, and other useful geotechnical information; (5) NDGS evaluated the geological, geochemical, and various geotechnical aspects of surface mine reclamation; and (6) NDGS evaluated the effects on ground water by disposal of thermoelectric utility waste, by reclamation of abandoned surface mines, by oil and gas mud pits, and by sanitary landfills and municipal lagoons.

As part of an ongoing project investigating the geology, geophysics, and mineral potential of buried Precambrian rocks in North Dakota, USGS published a magnetic map of eastern North Dakota and a Bouguer gravity map of the entire State. USGS was also completing a petrologic analysis of all Precambrian core data acquired in the State and preparing geologic maps of the Precambrian basement, along with mineral-potential maps for Precambrian basement rock of North Dakota.

The Mining and Mineral Resources Institute at the University of North Dakota in Grand Forks, which was created under Title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—Compared with 1981 figures, clay and shale mined in North Dakota during 1982 decreased slightly in value, but remained relatively unchanged in quantity. All production was obtained from two operations in Morton County.

Near Hebron, Hebron Brick Co. used its clay production in manufacturing face brick. At a plant in Mandan, U.S. Noonlite Ltd. manufactured lightweight aggregate from its locally mined clay. The lightweight aggregate was used mostly in blocks and structural concrete products; lesser amounts were used in highway surfacing and other applications.

Gem Stones.—No commercial gem stone mining operations were reported in North Dakota during 1982. The value shown in this chapter is an estimate of material that rockhounds, mineral collectors, and other hobbyists collected.

Lime.—Quicklime production in North Dakota during 1982 increased moderately in quantity and significantly in value compared with that of 1981. Two firms reported output: American Crystal Sugar Co. from plants near Drayton, Pembina County, and at Hillsboro, Traill County; and Minn-Dak Farmers Coop. at its plant near Wahpeton in Richland County. Entire lime output from the two companies was used in their sugar-refining operations at these same locations.

Approximately 105,000 tons of lime, obtained from all domestic sources, was consumed in the State during 1982.

Peat.—A single operation in Bottineau County accounted for the State's total peat output in 1982. Marketed exclusively in bulk form, the output did not reach the level attained in 1981.

Salt.—Compared with 1981 figures, quantity and attendant value of salt produced in North Dakota decreased significantly in 1982. Consisting of brine and evaporated material, the output was marketed for a variety of uses, including special salts for food processing and water softening and as a component in drilling muds utilized in oil and gas exploration. Hardy Salt Co. near Williston, Williams County, and Williams Exploration Co., Bowman County, reported

salt production during the year.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. In 1982, production of construction sand and gravel was the lowest since 1946. The average value of the commodity was $2.08 per ton, a 4% decrease from that reported marketed in 1981. Thirty-five companies and government agencies reported production from 65 pits in 27 North Dakota counties. Output by individual companies varied widely, with 12 firms producing less than 25,000 tons during the year; 12 between 25,000 and 50,000 tons; 3 between 50,000 and 100,000 tons; and 8 in excess of 100,000 tons.

Mountrail, the leading county in production, was followed in order by Ward, Stutsman, Burleigh, and Burke Counties, which collectively accounted for about one-half of the State's total output.

Eight companies and government agencies, each producing more than 100,000 tons, accounted for nearly two-thirds of the entire output reported for the year.

Most of the 1982 production was used for road base.

Approximately 83% of the sand and gravel produced during 1982 was shipped by truck; 1%, by rail; and the remainder, not transported.

Table 4.—North Dakota: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	475	$1,433	$3.02
Plaster and gunite sands	W	W	4.45
Concrete products	W	W	2.95
Asphaltic concrete	323	601	1.86
Road base and coverings[1]	1,256	2,118	1.69
Fill	183	354	1.93
Snow and ice control	(2)	1	4.48
Other	110	367	3.34
Total or average	2,347	[3]4,873	2.08

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (lime).
[2]Less than 1/2 unit.
[3]Data do not add to total shown because of independent rounding.

Table 5.—North Dakota: Construction sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	NA	NA	NA	444	$1,180	$2.65
Gravel	NA	NA	NA	1,753	3,396	1.94
Sand and gravel (unprocessed)	NA	NA	NA	150	297	1.98
Total or average	e3,000	e$6,500	e$2.17	2,347	4,873	2.08

eEstimated. NA Not available.

Table 6.—North Dakota: Construction sand and gravel sold or used by producers, by county

County	1980			1982		
	Number of mines	Quantity (thousand short tons)	Value (thousands)	Number of mines	Quantity (thousand short tons)	Value (thousands)
Barnes	2	30	$71	2	37	$78
Bottineau	1	W	W	1	8	11
Burke	3	303	555	1	W	W
Burleigh	8	775	3,148	2	214	525
Dickey	--	--	--	1	30	41
Divide	1	38	79	1	28	42
Eddy	3	298	777	2	W	W
Emmons	1	57	111	--	--	--
Kidder	3	77	94	3	31	36
McKenzie	1	160	290	1	189	350
McLean	4	278	622	3	118	218
Mercer	2	56	205	--	--	--
Morton	3	177	525	1	35	59
Mountrail	2	W	W	4	300	300
Ramsey	1	20	61	--	--	--
Richland	2	W	236	1	40	60
Rolette	2	53	63	15	60	67
Stark	3	465	1,585	4	W	W
Stutsman	9	254	909	5	224	548
Traill	3	72	155	2	W	W
Walsh	5	109	220	3	71	114
Ward	7	746	2,120	4	W	W
Williams	4	W	W	1	29	94
Undistributed[1]	r19	1,205	2,632	8	934	2,330
Total[2]	89	5,173	14,457	65	2,347	4,873

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]Includes Benson (1980), Bowman, Cass, Foster (1980), Grand Forks (1980), McHenry, Pembina, Pierce, Ransom (1980), Renville (1980), Towner, and Wells (1982) Counties, sand and gravel that cannot be assigned to specific counties (1982), and data indicated by symbol W.

[2]Data may not add to totals shown because of independent rounding.

Sulfur (Recovered).—Elemental sulfur was recovered as a byproduct at the natural gas processing plants of Aminoil USA Inc., at Tioga in Williams County; Koch Hydrocarbon Co. in McKenzie County; and Warren Petroleum Corp., at Little Knife, and Western Gas Processors Ltd., at Roosevelt, both in Billings County.

Vermiculite (Exfoliated).—Robinson Insulation Co. exfoliated crude vermiculite shipped into the State at its plant in Minot, Ward County. The quantity of exfoliated material produced was nearly one-third less than that produced in 1981. The expanded product was used mainly for insulation; lesser amounts were used for concrete aggregate, soil conditioners, and other horticultural purposes.

[1]State Liaison Officer, Bureau of Mines, Minneapolis, Minn.

Table 7.—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 kiln at beet sugar refinery.	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.
Williams Exploration Co	3025 South Parker Rd. Suite 600 Aurora, CO 80014	do	Bowman.
Sand and gravel (construction):			
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	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.
Vermiculite (exfoliated):			
Robinson Insulation Co	Box 1782 Minot, ND 58702	do	Ward.

The Mineral Industry of Ohio

By William A. Bonin[1]

The value of nonfuel mineral production in Ohio in 1982 was $450 million, compared with $552 million in 1981. Major mineral commodities produced included crushed stone, sand and gravel, salt, lime, clays, and cement. Also produced were gypsum, dimension stone, peat, and abrasives. Iron ore concentrates, alumina, beryllia, titanium raw materials, talc, perlite, vermiculite, zinc concentrates, and zircon were shipped into the State for processing.

Nationally, Ohio ranked 15th in the value of nonfuel mineral production. The State ranked first in the production of ferralloys, lime, and steel slag; second in pig iron and fire clay; third in iron slag and natural abrasives; and fourth in salt, construction sand and gravel, and common clay.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	105	$7,129	86	$6,170
Portland	do.	1,461	69,517	1,326	59,598
Clays	do.	2,217	10,411	1,451	6,100
Gypsum	do.	148	1,566	109	1,335
Lime	do.	2,767	127,751	1,666	76,370
Peat	do.	10	191	5	144
Salt	do.	3,608	90,254	3,514	90,572
Sand and gravel:					
Construction	do.	e32,240	e95,570	26,311	83,684
Industrial	do.	1,487	20,893	1,223	17,816
Stone (crushed)	do.	36,950	125,588	p30,300	p105,200
Combined value of abrasives, gem stones, and stone (dimension)		XX	3,290	XX	3,240
Total		XX	r552,160	XX	450,229

eEstimated. pPreliminary. rRevised. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Adams	W	W	Stone (crushed).
Allen	$2,531	$3,065	Do.
Ashland	W	W	Clays.
Ashtabula	W	W	Lime.
Athens	W	W	Stone (crushed).
Auglaize	W	W	Stone (crushed), clays.
Belmont	W	657	Stone (crushed).
Brown	233	3	Do.
Butler	7,495	(3)	
Carroll	W	W	Stone (crushed), stone (dimension).
Champaign	631	(3)	
Clark	W	531	Stone (crushed).
Clermont	283	(3)	
Clinton	W	W	Stone (crushed).
Columbiana	W	W	Clays, stone (crushed).
Coshocton	W	W	Stone (dimension), clays.
Crawford	W	W	Stone (crushed).
Cuyahoga	23,314	28,499	Salt, lime, clays, peat.
Darke	2,456	(3)	
Delaware	3,695	2,611	Stone (crushed), clays.
Erie	W	W	Lime, stone (crushed), sand and gravel (industrial).
Fairfield	W	(3)	
Fayette	W	W	Stone (crushed).
Franklin	W	W	Stone (crushed), clays.
Gallia	W	W	Sand and gravel (industrial).
Geauga	W	W	Sand and gravel (industrial), stone (crushed).
Greene	32,760	25,376	Cement, stone (crushed), clays.
Hamilton	11,072	(3)	
Hancock	1,766	1,960	Stone (crushed).
Hardin	W	377	Do.
Harrison	W	W	Stone (crushed), clays.
Henry	W	W	Clays.
Highland	W	W	Stone (crushed).
Hocking	W	W	Clays.
Holmes	W	W	Stone (crushed), clays.
Huron	W	W	Stone (crushed).
Jackson	W	W	Clays, stone (crushed), sand and gravel (industrial).
Jefferson	W	W	Clays.
Knox	W	W	Sand and gravel (industrial), stone (dimension).
Lake	W	W	Salt, lime.
Lawrence	W	W	Cement, clays, stone (crushed).
Licking	W	W	Clays.
Logan	1,753	W	Stone (crushed), peat.
Lorain	19,047	W	Lime, stone (dimension), stone (crushed), abrasives.
Lucas	W	W	Stone (crushed), cement, clays.
Mahoning	W	W	Stone (crushed), clays, peat.
Marion	2,710	1,985	Stone (crushed), clays.
Medina	W	W	Clays, stone (crushed).
Meigs	2,402	(3)	
Mercer	W	W	Stone (crushed).
Miami	6,842	W	Stone (crushed), stone (dimension).
Monroe	W	W	Stone (crushed).
Montgomery	W	W	Do.
Morgan	W	244	Do.
Morrow	241	(3)	
Muskingum	W	W	Cement, stone (crushed), clays.
Noble	1,274	1,760	Stone (crushed).
Ottawa	W	W	Stone (crushed), lime, gypsum.
Paulding	21,660	W	Cement, stone (crushed), clays.
Perry	W	W	Sand and gravel (industrial), stone (crushed), clays.
Pickaway	W	W	Stone (crushed).
Pike	W	W	Do.
Portage	7,771	(3)	
Preble	1,010	W	Stone (crushed).
Putnam	W	W	Stone (crushed), clays.
Richland	W	W	Clays.
Ross	2,033	W	Sand and gravel (industrial).
Sandusky	W	W	Lime, stone (crushed).
Scioto	W	W	Stone (dimension), clays.
Seneca	W	15,787	Lime, stone (crushed), stone (dimension), clays.
Shelby	1,417	654	Stone (crushed).
Stark	11,310	W	Cement, stone (crushed), clays.
Summit	W	W	Salt, stone (crushed), sand and gravel (industrial).

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Trumbull	W	$479	Stone (crushed).
Tuscarawas	W	W	Clays, sand and gravel (industrial), stone (crushed).
Union	W	W	Stone (crushed).
Van Wert	$1,045	1,105	Do.
Vinton	W	--	
Warren	W	(3)	
Washington	1,180	111	Stone (crushed).
Wayne	W	37,307	Salt, stone (crushed), clays.
Williams	W	6	Peat.
Wood	4,322	3,513	Stone (crushed).
Wyandot	W	W	Stone (crushed), lime, peat, clays.
Undistributed[4]	390,082	330,571	
Sand and gravel (construction)	XX	e95,570	
Total[5]	562,340	552,160	

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

[1]Defiance, Fulton, Guernsey, and Madison Counties are not listed because no nonfuel mineral production was reported.

[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, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

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

Table 3.—Indicators of Ohio business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	5,009.0	5,122.0	+2.3
Unemployment	do	492.0	640.0	+30.1
Employment (nonagricultural):				
Mining[1]	do	30.7	30.7	--
Manufacturing	do	1,232.6	1,103.6	-10.5
Contract construction	do	153.7	135.5	-11.8
Transportation and public utilities	do	217.2	207.6	-4.4
Wholesale and retail trade	do	950.1	936.5	-1.4
Finance, insurance, real estate	do	205.8	206.4	+.3
Services	do	851.5	859.7	+1.0
Government	do	676.0	658.6	-2.6
Total nonagricultural employment[1]	do	4,317.6	[2]4,138.7	-4.1
Personal income:				
Total	millions	$111,186	$116,364	+4.7
Per capita		$10,314	$10,783	+4.5
Construction activity:				
Number of private and public residential units authorized		21,868	16,735	-23.5
Value of nonresidential construction	millions	$1,398.2	$1,273.5	-8.9
Value of State road contract awards	do	$327.0	$345.0	+5.5
Shipments of portland and masonry cement to and within the State	thousand short tons	2,458	2,139	-13.0
Nonfuel mineral production value:				
Total crude mineral value	millions	$552.2	$450.2	-18.5
Value per capita, resident population		$51	$42	-17.6
Value per square mile		$13,444	$10,922	-18.8

pPreliminary.

[1]Includes bituminous coal and gas extraction.

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

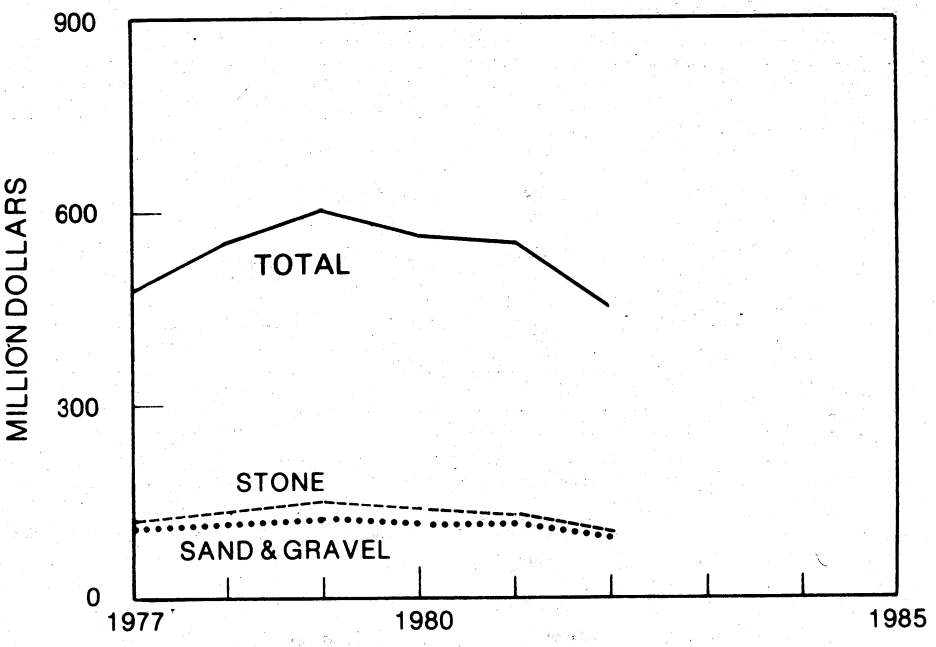

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Ohio.

Trends and Developments.—Construction mineral commodities continued to contribute the largest portion to mineral value in Ohio, even though combined sales of cement, sand and gravel, and stone fell $98.4 million below the 1979 record levels. The value of cement shipments decreased 14%, clays 41%, sand and gravel 13%, and crushed stone 16%, compared with that of 1981.

Among the industries hardest hit by the economic downturn was steel. The worldwide depression in industrial manufacturing resulted in a lack of demand for steel products. Price competition was extreme, intense, and worldwide, and the low levels of operations during 1982 resulted in substantial operating losses. The steel industry's response was to further reduce overhead and operating costs, which eliminated many jobs. As a result of production cutbacks, thousands of workers were laid off as many steel firms idled much of their steelmaking capacity or shut down plants. In November, only 3 of 11 blast furnaces, 5 of 7 basic oxygen furnaces (BOF), and 10 of 19 electric arc furnaces were operating in northern Ohio, where five steel companies reported having laid off about one-third of their workers because of a decreased number of orders.

In order to benefit from any future business recovery, the steel industry's capital expenditures were directed toward reducing operating costs. Examples of this were in research, the application of computer technology to the manufacturing process, and the modernization of existing manufacturing facilities. Timken Co. continued construction at its Faircrest steel plant and modernization of existing facilities in Canton. The new $500 million Faircrest plant will have an ingot capacity of 550,000 tons of specialty steel per year and employ 800 workers. The Faircrest plant, scheduled for completion by fall of 1985, represents Timken's largest single investment so far, equal to about two-thirds of its entire net worth.

Another indicator of the depressed 1982 economy was the decline of Great Lakes shipping, which experienced its worst year since the Depression. Only one-half of the 120 vessels that transport iron ore, coal, cement, and other bulk cargoes sailed in 1982 because of weakened demand for raw materials by the steel and construction industries. At yearend, nearly a year's tonnage of iron ore pellets was stockpiled along the lower shore at Cleveland, Lorain, Conneaut, and other ports.

The greatest problems facing the sand and gravel industry in the coming years are

obtaining zoning favorable to the extractive industries and persuading planning groups to set aside sand and gravel deposits to meet future needs. The supply is being depleted in northwestern Ohio, and a significant number of good deposits are not available for exploitation because mining is prohibited by zoning or deposits have been covered by urban sprawl and suburban development. The Ohio Surface Mining Act of 1975 assures communities that lands disturbed by the extractive industries will be reclaimed in a manner compatible with local land use. These reclamation requirements have forced operators to plan ahead in the handling of overburden and in the progress of mining.

Exploration Activities.—The Ohio Division of Geological Survey (DGS) continued exploration and mineral resource evaluations. The DGS's new Mobile B-16, wire-line, core drilling rig was active in coal and limestone areas throughout 1982. Coring in Gallia County provided new information on the downdip extent of the Clarion (No. 4A) coal. A second coal project was initiated in Belmont County to drill a series of nine cores penetrating the entire coal-bearing section. Information from these cores, which averaged 900 feet, will be integrated with previous State DGS and private industry data to better delineate the deep coal resources in Belmont County.

Three cores, ranging from 300 to 1,400 feet, were taken to evaluate the high calcium-limestone potential of the Black River Formation in Clermont and Butler Counties. A second series of three test borings, projected to bottom out below 2,000 feet, was started in Wood County to investigate sulfide mineralization and to gather general stratigraphic information on the Silurian and Ordovician rocks of northwestern Ohio.

In October, Crystal Mining Co., a Tucson, Ariz.-based company, began leasing large tracts of land in Wayne and adjacent Medina Counties to explore for deposits of undisclosed minerals. By mid-December, Crystal Mining had 12,000 acres under lease and had already drilled the first of its 280 planned test borings to a depth of 1,900 feet. The company planned to go deeper before taking core samples but had not indicated the target zone nor the commodity being sought. However, it acknowledged that potash, salts, and base metals were among the possibilities. The State DGS Report of Investigations No. 90, "Silurian Rock Salt of Ohio," reports anomalous gamma-ray readings that possibly identify potash beds (sylvite) in the leased area.

Transportation.—The 50,000-ton-capacity potash dock facility at the Toledo World Terminal on Lake Erie began operations in late 1982. The potash, which is mined in Saskatchewan, Canada, is to be distributed by the Chessie System Railroad in covered hopper cars to customers throughout the Midwestern States.

Legislation and Government Programs.—DGS's new program, created by House bill 385 to map and publish reports on the geology and mineral resources of each county started slowly because of reduced revenues from the State's mineral severance tax. However, upgrading of facilities in the DGS's Subsurface Section and hiring of additional personnel were accomplished. Also under the bill, the DGS became the custodian of statistics pertaining to Ohio's mineral producers. By yearend, tabulation of 1981 statistics was 20% complete. Major activities of the Mineral Statistics Program included development of a new format for reporting on coal and industrial mineral production and preliminary planning to computerize mineral statistics.

In 1982, the State DGS handled more than 50,000 requests for geologic information and distributed about 250,000 maps, publications, and gas and oil well cards. Two major projects completed in 1982 were a coal washability study (open file report 82-2) and the final report on Devonian shales as part of the Eastern Gas Shales Project. The Regional Geology Section was active in several nonfuel investigations during 1982. A glacial drift thickness and top-of-rock mapping program in Franklin County was begun in 1982. A similar study was completed for Delaware County, along with guides to the geology along Interstate 77 and along Interstate 70 from Columbus to the Indiana border. Ongoing projects in 1982 included a study of sand and gravel resources in Mahoning County, a minerals industries report for 1981-82, and a guide to the geology along Interstate 70 between Columbus and Bridgeport. "The Glacial Geology of Northeast Ohio" (Bulletin 65) was published in 1982. Also issued were "Analysis of Ohio Coals, 1977-1978" (Information Circular 50) and "Guide to the Geology Along I-75 Between Toledo and Cincinnati" (Educational Leaflet 13).

The U.S. Department of Energy (DOE) terminated all plans to utilize salt mines under Lake Erie near Cleveland as test sites. The mines are in salt beds that occur at a depth of 1,850 feet. The department had

wanted to determine if salt mines generally were secure geologic environments for safe disposal of nuclear waste. Battelle Memorial Institute of Columbus had a contract with DOE to test the mines with electric devices that simulate the heat produced by nuclear waste.

Work on a comprehensive land management plan for the 176,787-acre Wayne National Forest was still in the early stages at yearend. A review draft of the plan is not expected until late 1983. Complicating the planning process is the fact that the U.S. Forest Service owns less than 30% of the oil and gas and less than 25% of the coal rights. Furthermore, the forest has been mined for coal, gas and oil, clay, and limestone. About 70% of the oil and gas beneath Wayne National Forest is privately owned. At one point during the past 5 years, Washington County ranked third nationally in the number of new oil and gas wells drilled because of oil development in Wayne National Forest. Some wells in the forest have been producing for more than a century.

In addition to oil and gas operations in the Wayne National Forest, it contains many active strip mines as well as some that have been abandoned, such as the Weltzheimer tract that is scheduled for reclamation in 1983. The Weltzheimer lands consist of more than 5 miles of highwall, seven acid-water filled mine pits, and a 1-mile-long section of forest stream choked by toxic sediments. The project, which is funded by the U.S. Office of Surface Mining, is estimated to cost $1.1 million.

Eagle Crusher Co. Inc., Galion, successfully completed surface field tests of the M44 portable underground hard-rock crusher at the Duffy limestone quarry, Huntsville. The low-profile crusher, developed under a research contract with the U.S. Bureau of Mines, will improve the efficiency of most conveyor systems and make it possible to bring conveyor haulage closer to rock-handling locations.

The U.S. Bureau of Mines, through a Memorandum of Agreement with the State, tested a method of sealing abandoned mine openings in Ohio by means of pneumatic stowing of sand with crushed limestone and gravel. This technique, published in Bureau of Mines Report of Investigations 8730, was used to seal four mine openings and one shaft in compliance with Mine Safety and Health Administration requirements.

The Mining and Mineral Resources and Research Institute at Ohio State University in Columbus, which was created under title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—Cleveland Quarries Co. produced grindstones at its Amherst quarry in Lorain County as a coproduct of its dimension sandstone quarrying operation. The company is the sole natural grindstone producer in the Nation and markets the 8-inch to 6-foot-diameter grinding wheels throughout the United States. The 93.13% pure silica sandstone is selectively quarried from the Berea Formation for these grindstones. Rock from the Berea makes an excellent grindstone owing to the angularity of the grain.

Three companies produced metallic abrasives during the year. National Metal Abrasives Co., Wadsworth, and Globe Steel Abrasives Co., Mansfield, produced steel shot and grit. Steel Abrasives Inc., Fairfield, produced chilled and annealed shot and grit. The metallic abrasives industry was particularly depressed by current economic conditions and overcapacity.

The General Electric (GE) Co., Specialty Materials Department, Worthington, manufactured industrial abrasives and diamonds. GE, which began making diamonds in 1957, is the world leader in manufactured industrial diamonds. GE plans to develop synthetic diamond products that will allow the company to service the plus 20-mesh to 6-stone-per-carat market areas.

Cement.—Five companies in Ohio operated six cement plants during 1982. Both portland and masonry cement were produced by Columbia Cement Corp., Zanesville; General Portland Inc., Paulding; Marquette Co., Superior; and Southwestern Portland Cement Co., Fairborn. SME Cement Inc., at its Middlebranch and Sylvania plants, produced only portland cement. Portland cement shipments totaled 1.3 million tons, down 9.2% from those of 1981, while masonry cement shipments fell 18.1% to 86,000 tons.

In 1982, Columbia Cement became a wholly owned subsidiary of Ashland Technology Inc., which in turn is a wholly owned subsidiary of Ashland Oil Inc. The compa-

ny's limestone operations in Zanesville moved from underground mining to surface mining during 1981.

Table 4.—Ohio: Portland cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	6	6
Production	1,570,984	1,380,902
Shipments from mills:		
Quantity	1,460,959	1,326,035
Value	$69,516,803	$59,597,511
Stocks at mills, Dec. 31	160,979	157,552

Table 5.—Ohio: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	4	4
Production	112,057	78,673
Shipments from mills:		
Quantity	105,226	86,472
Value	$7,129,491	$6,170,030
Stocks at mills, Dec. 31	27,402	19,914

Clays.—Ohio ranked fourth nationally in the production of common clay and shale and second in output of fire clay. Common clay and shale accounted for 90% of the State's clay production, with fire clay accounting for the remainder. In 1982, 31 companies operated 43 pits to excavate common clay and shale; 12 companies mined fire clay at 13 operations.

Total production of common clay and shale in Ohio decreased 30% to 1.3 million tons from 1981 to 1982, while the average unit value fell from $3.10 to $2.99 per ton. These materials were used in the manufacture of structural clay products such as brick and drain tile, floor and wall tile, portland cement clinker, and bloated lightweight aggregate.

In 1982, the total output of fire clay decreased 58% from 1981 levels to 152,000 tons, while the average unit value rose from $12.89 per ton to $14.57 per ton. Major end uses of fire clay were in the manufacture of refractories and floor and wall tiles. Fire clay commonly occurs as underclays below coal seams.

The 30% decrease in Ohio's production of common clay and shale resulted from the downturn in construction activities that lowered demand for clay building materials. The 58% decrease in the State's output of fire clay resulted not only from lower demand by the major consumers—steel, foundry, aluminum, and cement industries—but also from major technological changes within these basic industries.

General Clay Products Co., headquartered in Columbus, operated six plants in Ohio. Raw fire clay and shale, produced from company mines, was processed into brick for commercial, industrial, and residential use. At its Newcomerstone plant, 25 workers, using an improved discharge system that handles 165 tons of material in a 7-hour workday, can produce 18 million brick annually.

United States Brick Co., owner of Richland Brick Co., negotiated at yearend with a potential buyer for its aging and then-idle Mansfield facility. Production was halted in November at the plant that once turned out 60 million brick per year and employed as many as 200 hourly workers.

Fluorspar.—Seaforth Mineral & Ore Co., Cleveland, operated a fluorspar concentrate drying and processing mill in East Liverpool. The facility handled acid-grade fluorspar imported from Mexico, the Republic of South Africa, and Spain. Company shipments were made throughout the United States and Canada. Acid-grade fluorspar is used as feedstock in the manufacture of hydrofluoric acid, a key ingredient used by the aluminum, fluorochemical, and uranium industries. When the East Liverpool plant began operations in 1980, it produced ceramic-grade filter cake, mostly for the ceramic industry.

Gem Stones.—An estimated $10,000 in gem stones and mineral specimens were collected by mineralogists and rock hounds in 1982.

Graphite (Synthetic).—The Carbon Products Div. of Union Carbide Corp., Fostoria, continued to produce manufactured graphite. Products include high-modulus fibers, anodes, electrodes, unmachined shapes, motor brushes, powder, cloth, and other graphite articles.

Gypsum.—Deposits of economic value occur in Ottawa and Erie Counties north and south of Sandusky Bay near the 1821 discovery sites. Celotex Corp., a subsidiary of Jim Walter Corp., continued to be the only company that mined gypsum. The company reported a 26% drop in production from its open pit mine on Marblehead Peninsula in Ottawa County.

Celotex, National Gypsum Co., and United States Gypsum Co. calcined crude gypsum mined in Ohio and other States at plants in Ottawa and Lorain Counties. Calcined gypsum produced by these major inte-

grated companies was used primarily to make wallboard. Production fell 26% from that of 1981 because of the continuing decline in building construction. In early 1982, United States Gypsum closed its gypsum plant in Ottawa County.

Lime.—Although production fell from nearly 15% to less than 12% of the Nation's total output, Ohio continued to lead the United States in lime production and to rank second in lime consumption.

The leading individual uses of lime were in steel furnaces, glass, refractories, water purification, and sewage treatment. The use of lime in agriculture continued its long-term decline and has become of small significance. Conversely, the less active, pulverized limestone continued its long-term upward trend as an alternative to agricultural lime. The lime industry is energy-intensive, averaging about 7.1 million British thermal units per ton of lime produced. Hence, crushed and pulverized limestone is substituted for lime in fluxing and sulfur removal, as well as in agriculture.

Sales of lime for environmental uses remained essentially at the same levels as those of 1981. Environmental regulations have caused an increased demand for lime, which is used for desulfurization of stack gases from coal-fired powerplants, smelters, refineries, and other chemical plants, and for neutralizing industrial effluent water.

Twelve companies produced lime in Ohio during 1982. Martin Marietta Corp., the fourth leading lime producer in the Nation, operated two plants in Woodville. In January, the company purchased the Woodville Lime & Chemical Corp. plant in Woodville. This plant is adjacent to their Woodville No. 1 plant, which ranks sixth in total output in the Nation. The company also joined the two adjacent quarries using a single blast to take down the back-to-back highwalls, which in September were separated by 90 feet.

The J. E. Baker Co., Millersville, dolomitic lime and dead-burned dolomite plant in Sandusky County, which had been closed in October, was purchased by Steetley Resources Inc. of Woodville. Strongly influenced by the depressed iron and steel industry, the United States Steel Corp. captive plant in Lorain County remained dormant throughout the year and the Pfizer Inc. dolomitic lime plant in Gibsonburg ceased operations in January 1983.

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

Use	1981		1982	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, basic oxygen furnace	1,534,288	$70,864	723,174	$34,178
Steel, electric	211,171	10,232	127,571	6,491
Refractories	193,894	10,061	107,072	4,842
Steel, open-hearth	86,631	4,483	140,908	6,741
Glass	143,918	6,393	115,814	4,832
Agriculture	6,997	363	7,665	357
Sewage treatment	10,563	461	8,731	399
Other[1]	579,914	24,894	435,099	18,530
Total	2,767,376	127,751	1,666,034	76,370

[1]Includes acid water neutralization, calcium carbide, fertilizer, finishing lime, magnesia from seawater or brine, mason's lime, magnesium, other chemical and industrial uses, other construction lime, other metallurgy, other unspecified uses, road stabilization, sugar refining, and water purification.

Peat.—Six companies produced a total of 5,000 tons of peat in five counties. Reedsedge and sphagnum moss peat were mined in Logan County; humus peat was mixed in Cuyahoga, Mahoning, Williams, and Wyandot Counties. Packaged peat was used primarily for general soil improvement and seed inoculant. Peat sold in bulk was used for golf courses, nurseries, and earthworm cultivation, as well as seed inoculant and general soil improvement. While domestic production and apparent demand increased about 6% compared with that of 1981, production in Ohio fell 50%, with a 25% drop in total value.

Perlite (Expanded).—Crude perlite shipped from the Western States was expanded by Celotex in Hamilton County and Cleveland Gypsum Co., a division of Cleveland Builders Supply Co., in Cuyahoga County, with production decreasing 7.5% from that of 1981. Construction industry-related uses, such as concrete and plaster aggregate, wallboard and ceiling tile, and loose fill insulation, continued to account for two-thirds of sales.

Quartz Crystal (Synthetic).—Sawyer Research Products Inc., a subsidiary of Brush

Wellman Inc., Eastlake in Lake County, imported lasca, a natural, nonelectronic-grade, pure lump quartz material, to grow cultured quartz crystals. The company sold "as-grown" and "lumbered" cultured quartz crystals to manufacturers of quartz devices for frequency-controlled oscillators. About 50% of sales was to international markets, especially Japanese integrated producers of quartz devices.

In November, the board of directors of Brush Wellman approved a plan for divestiture of its quartz products business. The Eastlake facility represented more than one-half of the installed capacity for growing single crystal-cultured quartz in the United States.

Salt.—Total sales of salt in Ohio decreased 3% to 3.5 million tons from 1981 to 1982. Nevertheless, the State accounted for 9% of domestic sales and continued to rank fourth behind Louisiana, Texas, and New York in salt production. Rock salt was recovered from two underground mines. International Salt Co. operated its Whiskey Island Mine on the Lake Erie shore not far from Cleveland's Public Square. The Morton Salt Co. Inc. deep mine is 30 miles northeast of downtown Cleveland along Lake Erie at Grand River. Morton Salt, like International Salt, mines about 1,900 feet below the surface of Lake Erie at its Lake County location.

International Salt has been mining at Whiskey Island since 1961. The first of four distinct 20- to 40-foot-thick layers of salt has been mined, and the company now is working the next lower level. Salt is mined 16 hours per day with two shifts working 5 days per week. The mine has the capacity to produce 8,000 tons of salt per day, 250 working days per year. About 1 million tons of the salt brought out of the International Salt Whiskey Island Mine each year is shipped across the Great Lakes and through the St. Lawrence Seaway to cities from Duluth, Minn., to Montreal, Canada. Some was shipped to State and local agencies in Ohio and surrounding States for highway and street ice control.

The remainder of Ohio's salt production comes from three brine operations in Summit and Wayne Counties that extract naturally occuring brine. This was pumped by PPG Industries Inc. and Diamond Crystal Salt Co. in Summit County and by Morton Salt in Wayne County. The open-pan, vacuum-pan, and pressed-block processes were used to recover salt from brine mainly for the chemical and food-processing industries.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Ohio ranked fourth nationally in sand and gravel production in 1982, with the commodity furnishing 45% of the State's construction aggregate. In 1982, 175 companies operated 228 pits, 215 with processing plants, to produce 26 million tons of sand and gravel valued at $83.7 million. While production fell 5.9 million tons (18%) from that of 1981, value dropped $11.9 million (12%) to an average price per ton of $3.18.

The largest production came from counties close to major metropolitan areas, reflecting not only the availability of sand and gravel from local deposits but also the critical competitive factor in production—the distance to its site of usage. Because the commodity is a very low unit-cost item, fuel and labor costs for transport largely determine whether or not a deposit can be economically exploited. Haul distance commonly controls the price of sand and gravel. For example, the cost of gravel processed on the south side of Columbus is doubled by the time it is delivered to the north end of the city.

Since high interest rates and the generally poor economic climate have almost stopped home and commercial construction, the major construction activity using processed sand and gravel was highway resurfacing. In terms of road resurfacing, sand and gravel producers in northwestern Ohio fared better than did producers elsewhere in the State. According to the Ohio Flexible Pavement Association, the amount of asphalt surfacing applied in 1982 was almost double that of 1981 in that area.

Since 1949, more than 23.5 million tons of sand and gravel has been dredged from the beds of Lake Erie and the Maumee River for use in the construction industry, principally in the counties bordering the lake. This activity has provided the State with more than $2.1 million in royalties.

Industrial.—In 1982, 11 companies operated 14 quarries with onsite processing plants that produced 1.2 million tons of industrial sand and gravel. Production decreased 18% from that of 1981, while the

average unit value remained essentially unchanged. Leading producers were Central Silica Co. of Zanesville, with operations in Glass Rock, Perry County, and Millwood, Knox County; and Best Sand Inc. in Chardon, Geauga County.

At the Central Silica operations, sandstone is quarried and processed for use in the glass, foundry, and ceramics industries and in hydraulic fracturing. Central Silica distributes to Ohio and Pennsylvania.

Best Sand operation in Geauga County quarries the Sharon sandstone an extremely pure (98%) silica, poorly cemented quartz sandstone that is easily crushed and screened into various size fractions ranging from fine sand to pebbles. After processing, the 99.5% purity of the product meets specifications for foundry use and exceeds requirements for most other applications. The firm is a major supplier of molding and core sands. Other markets for various grades of sand range from chemical processing and hydraulic fracturing for oil and gas production to sandblasting and filtration. The products are used in such applications as production of glass, sodium silicate, and silicon carbide, as well as in foundries, refractories, and ferroalloy production. The finished product is supplied bagged or in bulk over a seven-State area and Canada. Self-unloading lake vessels are used to make deliveries to U.S. Great Lakes ports and Canada.

Crushed sandstone is the prime source of all of Ohio's industrial sand. Sandstones are more widely used than sand deposits for this purpose because of their higher and more uniform quality. Ohio's crushed and processed sandstone are used primarily for foundry and glass sand. Silica sand is also widely used as a filter medium in water and sewage treatment.

Table 7.—Ohio: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	9,448	$29,558	$3.13
Plaster and gunite sands	253	851	3.37
Concrete products	1,872	5,813	3.11
Asphaltic concrete	5,776	19,010	3.29
Road base and coverings[1]	5,241	18,666	3.56
Fill	2,879	6,596	2.29
Snow and ice control	324	977	3.02
Railroad ballast	2	6	2.88
Other	516	2,206	4.27
Total or average	26,311	[2]83,684	3.18

[1]Includes road and other stabilization (cement and lime).
[2]Data do not add to total shown because of independent rounding.

Table 8.—Ohio: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	11,478	$33,417	$2.91
Gravel	NA	NA	NA	12,481	44,698	3.58
Sand and gravel (unprocessed)	NA	NA	NA	2,352	5,569	2.37
Total or average	e32,240	e$95,570	e$2.96	26,311	83,684	3.18
Industrial:						
Sand	1,421	20,395	14.35	1,169	17,410	14.89
Gravel	66	498	7.57	53	405	7.59
Total[1] or average	1,487	20,893	14.05	1,223	17,816	14.57
Grand total[1] or average	e33,727	e116,463	e3.45	27,533	101,499	3.69

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent - rounding.

Slag (Iron and Steel).—In 1982, Ohio continued to rank second, behind Pennsylvania and ahead of Indiana, in the sale of iron and steel slag. Almost 60% of sales was marketed within these three States. In iron (blast furnace) slag sales, Ohio ranked third nationally with 2.2 million tons valued at $10.1 million. In steel slag sales, the State ranked first with 1.1 million tons valued at $3.8 million. Total slag sales and value decreased 23% to 3.3 million tons at $13.9 million compared with those of 1981. This sharp fall parallels the decline in most forms of construction in which slag is used. The State's production of slag in 1982 fell because of major declines in iron and raw steel production. Ohio's pig iron and raw steel production declined 33% from 1981 levels.

Three companies—Standard Slag Co., American Materials Co., and United States Steel Corp.—processed air-cooled iron (blast furnace) slag at eight locations in Cleveland, Hamilton, Lorain, Middletown, Mingo Junction, New Boston, and Warren. Standard Slag also processed granulated slag in Lordstown, south of Warren. Air-cooled iron slag was used mainly for road base, as asphaltic concrete aggregate, and as fill. Granulated slag was used in concrete products as a lightweight aggregate. During the year, Standard Slag closed its Republic plant in Youngstown.

Steel slag was processed by four companies—Heckett Co., Stein Inc., McGraw Construction Co., and International Mill Service—at seven locations in Canton, Cleveland, Lorain, Mansfield, Middletown, Mingo Junction, and Warren. Five electric furnaces, three BOF, and one open-hearth furnace were the sources of the steel slag. Steel slag was typically used as fill and for road base.

In April, the National Slag Association presented its top safety award to the crew of the United States Steel Lorain-Cuyahoga slag-processing plant. On December 31, 1981, more than 21 years (1,630,771 personnel hours) had been recorded without a lost-time accident.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and completed the following year.

Crushed.—Based on these estimates, total sales of crushed stone in Ohio decreased 18% to 30.3 million tons from 1981 to 1982. The State, with 3.8% of domestic sales valued at $105.2 million, ranked ninth nationally in the production of crushed stone. Crushed stone was produced from about 295 quarries throughout the State. The primary uses of crushed stone were for construction aggregate (mostly highway and street resurfacing), lime and cement manufacturing, flux stone, and dead-burned dolomite.

Limestone and dolomite accounted for 55% of Ohio's mined aggregate, with sand and gravel and a minor amount of sandstone composing the remainder. An additional 4 million tons of iron and steel slag was used for construction.

Crushed limestone is a key ingredient in the fluidized-bed process being utilized in the burning of Ohio's high-sulfur coal. Crushed limestone and lime are also being used in flue gas desulfurization processes.

Most of Ohio's limestones and dolomites are found at the surface in the western part of the State. The heaviest concentration of high-purity, surface-minable dolomite in the United States is found in northwestern Ohio. The State's sandstones occur at the surface in the eastern part of the State; quarrying occurred primarily in northeastern Ohio.

Dimension.—Ohio has led the Nation for years in the production of dimension sandstone—about 93% of dimension stone production was from sandstone—the remainder was from limestone. The deepest and largest quarries in the State are located at South Amherst in Lorain County. The No. 6 quarry, called "The Grand Canyon," has been producing sandstone continuously for more than 100 years and is thought to be the largest sandstone quarry in the world. The Buckeye quarry is 240 feet deep and produces dimension stone from the massive sandstone that composes the lower portion of the Berea Formation. The thick bedding and excellent bearing strength make the Berea a valuable building stone.

The two leading U.S. producers of dimension sandstone are both located in Ohio. Briar Hill Stone Co. of Glenmont is No. 1. Next in production tonnage is Cleveland Quarries, which quarries Berea sandstone in Erie and Lorain Counties for grindstones, rubble, curbing, ashlar, and construction stone. Cleveland Quarries operates both the Buckeye and the Grand Canyon quarries.

Ohio's dimension stone industry continues to face stiff competition from brick,

cement, and Indiana limestone.

Strontium Compounds.—Barium & Chemicals Inc., Steubenville, produced various strontium compounds from shipment 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 compounds decreased 22% from 1981 to 1982. The slackened demand was most evident in the color television picture tube manufacturing industry, which is the largest consumer of strontium. 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 byproduct from petroleum refining operations by Standard Oil Co. of Ohio at its refineries in Lima, Allen County, and Toledo, Lucas County; by Sun Co. Inc. at Toledo; and by Ashland Oil at Canton. Republic Steel Corp. also recovered sulfur from its coking plants in Cuyahoga and Trumbull Counties. Production in Ohio decreased 11.5% to 27,700 metric tons from 1981 to 1982. Shipments totaled 27,300 metric tons valued at $3.1 million, a decrease of 10.6% in quantity but an increase of 44% in value compared with that of 1981.

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 30 States producing exfoliated vermiculite in 1982. Cleveland Gypsum in Cleveland and O. M. Scott & Sons Co. in Marysville exfoliated vermiculite shipped in from other States. Sales decreased 15% from 1981 levels and 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 17 States in which primary aluminum was produced in 1982. U.S. production fell to 3.6 million tons, down 27% from that of 1981, the lowest annual production rate since 1968.

Ormet Corp., which is 66% owned by Consolidated Aluminum Corp. (Conalco) and 34% owned by Revere Copper & Brass Inc., continued to produce primary aluminum in Hannibal at sharply reduced capacity. The alumina for the plant is refined at its Burnside, La., refinery from Porto Loko, Sierra Leone, bauxite. Output at its 270,000-ton-per-year reduction plant in Hannibal, Monroe County, was down 31% from that of 1981, roughly paralleling that of total domestic production, which fell 27%. By May, Ormet had laid off about 800 workers (almost one-half of its employees) and had cut back one-third of its operations. At yearend, conditions remained unchanged and a turnaround was not expected until 1983.

During 1982, Ormet increased the efficiency of existing potlines and continued to benefit from its long-term, fixed-rate contract for coal-generated power from West Virginia. Ormet had owned two powerplants but sold them several years ago to a power company with the requirement that it continue to receive low-cost power. Power consumption accounts for about one-third of the cost to produce aluminum.

Conalco, the 66% owner, operates an aluminum rolling mill in Hannibal and markets sheet and plate nationwide. Its subsidiary, Swiss Aluminium Ltd. (Alusuisse) of Zurich, proceeded with a $200 million expansion and modernization project at Hannibal. The project features some of the most advanced rolling and casting technology. The first phase includes the installation of a $27.5 million continuous caster for the production of ingots from the refined aluminum supplied by the adjacent Ormet reduction plant. The new caster will use an electromagnetic process developed by Alusuisse whereby ingots are cast in an electric field rather than in a mold. Conalco is the first company in the West to use this process to produce improved aluminum ingots. Recall and layoff of hourly workers at the Hannibal mill fluctuated throughout the year in response to orders for flat sheet, while the company operated successfully in the area of can stock. Revere, the 34% owner, after suffering massive and continuing operating losses and further projected losses from primary aluminum and rolling mill operations, became the first major aluminum industry casualty when it filed for reorganization under Chapter 11 of the Federal Bankruptcy Code.

Beryllium.—Brush Wellman, the Western World's only integrated producer of

beryllium, continued to produce beryllium alloys, metallic beryllium, and beryllia ceramics, as well as high-energy friction materials and long-wearing cutting edges, at its Elmore plant. Beryllium hydroxide, which is the feed material for each of Brush Wellman's product lines, is produced at its extraction plant near Delta, Utah.

Beryllium alloys (primarily beryllium copper) are produced in cast and wrought forms in several compositions, with about one-half of the product lines sold as thin strip, but also wire, rod, tube, bar, and plate. Beryllium alloys offer a combination of properties, such as electrical and thermal conductivity, strength, hardness, corrosion resistance, fatigue resistance, and formability. Metallic beryllium offers light weight and stiffness, the ability to absorb large quantities of heat, plus special nuclear properties. Beryllia ceramics conduct heat in combination with its electric insulating properties.

In September, Brush Wellman approved a $13 million modernization and expansion of its wire, tube, and rod manufacturing capabilty. Metallic beryllium is produced at the company's Elmore facility. This plant is the sole domestic production facility for this strategic metal. About 90% of the metal was consumed for aerospace and national defense. DOE awarded a $3.4 million research and development contract to Brush Wellman with the objective of ensuring uninterrupted availability of highest-quality beryllium. Beryllia is fabricated and fired to produce ceramic materials.

In December, Brush Wellman entered the specialty clad metals business when it acquired for approximately $46 million the operating assets of Technical Materials Inc., a leading producer of inlaid metals. These materials offer superior performance and elimination of processing steps, as well as savings in precious metals required for high-technology components in electrical, electronic, telecommunications, and semiconductor applications.

Also in the year, Brush Wellman signed an agreement with Kaigai Kinzoku Sangyo to form a joint marketing venture in Japan. The new company, Brush Wellman (Japan) Ltd., will sell and market beryllium-containing alloy products produced by Brush Wellman in the United States.

Brush Wellman experienced relatively strong demand from defense-related markets and computer and telecommunications markets in 1982. Sales of metallic beryllium were significantly higher than those of 1981, as were sales of friction disks for military tank transmissions and beryllia ceramics used extensively in high-reliability defense electronic systems.

Ferroalloys.—Although total domestic production in 1982 was down sharply by 46% from the low levels of 1981, Ohio continued to lead the Nation in ferroalloys shipments from domestic producers. The State accounted for 38% of the Nation's total shipments in what constituted the industry's most dismal year since 1939. This decline was due primarily to weak demand by the steel and ferrous foundry industries, which account for about 90% of all ferroalloys consumption end uses; weak demand by the aluminum and chemical industries for silicon metal; and intense competition from low-priced imports.

Within Ohio's ferroalloys industry, there was one plant closure and several production shutdowns and cutbacks.

Elkem Metals Co. continued to produce a full line of silicon products at its Ashtabula plant and a full line of manganese products at its Marietta plant, although at sharply reduced rates. In October, the Marietta plant was operating at 15% of capacity. The company became the only current U.S. producer of standard-grade ferromanganese.

Globe Metallurgical Div. of Interlake Inc., halted production of ferrochromium, ferrosilicon, and silicon metal at its Beverly plant in early November and laid off 190 workers. The plant had been operating at one-half capacity throughout the year. Globe acquired its first long-term lease to mine deposits of quartzite, the basic raw material to produce silicon ferroalloys and silicon metal, from properties in Autauga County, Ala. Initial annual production, which began in late 1982, is expected to total 100,000 tons of gravel. That output is expected to meet the needs of the nearby Selma, Ala., plant and a portion of the requirements of the Beverly plant.

Ohio Ferro-Alloys Corp. continued to be plagued by financial losses, which totaled $20.3 million in 1982. Ohio's four silicon furnaces at Powhatan Point have been shut down since November 1981. The company's Philo plant produced no high-carbon ferromanganese in the two furnaces, and the ferrosilicon furnaces operated at less than 25% capacity.

Satralloy Inc. Div. of Satra Corp. at Steubenville, closed its ferrochromium and

ferrochromium-silicon plant in early November and laid off 200 workers. The plant had been running at 25% of its 96,000-ton-per-year capacity.

Table 9.—Producers of ferroalloys in Ohio in 1982

Producer	Plant location	Products[1]	Type of furnace
Elkem AS, Elkem Metals Co	Ashtabula	Cr, FeCr, FeMn, FeSi, SiMn, Mn, other.[2]	Electric and electrolytic.
	Marietta	do	Do.
Foote Mineral Co., Ferroalloys Div	Cambridge	FeV and other[2]	Electric.
Interlake Inc., Globe Metallurgical Div.	Beverly	FeCr, FeCrSi, FeSi, Si, SiMn.	Do.
Ohio Ferro-Alloys Corp	Philo	FeMn, FeSi, Si, SiMn.	Do.
	Powhatan Point	do	Do.
The Pesses Co	Newton Falls	FeAl, FeB, FeCb, FeMo, FeNi, FeTi, FeW, other.[2]	Electric and metallothermic.
	Solon	do	Do.
Satra Corp., Satralloy Inc. Div	Steubenville	FeCr	Electric.
Union Carbide Corp., Metal Div	Marietta	FeV	Do.

[1]Cr, chromium metal; FeAl, ferroaluminum; FeB, ferroboron; FeCb, ferrocolumbium; FeCr, ferrochromium; FeCrSi, ferrochromium-silicon; FeMn, ferromanganese; FeMo, ferromolybdenum; FeNi, ferronickel; FeSi, ferrosilicon; FeTi, ferrotitanium; FeV, ferrovanadium; FeW, ferrotungsten; Mn, manganese metal; Si, silicon metal; SiMn, silicomanganese.
[2]Includes specialty silicon alloys, zirconium alloys, and miscellaneous ferroalloys.

Iron Oxide Pigments (Synthetic).—In 1982, shipments of finished iron oxide pigments fell 28% to 6,603 tons, while value increased 7% to $5.7 million compared with that of 1981.

The Hilton-Davis Chemical Co., a division of Sterling Drug Inc. at Cincinnati, continued to produce industrial flushed and dry colors. These products included iron oxide and other pigments, dyestuffs, optical brighteners, organic intermediates, and special chemicals.

The Ottawa Chemical Div. of Ferro Corp. at Toledo produced ferrite powder. This magnetic iron oxide material was used in audio speakers; permanent magnet motors for the various small automotive, direct-current motors; and magnetic sealing strips and weather stripping.

In December, a major producer completed construction of a hydrogen chloride regenerator oxide facility for Republic Steel in Warren.

Iron and Steel.—Pig iron and raw steel production in Ohio, like that of the Nation, dropped to the lowest level since 1946 because of the recession and the weak world steel market. In December, coincident with the bottoming out of the 1981-82 recession, the domestic steel industry operated at one-third of capacity. The rate of domestic raw steel capability utilization, which had averaged 78.3% in 1981, fell to 48.4% in 1982.

In 1982, Ohio ranked second in the production, shipment, and consumption of pig iron behind Indiana and ahead of Pennsylvania, which relinquished the No. 2 ranking. Production and shipments fell 33% to 7.9 million tons in 1982, which was 18% of total U.S. production, while consumption fell to 8.1 million tons. Raw steel production in Ohio dropped 32% to 12.2 million tons in 1982, which was 16% of the total U.S. production of carbon, stainless, and all other alloy steel.

Ohio's blast furnaces consumed 66,000 tons of domestic and 1.6 million tons of imported iron and manganiferous ores, 11.6 million tons of agglomerates, 321,000 tons of ferrous scrap, 4.2 million tons of coke, and 726,000 tons of fluxes to produce 7.9 million tons of pig iron. The pig iron, which was not cast directly from blast furnace hot metal into ingots, was consumed in steel furnaces along with ferrous scrap, ferroalloys, and iron ore and agglomerates to produce 12.2 million tons of raw steel. During the year, 10 of 21 operating blast furnaces were down for more than 180 days, and 2 were shut down completely.

The structure of Ohio's steel industry changed rapidly during 1982. Major steel companies reported net losses of billions of dollars. Smaller companies went bankrupt, many major steel mills closed, some were shut down indefinitely, while others changed ownership.

The Economic Development Administration (EDA), U.S. Department of Commerce, froze the assets of Youngstown Steel Co., forcing the shutdown of the company's rail spike plant in Struthers. The company had

been formed about 2 years earlier with the assistance of $14 million in EDA loans. The company was building an electric furnace and a continuous caster, which were due to start up later in the year. The plant is now being operated by L. B. Foster Co. of Pittsburgh, Pa., and Youngstown Steel is currently being used by the U.S. Department of Justice.

United States Steel leased a portion of its former McDonald Works in Youngstown, which was closed in 1979, to a group that formed McDonald Steel Corp., which began producing bar products in special shapes. In April, four Ohio Works blast furnaces were removed to allow room for a new industrial park at the former United States Steel facility in Youngstown. United States Steel had closed the Ohio Works furnaces in June 1980. There were at one time about 30 blast furnaces operating in the area. In 1982, 11 remained, 5 of which were in operating condition and only 2 actually making iron.

Republic Steel resumed primary steel operations in January at its Warren plant to replenish inventories of unfinished steel, resulting in the recall of 450 workers. Operating levels were determined on a week-to-week basis. In November, 440 workers in Warren were laid off indefinitely. By yearend, Republic Steel indefinitely suspended production at its bar mill in Cleveland. The closing was to enable the company to utilize more efficiently the bar-producing capacity at its Canton plant. Prior to the closing, more than 1,000 workers out of a work force of 6,500 already had been laid off at the Cleveland facilities, which include the bar mill, coke ovens, blast furnace operations, and strip mills. Republic Steel also closed one of its two blast furnaces in Cleveland, leaving only one in operation. Previously, the company had idled its blast furnaces in Youngstown and Warren. However, Republic Steel was still operating electric arc furnaces in Canton and BOF in Cleveland. In December, Republic Steel closed its coke production plant in Youngstown. The company, which had a total of 39,000 employees at the beginning of the year, laid off 14,000, and an additional 4,000 workers were on short workweeks.

Armco Inc., Middletown, at yearend had more than 32% of its specialty steel work force on layoff. Armco also closed its coke plant in New Miami.

The Erie Coke & Chemical Co. of Fairport Harbor, a producer of foundry coke, halted production indefinitely and stopped deliveries in October because of weak demand by metal producers. Erie Coke, a noncaptive operation, produced about 150,000 tons annually for customers within a 200-mile radius.

Because of financial constraints and uncertain future demand, United States Steel delayed its continuous caster project at the Lorain-Cuyahoga Works. Timken continued construction of its $500 million electric-furnace steel plant near Canton but delayed completion for 6 months until the fall of 1985. Grants totaling $3.1 million were approved by the State Controlling Board for Timken in a move to create 1,400 jobs in Canton. The Ohio Department of Economic and Community Development said the money would be used in the company's plans to build the new $500 million steel mill. However, Copperweld Steel Corp. of Warren announced it would spend $33 million in the next 2 years to expand and modernize its plant. The project would increase shipping capacity by 15% and increase its 21-inch bar mill capacity by 25%. Also slated for expansion was the thermal-treating facility, the largest in the industry, with the addition of four furnaces.

Titanium.—RMI Co., the Nation's second largest integrated titanium producer, produced titanium sponge at its Ashtabula plant and processed the sponge into semifinished and finished mill products at its Niles plant. The lightweight, high-strength, corrosion-resistant metal is used in jet engines, airframes, and space and missile applications; in the chemical-processing industry, power generation, and marine and ordnance applications; and in steel and other alloys.

RMI purchases its raw material, titanium tetrachloride (commonly known as "tickel"), from Gulf + Western Industries Inc., Ashtabula, by way of pipeline for its production of sponge. Tickel is an intermediate product produced after the processing of rutile, the major raw material for titanium metal production. Titanium sponge is produced after reduction of tickel with sodium. The Gulf + Western plant receives its raw materials at the Pinney Dock on Lake Erie at Ashtabula Harbor for the production of titanium dioxide and titanium tetrachloride, which are marketed nationwide. Raw materials include imported rutile concentrate, synthetic rutile, and some iron-titanium slag.

In 1982, RMI sales plunged 32% to $178.9 million, compared with $264.9 million in

1981, its record-breaking year. The bottom fell out of the titanium market following the best first quarter in RMI history, primarily because the recession-hit airlines stopped ordering new airplanes and canceled or stretched out orders. The volatile nature of some titanium-heavy Government projects, such as the B-1 bomber, was contributary. Aerospace needs (one-half civilian and one-half military) account for at least 60% of RMI sales.

RMI, which had been operating at 100% capacity since May 1977, reduced production by 50% in the second quarter at both the Ashtabula sponge plant and the Niles melt shop and rolling mill. Production levels remained below 50% throughout the year. RMI is the fifth largest industrial employer in Trumbull County, with more than 1,000 workers at its headquarters and plant in Niles. The company's sponge capacity of 9,500 tons per year and ingot capacity of 12,000 tons per year represents 28% and 23%, respectively of total U.S. capacity.

In 1982, RMI began operating a new forging press, an evaporator plant, and a chemical cleaning facility. In mid-1983, the company expects to begin initial operation of a modern vacuum arc electric furnace. The new $20 million melt shop in Niles, a part of the company's $50 million modernization program started in 1979, was expected to increase ingot capacity by 20% and allow the company to melt 50,000-pound ingots, twice its current ingot size.

United States Steel and National Distillers & Chemical Corp., equal co-owners of RMI, placed the company up for sale at midyear. At yearend, they were still committed to a sale. Initially, the asking price for RMI was about $550 million, but the price reportedly was dropped to $300 million because of the current weak demand for titanium.

TIMET, a division of Titanium Metals Corp. of America, manufactured titanium mill products at its rolling mill in Toronto, Ohio, from ingots produced at its Henderson, Nev., plant. TIMET is not only the leading titanium producer but also the only integrated domestic producer of titanium that also produces titanium tetrachloride. Late March marked the first time that TIMET reduced its production and work force.

The SCM Corp. Glidden Pigments Group and the Gulf + Western Natural Resources Group, Chemicals Div., both in Ashtabula, produced titanium dioxide pigments by the chloride process. These white pigments are used primarily by the paint industry, and in plastics, paper, rubber, and ceramics.

Zinc Oxide.—Production of zinc oxide at the ASARCO Incorporated plant at Columbus totaled 13,800 tons (metal content), up 17% from that of 1981. The plant operated at 58% of capacity producing both American- and French-process zinc oxide. Zinc concentrates used in the American process were shipped from four captive mines in Tennessee: Young, New Market, Immel, and Coy. Refined zinc used in the French process was shipped from the Asarco refinery at Corpus Christi, Tex., and imported from Canada. The two Asarco plants at Columbus and Hillsboro, Ill., were operated at a combined capacity of less than one-half owing to depressed demand by the rubber and paint industries. Production amounted to 20,900 tons, 28% less than that of 1981.

Zirconium.—Seven companies in Ohio produced zirconium materials in 1982. End uses included foundry sand, refractory sand, abrasives, ceramics, high-temperature alloys, and zircon-titanium dioxide blends for welding-rod coatings.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.

Table 10.—Producers of zirconium in Ohio in 1982

Company	Location	Materials
Continental Mineral Processing Corp	Sharonville	Milled zircon.
Didier-Taylor Refractories Corp	Cincinnati	Refractories.
Ferro Corp	Cleveland	Ceramics and ceramic colors.
Foote Mineral Co	Cambridge	Alloys.
Lincoln Electric Co. Inc	Cleveland	Welding rods.
Sherwood Refractories Co	do	Zircon cores.
ZIRCOA Products	do	Oxide and ceramics.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives (natural):			
Cleveland Quarries Co.[1]	Amherst, OH 44001	Quarry	Lorain.
Aluminum (primary):			
Ormet Corp	Box 176 Hannibal, OH 43931	Plant	Monroe.
Beryllium:			
Brush-Wellman Inc	R.D. 1 Elmore, OH 43416	do	Ottawa.
Cement:			
Columbia Cement Corp.[2 3]	Box 1531 Zanesville, OH 43701	do	Muskingum.
General Portland Inc.[2 3]	Box 109 Paulding, OH 45879	do	Paulding.
Marquette Co.[3]	Box 8 Pedro, OH 45659	do	Lawrence.
SME Cement Inc.[2 3]	Box 1187 Uniontown, PA 15401	do	Stark and Lucas.
Southwestern Portland Cement Co.[2 3]	Box 191 Fairborn, OH 45324	do	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. Oak Hill, OH 45656	Pits	Jackson.
Ferroalloys:			
Elkem Metals Co.[4]	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	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, Rt. 7 Rd. Four St. Marietta, OH 45750	do	Washington.
Graphite (synthetic):			
Union Carbide Corp	Box J Fostoria, OH 44830	do	Seneca.
Gypsum:			
Celotex Corp.[5]	320 South Wayne Ave. Cincinnati, OH 45215	Pit and plant	Ottawa.
National Gypsum Co.[5]	1901 Henderson Dr. Lorain, OH 44052	Plant	Lorain.
United States Gypsum Co.[2 4]	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	Box 37869 Cincinnati, OH 45222	do	Hamilton.
Iron and steel:			
Armco Inc., Advanced Materials Div	1724 Linden Ave. Zanesville, OH 43701	Mill	Muskingum.
Armco Inc., Marion Works	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	1040 Pine Ave. Warren, OH 44481	do	Trumbull.
Republic Steel Corp.[4]	Box 700 Canton, OH 44701	do	Stark.
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.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lime:			
J. E. Baker Co	3964 Country Rd. 41 Millersville, OH 43448	Plant and quarry	Sandusky.
Cuyahoga Lime Co	1002 Belt Line Rd. Cleveland, OH 44109	____do ____	Cuyahoga.
Huron Lime Co	Box 451, 100 Meeker Huron, OH 44839	____do ____	Erie.
Martin Marietta Corp	755 Lime Rd. Woodsville, OH 43469	____do ____	Sandusky.
Ohio Lime Co	128 East Main St. Woodsville, OH 43469	Plants and quarries.	Do.
Pfizer Inc	Box F Gibsonburg, OH 43431	Plant and quarry	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.[6]	320 South Wayne Ave. Cincinnati, OH 45215	Plant	Hamilton.
Cleveland Builders Supply Co.[7]	2100 West 3d St. Cleveland, OH 44113	____do ____	Cuyahoga.
Quartz crystal (synthetic):			
Sawyer Research Products Inc	35400 Lakeland Blvd. Eastlake, OH 44094	____do ____	Lake.
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.[2]	Drawer 160 Greenville, OH 45331	Pits and plants	Champaign, Clark, Darke, Franklin, Green, Licking.
American Materials Co.[2 8]	Box 291 Hamilton, OH 45012	Wells and plants	Butler and Hamilton.
Ohio Gravel Co., Div. of Dravo Corp.	5253 Wooster Rd. Cincinnati, OH 45226	____do ____	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.
Stone:			
Crushed:			
American Aggregate Corp	Garst Ave. Greenville, OH 45331	Quarries and plants.	Clark, Fayette, Franklin, Greene, Montgomery, Warren.
The France Stone Co	Box 1928 Toledo, OH 43603	Quarries and plant	Lucas, Sandusky, Seneca, Wood.
National Lime & Stone Co.[4]	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	____do ____	Erie.
Dimension:			
Briar Hill Stone Co	Box 148, State Route 520 Glenmont, OH 44628	Quarry and plant	Holmes.
Cleveland Quarries Co.[3]	Quarry Rd. Amherst, OH 44001	Quarries and plants.	Erie and Lorain.
Waller Bros. Stone Quarry Co	134 County Rd. McDermont, OH 45652	Quarries and plant	Scioto.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sulfur (recovered):			
Standard Oil Co. of Ohio	1750 Midland Bldg. Cleveland, OH 44115	Refinery	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.
Vermiculite (exfoliated):			
Cleveland Gypsum Co., a division of Cleveland Builders Supply Co.	2100 West 3d St. Cleveland, OH 44113	do	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]Also dimension stone.
[2]Also crushed stone.
[3]Also clays.
[4]Also lime.
[5]Also expanded perlite.
[6]Also gypsum.
[7]Also exfoliated vermiculite.
[8]Also slag.

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 Albert E. Ward[1]

Total value of nonfuel minerals in Oklahoma was $225 million in 1982, down somewhat from that of 1981. Oklahoma continues to be the Nation's leading iodine producer. Basic construction materials again comprised the bulk of output value; topping the production list, in order of value, were cement, stone, and sand and gravel, unchanged from that of 1981.

The Center for Economic and Management Research at the University of Oklahoma, the U.S. Department of Commerce, and the U.S. Department of Labor reported that economic indicators for Oklahoma generally remained significantly more favorable than nationwide figures. Through the March quarter of 1982, strong oil and gas activity had shielded the State from the national economic downturn. However, collapse of this activity in the second quarter precipitated a rapid deterioration in business conditions throughout most of the State.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	838	$2,064	752	$1,907
Gem stones		NA	2	NA	2
Gypsum	thousand short tons	1,177	9,870	1,254	10,089
Helium:					
Grade-A	million cubic feet	49	1,274	--	--
Crude	do.	22	264	--	--
Pumice	thousand short tons	1	W	1	W
Sand and gravel:					
Construction	do.	e9,000	e21,700	7,490	17,733
Industrial	do.	1,500	14,317	1,222	13,114
Stone:					
Crushed	do.	29,930	83,407	p30,100	p84,200
Dimension	do.	18	738	p18	p968
Combined value of cement, feldspar, iodine, lime, salt, tripoli, and values indicated by symbol W		XX	100,876	XX	97,031
Total		XX	r234,512	XX	225,044

eEstimated. pPreliminary. 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 Oklahoma, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Adair	W	(3)	
Alfalfa	W	(3)	
Atoka	$2,676	W	Stone (crushed).
Beaver	W	W	Pumice.
Blaine	W	W	Gypsum.
Bryan	W	W	Stone (crushed).
Caddo	W	W	Gypsum, stone (crushed).
Canadian	W	W	Clays.
Carter	--	W	Stone (crushed).
Cherokee	W	W	Do.
Choctaw	4,642	$2,536	Do.
Cimarron	8,303	1,538	Helium.
Cleveland	1,501	(3)	
Coal	W	W	Stone (crushed).
Comanche	W	W	Stone (crushed), gypsum.
Cotton	1,360	(3)	
Craig	673	W	Stone (crushed).
Creek	W	W	Stone (crushed), clays.
Custer	W	W	Clays.
Garvin	W	(3)	
Greer	W	W	Clays, stone (dimension).
Harmon	W	W	Salt.
Haskell	W	360	Stone (crushed).
Hughes	W	(3)	
Jackson	W	W	Gypsum.
Johnston	W	W	Sand and gravel (industrial), stone (crushed), stone (dimension).
Kay	W	W	Stone (crushed).
Kingfisher	W	(3)	
Kiowa	W	W	Stone (crushed), stone (dimension).
Le Flore	W	W	Stone (dimension), clays.
Logan	419	(3)	
McClain	1,154	(3)	
McCurtain	W	1,342	Stone (crushed).
McIntosh	W	W	Do.
Major	W	W	Do.
Marshall	--	W	Do.
Mayes	W	W	Cement, stone (crushed), clays.
Murray	W	13,248	Stone (crushed).
Muskogee	W	W	Sand and gravel (industrial), feldspar.
Noble	--	W	Stone (crushed).
Nowata	W	--	
Oklahoma	W	W	Clays.
Okmulgee	W	W	Stone (crushed).
Osage	1,405	1,280	Do.
Ottawa	W	W	Tripoli, stone (crushed).
Pawnee	1,157	1,364	Stone (crushed).
Payne	W	665	Do.
Pittsburg	1,758	W	Do.
Pontotoc	W	W	Cement, stone (crushed), sand and gravel, clays, stone (dimension).
Pottawatomie	W	(3)	
Pushmataha	W	(3)	
Rogers	W	W	Cement, stone (crushed), clays.
Seminole	W	W	Stone (crushed), clays.
Sequoyah	W	W	Lime, stone (crushed).
Stephens	W	(3)	
Texas	W	(3)	
Tillman	W	(3)	
Tulsa	13,220	7,564	Stone (crushed).
Wagoner	877	(3)	
Washington	W	W	Stone (crushed).
Woodward	W	W	Iodine.
Undistributed[4]	184,987	182,916	
Sand and gravel (construction)	XX	e21,700	
Total[5]	224,133	234,512	

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

[1]Beckham, Delaware, Dewey, Ellis, Garfield, Grady, Grant, Harper, Jefferson, Latimer, Lincoln, Love, Okfuskee, Roger Mills, Washita, and Woods Counties are not listed because no nonfuel mineral production was reported.

[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 are not available by county.

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

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

Table 3.—Indicators of Oklahoma business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,446.0	1,468.0	+1.5
Unemployment	do	52.0	83.0	+59.6
Employment (nonagricultural):				
Mining[1]	do	100.1	108.0	+7.9
Manufacturing	do	200.2	183.6	-8.3
Contract construction	do	54.7	56.8	+3.8
Transportation and public utilities	do	70.2	71.2	+1.4
Wholesale and retail trade	do	277.3	294.7	+6.3
Finance, insurance, real estate	do	58.8	61.5	+4.6
Services	do	204.5	218.6	+6.9
Government	do	235.7	237.8	+.9
Total nonagricultural employment[1]	do	1,201.5	1,232.2	+2.6
Personal income:				
Total	millions	$31,753	$34,233	+7.8
Per capita		$10,241	$10,766	+5.1
Construction activity:				
Number of private and public residential units authorized		15,283	28,178	+84.4
Value of nonresidential construction	millions	$1,000.0	$727.5	-27.3
Value of State road contract awards	do	$109.1	$179.1	+64.2
Shipments of portland and masonry cement to and within the State	thousand short tons	1,882	1,912	+1.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$234.5	$225.0	-4.0
Value per capita, resident population		$78	$71	-9.0
Value per square mile		$3,384	$3,219	-4.9

[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.

Unemployment rose to 5.7% in 1982, up from 3.7% in 1981, reversing a long-term downtrend in this bellwether statistic. Manufacturing unemployment, largely related to oilfield equipment, was the principal cause of this increase. Employment in oil and gas production was off about 10%. Employment in the mining industries, other than in oil and gas, was about 3,000. Approximately one-half of this number was employed in nonfuel mines; the other one-half was employed in coal mines.

Trends and Developments.—In recent years, Oklahoma has made substantial progress to assure an adequate water supply for future agriculture, industry, and mineral resource developments. The Oklahoma Comprehensive Water Plan, completed and published in 1981, was approved by the legislature. Water Use Data System, a comprehensive computer inventory of State water-use information initiated in 1979, was completed in 1982. Oklahoma participated in the High Plains Ogallala Aquifer Study, also begun in 1979 and completed in 1982. Geohydrologic investigations of the State's 14 major ground water basins were completed in 1982. Oklahoma was the first State to implement fully the Basic Water Monitoring Program for ongoing monitoring of toxic materials in surface waters, and first to activate an Underground Injection Control Plan for protecting and managing ground water in the State's 129 aquifers. Most Oklahoma communities and private citizens use ground water as their sole source of water.

In land conservation, cooperative procedures have been established between State and private landowners and the petroleum industry for reclaiming land disturbed by drilling activities. The Oklahoma Conservation Commission developed and activated the statewide plan for reclaiming abandoned mine lands. The Federal tax on coal production will provide the State with funds to reclaim upwards of 30,000 acres.

Oklahoma received a $2.21 million payment in mineral-leasing receipts for 1982 from the U.S. Bureau of Land Management, essentially unchanged from the $2.23 million received in 1981. The receipts represent one-half of all mineral-leasing rents, royalties, and bonuses collected within the State by the Federal Government. The other one-half is returned to the U. S. Department of the Treasury. High biannual payments the last half of 1981 and first half of 1982

indicate the timing of the latest peak in oil and gas exploration in the State.

To improve plant efficiency and product quality, George E. Failing Co., wholly owned by Consolidated Gold Fields PLC, added 38,000 square feet to its drilling-rig manufacturing facilities in Enid. Annually, Failing builds 250 to 275 portable drilling rigs and vibrators marketed in more than 100 countries.

Prestressed Concrete Inc. of Newton, Kans., announced plans to construct a three-building plant in Stillwater to manufacture prestressed bridge beams and building supplies. Financed by revenue bonds issued by the Payne County Industrial Authority, the $1.8 million project will employ 150 workers when the three-stage construction is completed in 3 years.

Smith-Gruner Mining and Industrial Products, a division of Smith International Inc., expanded its rotary drilling-bit manufacturing plant in Ponca City. The expansion was designed to increase productivity and to allow for manufacturing 17-inch-diameter bits, up from the previous 15-inch size.

Exploration Activities.—Owing to depressed mineral prices, no known exploration projects were in progress in the State during 1982. The Oklahoma Geological Survey published a report on copper deposits in the Oklahoma panhandle and began a study of analogous silver deposits in the State, scheduled to be completed in 1984.

Legislation and Government Programs.—The Oklahoma legislature revised underground mining laws in 1977 and gave the State Mining Board authority to write rules and regulations as mining changes developed. In 1982, the Board drafted initial new rules and regulations that reflected recent advances in mining technology; these new codes were to be available for approval in early 1983. The new rules dealt with health and safety, ventilation, mine-shaft development, electrical wiring, and transportation of mine employees. The revised underground mining law reduced the number of legal sections from 407 to 15 and spelled out the intent of the law. Many of the eliminated sections, written one-half century and more ago, had become obsolete because of advances in mining technology. The underground mining law largely was directed at coal mining in the State; however, many sections would apply to future noncoal underground mining operations. All undergound coal mines were closed in Oklahoma during 1982. Thicker, near-surface coal seams increasingly are beyond economic limits of strip mining; therefore, mining authorities in the State recognized the timely need to update the mining law for the forthcoming increase in underground coal mining, and for possible future underground mining of metallic and nonmetallic minerals.

The U.S. Geological Survey completed mapping 10,000 square kilometers of the Oklahoma part of a study entitled "Geologic Framework of the Ouachita Mountains, Arkansas-Oklahoma." Plans called for completing the project in 1985. The Survey published a seismicity map for the State, identified as "U.S. Geological Survey Miscellaneous Field Studies Map MF-1352," with a scale of 1:1,000,000 and reprinted the Geologic Map of Oklahoma, first printed in 1954. Cambrian and lower Ordovician lithostratigraphy and biostratigraphy of southern Oklahoma and central Texas were discussed in the Guidebook for Field Trip 3, International Symposium on the Cambrian System. The data are part of an ongoing survey assessing the use of biostratigraphic data for recognizing and correlating the Cambrian-Ordovician boundary in the Western United States.

Maps, which the Oklahoma Geological Survey compiled, showed the location and extent of past zinc-lead mining and the effects of subsidence and collapse of mine workings in the Oklahoma part of the Tri-State Mining District of northeast Oklahoma (Ottawa County). The Survey completed an inventory of all active and inactive surface mines in the State. In base metals activities, the Survey published three maps showing copper, lead, and zinc deposits in the Ouachita Mountains, and one map of the Southwest Davis Zinc Field in the Arbuckle Mountains.

In cooperation with the U.S. Geological Survey, the Oklahoma Geological Survey water resources program moved to the final stage of a nine-part series of hydrologic atlases for the State. Studies were completed on the Vamoosa-Ada aquifer in east-central Oklahoma and on the hydrology of the Arbuckle Mountains in southern Oklahoma.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—Best Barite Inc., a division of Blast Abrasives Inc., started up its third Oklahoma grinding plant at Cyril in Caddo County to serve the oil- and gas-drilling industry in the Anadarko Basin. Four grinding plants completed expansions or modifications in 1982; however, because of the sharp downturn in demand for drilling muds that accompanied the oil and gas glut during the year, no new major expansions or modifications were announced at any of the State's six facilities.

Cement.—Portland and masonry cement shipments declined about 5% in 1982 as continued high interest rates constrained the construction industry for the third consecutive year in most of Oklahoma. At yearend, portland cement stocks were up about one-quarter and masonry inventories were up one-sixth. The average price of portland cement was essentially unchanged in 1982, but the price of masonry rose almost 15%.

Statewide, the cement industry reversed its trend to coal for fuel, as natural gas use rose about 16% and coal use declined 8%. This reversal is partly explained by the flexibility natural gas fuel affords during curtailed and interrupted cement production. Fuel statistics also indicated a loss of efficiency because of plants operating well below capacity. Although most markets for portland cement declined moderately in 1982, demand from highway contractors almost doubled as sorely needed highway repairs and new highway projects were funded.

Clays.—Oklahoma produced only common clay or shale in 1982, the same as in 1981. Production continued to decline, off about one-tenth in 1982, and the average price continued its modest climb, up from $2.46 to $2.54. Housing and other construction markets for clay and shale products remained weak for most of the year. Nine companies produced clay or shale, down from 10 in 1981, from 11 mines in nine counties. Ideal Basic Industries Inc. was the leading producer in the State; output was used to supply its Pontotoc County cement plant.

Southwest Brick Co. opened a 5,000-square-foot plant near Claremore early in the year, and at yearend, was completing a 2,500-square-foot addition to accommodate an expanded product line. Southwest casts its brick using a clay aggregate consisting of selected grades of expanded shale. The company consumes only one-twentieth the energy to manufacture cast brick compared with ordinary fired brick. The cast brick has a high thermal quality and better fire rating in commercial construction; therefore, fire insurance companies view them favorably. Brick ingredients can be formulated, molded, and cured to American Society for Testing and Materials (ASTM) standards all within 24 hours. Output is primarily for commercial construction; however, the company plans to introduce a facing brick for home construction when the housing market improves.

Oklahoma Brick Corp. of Oklahoma City invested $2 million to extend its new kiln near Mounds and added equipment in the grinding room to blend raw materials.

Feldspar.—Arkhola Sand and Gravel Co. continued recovering feldspar-silica sands from the Arkansas River bed near Muskogee. Regional glass plants use the feldspar-silica mixture. Output declined about one-twelfth in 1982; however, price per short ton rose enough to permit the company to maintain its gross income essentially unchanged from that of 1981.

Gypsum.—Following 2 years of declining production in the State, crude gypsum output increased about 7% in 1982. Price per ton turned weak, however, easing down from $8.39 in 1981 to $8.05 in 1982. Five companies mined gypsum in four counties in 1982, unchanged from that of 1981.

Calcined gypsum output was essentially unchanged from that of 1980 and 1981; price per ton, however, was off sharply and fell below the 1980 price to more than lose the sharp increase in price gained in 1981. Two companies calcined gypsum in two counties, the same as in 1981.

Helium.—With the shutdown of the U.S. Bureau of Mines Keyes helium plant in Oklahoma in 1982, no crude helium was recovered and no high-purity helium was produced.

Iodine.—Oklahoma maintained its dominance in iodine production with more than three-fourths of the Nation's output in 1982, down from more than four-fifths in 1981. Owing to slack industrial demand for iodine throughout the year, output slipped about 10%; price, however, was firm and rose about 10%.

Woodward Iodine Operations, 51% owned by PPG Industries Inc. and 49% owned by Amoco Production Co., completed its seventh year of iodine recovery from brine in

the 7,500-foot-deep Pennsylvanian Morrowan Formation. Amoco manages the nine-well field, which yields about 2.5 million gallons of iodine-rich brine daily. Stripped brine is returned to the Morrowan through six reinjection wells to maintain pressure on the remaining iodine-bearing brine. Brine from the 15-well field enters the iodine recovery plant, which is operated by PPG with 20 employees. Iodine is marketed in 150-kilogram fiberboard drums that contain the flaked iodine in a sealed plastic bag within a heavy-duty, protective polypropylene bag.

In November, North American Brine Resources began recovering iodine in brines from oilfields in Kingfisher County to become Oklahoma's second commercial iodine facility. Brines will be processed through charcoal absorbers at three miniplants, and spent brine will be reinjected into the ground. The operation is a joint venture of Beard Oil Co. of Oklahoma City (40%) and two Japanese firms, Godoe Inc., a subsidiary of United Resources Industry Co. (50%), and Inorgchem Development Inc., a subsidiary of Mitsui & Co. (10%).

Lime.—St. Clair Lime Co. in Sequoyah County continued producing lime in 1982 but at a reduced rate, largely because of slack demand from the State's construction industry. Quantity produced was off about one-tenth, but price per ton held firm, essentially unchanged from that of 1981.

To achieve more internal kiln volume at its Marble City facility, St. Clair replaced the 9-inch refractory lining with 6-inch brick plus insulating backing on its No. 1 kiln and installed an improved drive train. The company also is making similar improvements on its No. 2 kiln, with completion scheduled for 1983. When completed, these changes will add 150 tons per day of quicklime output, increasing daily plant capacity to 500 tons.

Perlite.—Western Mining & Materials Ltd. broke ground in August for a $3.2 million perlite processing plant at a 9-acre industrial parksite in Wetumka, Hughes County. Completion of the project originally was expected by the spring of 1983; however, the project was delayed near yearend. Western Mining comprises Western Clay Products Inc., the general and operating partner, and the limited partners, Boron Resources Inc. and Aquila Corp. Perlite ore and clay will be mined and prepared for processing at the Okfuskee minesite, 6 miles northeast of Wetumka. The processing plant will also handle perlite ore imported from the Western United States. Western Clay has operated a clay facility since 1980 in Stroud, 40 miles northwest in Lincoln County. This operation will be moved to the Wetumka plant when its construction is completed. The plant will have two specially designed vertical furnaces for processing the perlite ore with space available for four additional furnaces in the future. Proven ore reserves are about 9 million tons, sufficient for about 85 years of operation with the initial two-furnace installation.

Pumice (Volcanic Ash).—Axtell Mining Corp. continued to mine volcanic ash, largely shards of volcanic glass mixed with lesser amounts of clay, feldspar, mica, quartz, and diatom fossils, from its Pleistocene age dry lakebed deposit near Gate, Beaver County. Output and value were about the same as that of 1981.

Salt.—Salt production increased sharply in 1982, but demand was down resulting in a significant increase in inventories. The State's salt is recovered from brines produced from the Permian Flowerpot Shale in Harmon County.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U. S. Bureau on Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. Construction sand and gravel output in Oklahoma declined again in 1982; construction markets were weak early in the year with some pickup in activity in the later months. Quantity produced was off about one-sixth from the revised 1981 figure and down about one-quarter from the 1978-79 cyclic peak. Among nonfuel minerals, the State's construction sand and gravel output continued to rank second in quantity to stone and third in value, behind stone and cement. Average value at $2.37 per ton was essentially unchanged from that of 1981.

Industrial.—Industrial sand and gravel output fell by almost one-fifth in 1982; however, the price was firm, moving up to $10.73 from $9.54 per ton in 1981.

Tar sands near Sulfur in Murray County, about 70 miles south of Oklahoma City, received renewed attention as a bitumen source. Tests showed a good-quality, residual grade-6 sand byproduct that, if marketable in large quantities for asphalt, ceramic, and glass uses, would enhance the present marginal economics of bitumen recovery.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	5,551	$13,515	$2.43
Gravel	NA	NA	NA	869	2,571	2.96
Sand and gravel (unprocessed)	NA	NA	NA	1,069	1,647	1.54
Total or average	e9,000	e$21,700	e$2.41	[1]7,490	17,733	2.37
Industrial sand	1,500	14,317	9.54	1,222	13,114	10.73
Grand total or average	e10,500	e36,017	e3.43	8,712	30,847	3.54

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

Table 5.—Oklahoma: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,175	$11,757	$2.82
Plaster and gunite sands	174	301	1.73
Concrete products	241	790	3.28
Asphaltic concrete	532	1,073	2.02
Road base and coverings	280	593	2.12
Fill	2,023	2,845	1.41
Snow and ice control	5	14	3.08
Other	61	360	5.92
Total or average	[1]7,490	17,733	2.37

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

Stone.—To reduce reporting burdens and costs, the U. S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Crushed.—Estimated crushed stone production inched up about 0.5% in 1982, and average value per ton was essentially unchanged. Based on estimated production data, Oklahoma ranked 9th among the 48 States that produced crushed stone in 1982, up from 14th place in 1981—an indication of the State's relative economic strength.

Dimension.—Dimension stone output declined about 2%, but average value per ton moved up to $54.31 in 1982 from $40.48 in 1981.

Tripoli.—Oklahoma retained its number two position nationally in tripoli output, with production again in the usual one-eighth to one-seventh range. Output rose about 12% in 1982, about the same as in 1981, as the level of production approached the recent peak output of 1979. Price also rose about one-eighth over that of 1981. The approximate 10% disparity between the price of tripoli in Oklahoma and the national average price that appeared in 1981 was halved in 1982 as the market value of tripoli in the State moved up to within 5% of the national average price. As in past years, raw tripoli was shipped to Seneca, Mo., and processed into fine-grained abrasives.

Vermiculite (Exfoliated).—Production of exfoliated vermiculite declined by about one-eighth at the Oklahoma City plant of W. R. Grace & Co. Price also eased downward slightly. Markets for various construction aggregate additives were weak, and demand for loose-fill insulation and for horticultural agriculture turned particularly weak in 1982. Block and loose-fill insulation took most of the output; concrete,

plaster, and roofing aggregates consumed about one-third of the vermiculite.

METALS

No metallic ore was mined in Oklahoma during 1982. Several metals were recovered from in-State smelters that used recycled materials from local and out-of-State sources and ore concentrates from out-of-State producers.

Iron Ore.—Oke-Iron Co. obtained a permit to mine brown iron ore in the Arbuckle Mountains near Scallin in Murray County, about 80 miles south-southeast of Oklahoma City.

The sharp decline in oil and gas drilling dampened foundry work in Oklahoma in 1982. Defense-related foundry work remained firm. Custom Engineering and Manufacturing Corp., a manufacturer of oil and gas industry equipment, initiated a $5 million expansion at its Tulsa plant. Also in Tulsa, Gear Products Inc., a manufacturer of oilfield, mining, and construction equipment, began a $263,000 expansion of its facility.

Vanadium.—The Bartlesville operation of Somex Ltd., a division of Phibro-Salomon Inc., was closed by a strike in the autumn. Somex recovered vanadium concentrates from oil-burning powerplant soot obtained from domestic and foreign sources.

Zinc-Lead.—National Zinc Co., a subsidiary of Phibro-Salomon, closed its Bartlesville custom smelter for 6 weeks in midyear; about 300 workers were affected. Closure was necessary because of excessive zinc stocks and continued soft demand of zinc. This shutdown was the first of this type in National Zinc's 75 years in Bartlesville. On November 1, workers struck National Zinc, the plant shut down, and the strike continued through yearend.

National Zinc's smelter is the only operating smelter in Oklahoma. It began as the Bartlesville Zinc Co. in 1907, the same year as Oklahoma statehood. It and two other smelters were built about the same time, and during the peak of mining activity in the early 1920's there were nine retort smelters operating in northeastern Oklahoma. Although the current smelter is electrolytic, earlier smelters were horizontal retorts. The reason for their concentration in this part of the State was the availability of zinc concentrates and abundant low-cost natural gas supplies.

Ore produced from the Picher Field (in Ottawa County, Okla.; Jasper County, Mo.; and Cherokee County, Kans.) during its 1904-70 67-year life span, was about 250 million tons. (Unrecorded mining of zinc ore from surface outcrops apparently occurred as early as 1891, and the earliest production records from the 1904-10 interval are incomplete.) Picher Field ores yielded concentrates containing about 7 million tons of zinc and 2 million tons of lead. The long-term ratio of zinc-to-lead metal in Picher ores generally ranged between 4 to 1 and 3 to 1, with richer lead values appearing early in the district's productive period and leaner lead values showing by the mid-1920's.

Ore production from the Picher Field peaked at 13.9 million tons in 1926, and recoverable zinc and lead in concentrate peaked at 387,000 and 100,000 tons, respectively, in 1925.

Reworking of tailings began to reach significant proportions of the total material processed in the middle 1920's. In 1925, almost 1 million tons of tailings were retreated and this activity increased to approximately 10 million tons in 1944. Nearly 100 million tons of tailings were re-treated from 1925 through 1947. The tonnage of retreated ores exceeded the tonnage of mined ores treated each year from 1934 to 1947.

Mining ceased in 1970, but there remain some post mine problems such as open mine shafts, mine collapse areas, and metal-contaminated mine waters. In a U. S. Bureau of Mines contract study entitled "A Study of Stability Problems and Hazard Evaluation of the Oklahoma Portion of the Tri-State Mining Area," by the Oklahoma Geological Survey, it has been pointed out that there are approximately 2,540 acres of land underlain by underground lead-zinc mines in Oklahoma. There are 481 mine shafts that remain open in various stages of collapse, 52 mine collapse features, and 2,900 acres covered by mine and mill wastes. In 1980, there was an estimated 45 million cubic yards of salable chat for use as highway construction, railroad ballast, etc., remaining in 33 major chat piles.

When mining ceased and pumps were shut off, the mines began to fill with water. A study of the water quality of the mine waters in the Picher area was carried out from September 1975 to June 1977 by the U.S. Geological Survey, Water Resources Division, in cooperation with the Oklahoma Geological Survey. This study indicated that the waters were unfit for municipal and industrial use owing to the highly variable pH and high metal content. The study forecast that the mines would fill

with water by 1980; in late 1979, the mines had indeed filled, and contaminated water began flowing from mine workings into Tar Creek at the south end of the field.

In November 1981, the U.S. Environmental Protection Agency (EPA) identified the Tar Creek area as the most hazardous waste site in the Nation. This negative classification gave added emphasis to ongoing investigations in the area and triggered additional efforts in early 1982 to correct the pollution problem and to protect the Roubidoux Formation, an underlying aquifer that serves as a source of water supply in much of the Tri-State district. Since 1978, more than $700,000 has been expended studying Tar Creek, and estimates to clean up the area now range up to $40 million. Initial attempts to seal some mine workings were begun in 1982; a number of corrective measures are expected to be initiated in 1983, with funding foreseen from customary EPA sources as well as from the newly enacted EPA Superfund.

[1]State Liaison Officer, Bureau of Mines, Denver, Colo.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ideal Basic Industries Inc., Ideal Cement Co.[1 2]	Box 8789 Denver, CO 80201	Quarry and plant	Pontotoc.
Lone Star Industries Inc.[1 2]	Box 68 Pryor, OK 74361	do	Mayes.
Martin Marietta Cement Western Div.[1 2]	5350 East 46th St. Tulsa, OK 74135	do	Rogers.
Clays:			
Chandler Materials Co	5805 East 15th St. Tulsa, OK 74102	Mines and plants	Oklahoma and Rogers.
Commercial Brick Corp	Box 1382 Wewoka, OK 74884	Mine and plant	Seminole.
W. S. Dickey Clay Manufacturing Co	Box 6 Pittsburg, KS 66762	Mine	Le Flore.
Justin Industries Acme Brick Co	Box 425 Fort Worth, TX 76101	Mines and plants	Canadian, Custer, Oklahoma, Tulsa.
Mangum Brick Co	Box 296 Mangum, OK 73554	Mine and plant	Greer.
Oklahoma Brick Corp	Box 75368 Oklahoma City, OK 73147	do	Canadian.
Feldspar:			
Ashland Oil Co.-Arkhola Sand and Gravel Co.[2 3]	Box 1627 Fort Smith, AR 72902	Dredge and plant	Muskogee.
Gypsum:			
Harrison Gypsum Co., Inc	Box 336 Lindsay, OK 73052	Quarry	Caddo.
Republic Gypsum Co	Box 750 Dallas, TX 75221	Quarry and plant	Jackson.
Temple Gypsum	Box 768 Irving, TX 75060	Quarry	Comanche.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	Quarry and plant	Blaine.
Iodine:			
North American Brine Resources	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	Plant and quarry	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:			
The Dolese Co	13 NW. 13th St. 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	do	Oklahoma.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
McMichael Concrete Co.[2]	Box 3878 Tulsa, OK 74102	Pit and plant	Tulsa.
Mohawk Rock and Sand Co	Box 640 Sand Springs, OK 74063	do	Do.
Pennsylvania Glass Sand Corp., Oklahoma Works.	Box 187 Berkley Springs, WV 25411	do	Johnston.
Shoffner Sand of Oklahoma Inc	Box 863 Edmond, OK 73034	do	Oklahoma.
Stone:			
Anchor Stone Co.[3]	Box 6130 Tulsa, OK 74106	Quarry	Tulsa.
Ashland Oil Co.-Standard Industries Inc.	Box 15670, Admiral Sta. Tulsa, OK 74112	Quarries	Kay, Osage, Tulsa.
Delta Mining Corp	Box 85 Mill Creek, OK 74856	Quarry	Johnston.
Dolese Bros. Co	Box 677 Oklahoma City, OK 73101	Quarries	Atoka, Caddo, Carter, Coal, Comanche, Kiowa, Murray, Seminole.
Eagle-Picher Industries Inc	Box 910 Miami, OK 74354	Rock waste recovery.	Ottawa.
Hallett Construction Co	Box 13 Boone, IA 50036	Quarry	Murray.
Lattimore Industries Inc	Box 1186 Denison, TX 75020	do	Bryan.
The Quapaw Co.[1]	Box 72 Drumright, OK 74030	do	Creek.
Tulsa Rock Co	Box 3878 Tulsa, OK 74102	do	Rogers.
Willis Granite Co	Box 188 Granite, OK 73547	Quarry and plant	Greer.
H. D. Youngman, Contractor	Box 647 Eufaula, OK 74432	Quarries and plants	Choctaw and McIntosh.
Tripoli:			
The Carborundum Co	Box 489 Seneca, MO 64865	Pits	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]

Oregon's nonfuel mineral production was valued at $108 million in 1982, a decline of 23% from that of 1981. Nonmetals accounted for 97% of the total mineral production. Major commodities produced were sand and gravel, stone, and cement, which accounted for nearly 90% of the State's nonfuel mineral production. The decline in Oregon's mineral production from that of 1981 was due to the serious recession in construction industries and the metals price slump that led to the shutdown of The Hanna Mining Co.'s Riddle nickel mine and smelter in April. Reduced activity by the larger gold producers was reflected in a significant drop in State production of this metal.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	176	$300	149	$212
Gem stones	NA	600	NA	500
Gold (recoverable content of ores, etc.) troy ounces	2,830	1,301	W	W
Nickel (content of ores and concentrates) short tons	12,099	W	3,203	W
Sand and gravel (construction) thousand short tons	e12,000	e35,100	9,513	30,629
Silver (recoverable content of ores, etc.) thousand troy ounces	7	79	--	--
Stone:				
Crushed thousand short tons	16,482	46,055	p14,200	p41,900
Dimension do	(2)	5	p(2)	p5
Talc do	W	W	(2)	82
Combined value of cement, copper (1981), diatomite, lead (1981), lime, pumice, and values indicated by symbol W	XX	56,107	XX	34,515
Total	XX	r139,547	XX	107,843

eEstimated. pPreliminary. 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.

Trends and Developments.—In the metals processing industry, the two aluminum plants were affected by weak markets. Reynolds Metals Co., at Troutdale, had already been operating at less than capacity at the start of the year with two 25,000-short-ton potlines closed since October 1981. In July, it closed two more potlines, reducing its production to one 30,000-ton potline. Reynold's rated capacity was 130,000 short tons of aluminum per year. Martin Marietta Aluminum Inc., at The Dalles, started to reduce production in April with the shutdown of 18,000 short tons of capacity, and in June another cut was made to 54,000 tons per year. Rated capacity of the Martin Marietta plant at The Dalles was 90,000 short tons per year. Thus at yearend the two Oregon plants were operating at only 38% of capacity.

In August, Alumax Pacific Corp. reactivated a 10-year proposal to build a $660 million, 220,000-short-ton-per-year aluminum smelter outside Umatilla. The proposal was deferred again at yearend.

Oregon Metallurgical Corp. (OREMET) in Albany, the third largest U.S. producer of titanium, by November 15 reduced its sponge output to between 35% and 40% of its 4,500-short-ton-per-year capacity, and by yearend to 20%. The ingot facility was operating at less than 25% of capacity. This trend was expected to continue into mid-1983 because of the depressed aerospace, defense, commercial aircraft, and industrial markets. In 1981, the plant was operating at full capacity. In March 1982, Armco Inc. completed the purchase of enough OREMET common stock to give it 80% ownership of the Albany plant. During the year, OREMET completed construction of a new 50,000-square-foot mill products plant at its Albany complex. The plant will produce plate, bar, and billet.

A new casting facility was also completed by Precision Castparts Corp. at Albany. The plant will produce titanium castings for gas turbine and airframe applications.

Teledyne Wah Chang Albany (TWCA) was the largest of four zirconium sponge producers worldwide in 1982. The plant at Albany has a capacity for the production of 3,600 metric tons of zirconium sponge annually. Although TWCA operated at only 50% of its production capacity, most of the metal supplied to the world in 1982 came from the Albany plant. The largest share of the metal was consumed in nuclear fuel reloading. Demand was reduced owing to the continued slowdown in commercial nuclear powerplant construction. Other than for nuclear application, zirconium demand was mixed between commercial and military uses. TWCA also produced byproduct hafnium, which continued to outdistance demand.

TWCA continued to produce columbium and tantalum in 1982. The company cut its operating rate in August to 50% of capacity at its 2-million-pound-per-year, high-purity columbium pentoxide plant. This action was necessary owing to reduced sales of reactor-grade metal used in the aerospace industry.

Hanna Mining suspended its Riddle operation in April after 28 years of operation. Although Hanna was the only integrated nickel producer in the United States, demand and prices had fallen so drastically that it was forced to shut down. In addition, the plant was plagued by escalating power costs that significantly raised its overall production costs.

Early in the year, Bergsoe Metal Corp. completed an addition to its plant at Saint Helens for secondary lead smelting. The new process smelts unbroken lead-acid batteries and eliminates a number of the traditional steps in smelting and refining. The smelter is projected to have an annual capacity of 40,000 tons of lead production, but initially is expected to produce only 28,000 tons annually.

Exploration.[2]—Although at a lower rate than that of 1981, mineral exploration in Oregon continued at a good pace, with 34 sites being actively explored. Principal areas of interest were in northeastern Oregon—Baker and Grant Counties—the southwestern part of the State—Douglas, Josephine, and Jackson Counties—and in southern Lake and northern Malheur Counties.

Brooks Minerals Inc. and AMAX Exploration Inc. continued exploration at the E and E and North Pole gold mines on the once famous North Pole-Columbia lode. The mine is near Bourne, 6 miles north of Sumpter. Brooks Minerals acquired the property in 1980 and was joined in exploration by AMAX, but in September 1982, AMAX withdrew from the joint venture and exploration was suspended.

The Bald Mountain and Ibex Mines on the Baker-Grant County line, about 5 miles west of Sumpter, were being explored by Nerco Inc. (Northern Energy Resources Co.). Progress to the end of 1982 included rehabilitation of about 3,000 feet of old workings, 2,000 feet of new underground work, and 39,000 feet of diamond drilling. Additional development drilling was planned. The Bald Mountain-Ibex vein is a min-

eralized fault zone 8 to 20 feet thick. Past production was about 9,000 ounces of gold and 150,000 ounces of silver.

Rehabilitation of the old Cornucopia gold mine, about 70 miles northeast of Baker, was continued by UNC Mining and Milling Co. The Coulter and Clark level crosscut adits were reopened. Work was stopped in October owing to company budget constraints. Company officials reported that work would be resumed when financing becomes available.

The Turner-Albright Mine in southwestern Oregon was taken over by Noranda Mines Ltd. in 1982. Noranda did additional drilling and evaluation. Accumulated data indicated important bodies of gold-bearing massive sulfides. Future plans are indefinite.

Legislation and Government Programs.—The Oregon Department of Geology and Mineral Industries, administered from its main office in Portland, has field offices in Albany, Baker, and Grants Pass. Ongoing geologic programs were basic geologic mapping, geothermal resource investigations, inventories of metallic and nonmetallic resources, and oil and gas investigations. Mapping efforts included coverage of some of the mineralized ophiolite terrains in northeastern and southwestern Oregon, and Quaternary and Tertiary volcanic accumulations making up the Cascade Range. Major publications included nine geologic maps, special papers, and open file reports.

Oregon's Mined Land Reclamation Program made progress in 1982. During the year, 682 field inspections were completed, compared with 912 in 1981. A total of 156 acres was reclaimed in 1982, and at yearend there were 400 sites under permit for reclamation.

Distribution of proceeds to Oregon counties and to the State derived from mineral fees on lands managed by the U.S. Bureau of Land Management (BLM) in Oregon was $4.4 million in 1982, which was 9% of total revenues received by the State from BLM.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Baker	$18,275	$20,570	Cement, stone (crushed), gold, copper, clays, silver, lead.
Benton	W	1,004	Stone (crushed).
Clackamas	W	W	Cement, stone (crushed), clays.
Clatsop	1,403	901	Stone (crushed).
Columbia	W	455	Do.
Coos	W	1,236	Do.
Crook	W	W	Do.
Curry	W	69	Do.
Deschutes	W	W	Pumice, stone (crushed).
Douglas	W	W	Nickel, stone (crushed).
Grant	W	3	Gold.
Harney	W	--	
Hood River	W	81	Stone (crushed).
Jackson	W	W	Stone (crushed), talc.
Jefferson	W	260	Stone (crushed).
Josephine	W	61	Do.
Klamath	W	W	Stone (crushed), clays.
Lake	W	W	Diatomite, stone (crushed).
Lane	7,726	844	Stone (crushed).
Lincoln	W	1,586	Do.
Linn	1,179	236	Do.
Malheur	W	W	Lime.
Marion	3,513	17	Stone (crushed).
Morrow	W	100	Do.
Multnomah	W	6,497	Lime, stone (crushed), clays.
Polk	873	638	Stone (crushed).
Tillamook	782	362	Do.
Umatilla	1,612	W	Stone (crushed), silver, copper.
Union	W	181	Stone (crushed).
Wallowa	W	(3)	
Wasco	479	--	
Washington	10,485	5,491	Stone (crushed).
Yamhill	2,021	702	Do.
Undistributed[4]	103,623	63,151	
Sand and gravel (construction)	XX	e35,100	
Total[5]	151,970	139,547	

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

[1]Gilliam, Sherman, and Wheeler Counties are not listed because no nonfuel mineral production was reported.

[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 stone that cannot be assigned to specific counties and values indicated by symbol W.

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

Table 3.—Indicators of Oregon business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,337.0	1,315.0	-1.6
Unemployment	do	132.0	152.0	+15.2
Employment (nonagricultural):				
Mining	do	2.2	1.8	-18.2
Manufacturing	do	202.7	185.6	-8.4
Contract construction	do	37.5	29.6	-21.1
Transportation and public utilities	do	59.3	56.7	-4.4
Wholesale and retail trade	do	253.5	238.9	-5.8
Finance, insurance, real estate	do	68.5	65.0	-5.1
Services	do	192.1	187.5	-2.4
Government	do	202.6	195.7	-3.4
Total nonagricultural employment	do	1,018.4	960.8	-5.7
Personal income:				
Total	millions	$26,529	$27,523	+3.7
Per capita		$10,009	$10,392	+3.8
Construction activity:				
Number of private and public residential units authorized		12,887	7,334	-43.1
Value of nonresidential construction	millions	$404.3	$347.1	-14.2
Value of State road contract awards	do	$175.4	$172.4	-1.7
Shipments of portland and masonry cement to and within the State	thousand short tons	627	574	-8.5
Nonfuel mineral production value:				
Total crude mineral value	millions	$139.5	$107.8	-22.7
Value per capita, resident population		$56	$41	-26.8
Value per square mile		$1,514	$1,112	-26.6

[p]Preliminary.

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

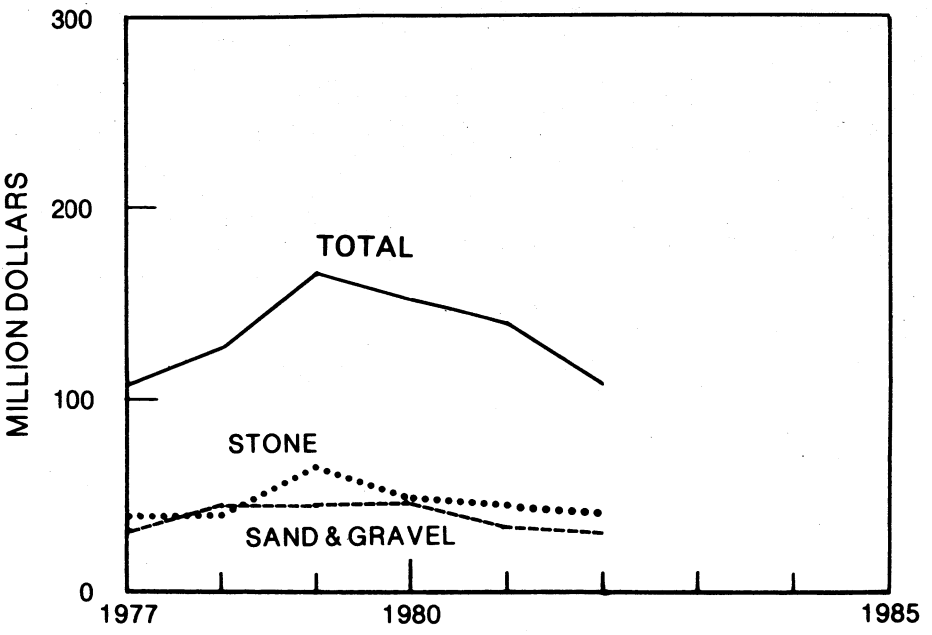

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Oregon.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Value of nonmetallic minerals produced declined 15% in 1982 from that of 1981 because of the national economic climate. This decline was reflected in the issuance of fewer permits for natural resource development. Permits were issued for about 650 surface mines in 1982 for nonmetallic mineral resources (primarily sand and gravel and stone).

Cement.—Oregon Portland Cement Co. was the sole cement producer in the State in 1982. Production was down for the year compared with that of 1981. Production was only from the Durkee plant. The company did not operate its kilns at the Lake Oswego plant during the year, but continued to use that site for finish grinding of clinker and distribution of cement. This procedure will continue until market conditions justify restarting the Lake Oswego plant. Market conditions also caused the curtailment of clinker production at the Durkee plant on October 29.

A major improvement was made at the Durkee plant in 1982 with the installation of a computer control to the kiln; it was the first of its kind in the world for a dry-process plant.

Clays.—Common clay and shale was produced by three companies from four pits in three counties. Clay production was down 15% from that of 1981.

The Teague Mineral Products Co.'s drying, grinding, and bagging plant near Adrian, in Malheur County, continued production of bentonite and zeolite. The bentonite was mined from pits near the head of Sucker Creek; the zeolite came from deposits near Rome.

Diatomite.—Oil-Dri Production Co. at Christmas Valley was the only company that mined and processed diatomaceous earth. End use was for pet litter and as absorbents for oil in floor sweeping. Production was the same as that of 1981.

Lime.—Ash Grove Cement Co. in Portland and Amalgamated Sugar Co. in Nyssa continued to produce lime during the year. Most of the lime produced was quicklime, with some hydrated lime produced by Ash Grove. Amalgamated Sugar used all of the lime produced in their own sugar refinery. Lime produced by Ash Grove was used primarily by the pulp and paper and the electric steel industries.

Sand and Gravel.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Sand and gravel was produced from 108 operations by 73 companies in 27 counties. Reported production was down 41% from that of 1980, the most recent year for which a survey was made. Value was down 35% from that same period. Eight companies produced 50% of all the sand and gravel in the State, and the leading 22 companies produced 80%. Uses of sand and gravel are shown in table 5. The product was transported by truck (84%), waterway (3%), other (1%), and 12% was used onsite.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	NA	NA	NA	1,387	$4,959	$3.58
Gravel	NA	NA	NA	6,986	22,768	3.26
Sand and gravel (unprocessed)	NA	NA	NA	1,139	2,901	2.55
Total[1] or average	[e]12,000	[e]$35,100	[e]$2.93	9,513	30,629	3.22

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

Table 5.—Oregon: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,678	$5,343	$3.19
Plaster and gunite sands	8	46	5.68
Concrete products	223	1,154	5.17
Asphaltic concrete	1,941	6,483	3.34
Road base and coverings[1]	4,229	13,718	3.25
Fill	813	1,829	2.25
Snow and ice control	56	202	3.61
Railroad ballast	8	W	W
Other	557	1,854	3.28
Total or average	9,513	30,629	3.22

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization material (cement).

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year. In view of the above, the principal producers shown for stone in table 6 are based on 1981 data.

The construction industry continued to be in a serious recession, and based on this indicator, it was estimated that crushed stone production was down 14% in quantity and 9% in value from that of 1981.

Talc.—Steatite of Southern Oregon Inc. continued to mine and process talc in Jackson County. Processing was also done in Josephine County. The talc produced was used for sculpturing, stove tops, cooking griddles, and clock faces.

METALS

Aluminum.—Martin Marietta and Reynolds Metals continued to produce aluminum during the year, but at reduced rates. High interest rates continued to cripple the traditionally strong aluminum markets, principally construction and transportation, and sharp escalation in power costs aggravated the situation.

Copper, Gold, and Silver.—Gold production was reported by two placer mining companies in Josephine and Malheur Counties. Several other placer and lode mines produced small amounts of gold during the year. Numerous one-man floating suction dredges were active along gold-bearing drainages in southwestern Oregon. Some gold was also produced at the Greenback and Snowbird lode mines. In Baker County, the Pyx and the Thomason lode mines produced some gold, as did several small placers. No silver or byproduct copper production was reported during the year.

Nickel.—In 1982, the Hanna Mining operation at Riddle produced only about 25% of its normal nickel output. All operations were suspended in April. Since startup in 1954, the plant has produced over 500 million pounds of nickel.

[1]State Liaison Officer, Bureau of Mines, Spokane, Wash.
[2]Ramp, L., H. C. Brooks, and J. J. Gray. Mineral Industry in Oregon, 1982. Oreg. Geol., v. 45, No. 4, April 1983, pp. 38-44.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Martin Marietta Aluminum Inc	6801 Rockledge Dr. Bethesda, MD 20034	Smelter	Wasco.
Reynolds Metals Co	6601 West Broad St. Richmond, VA 23261	do	Multnomah.
Cement:			
Oregon Portland Cement Co.[1]	111 SE. Madison St. Portland, OR 97214	Plants and quarries.	Baker and Clackamas.
Diatomite:			
Oil-Dri Production Co	Box 191 Christmas Valley, OR 97638	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	Mine and plant	Douglas.
Sand and gravel:			
Cascade Aggregates Inc	Box 1225 Scappoose, OR 97056	Pit and plant	Columbia.
Delta Sand & Gravel Inc	999 Division Ave. Eugene, OR 97402	Pit	Lane.
Malalla Sand & Gravel Co., Parker Div.	Box 149 Oregon City, OR 97045	Pits	Clackamas.
Morse Bros. Inc	Box 251 Tangent, OR 97389	do	Various.
Ross Island Sand & Gravel Co	4129 SE. McLoughlin Blvd. Portland, OR 97202	Pit and plant	Multnomah.
Western Pacific Construction Materials Co.	3510 SW. Bond Ave. Portland, OR 97201	do	Do.
Wildish Sand & Gravel Co	Box 7428 Eugene, OR 97401	Pits and plants	Benton and Lane.
Willamette Western Corp	Foot of North Portsmouth Ave. Portland, OR 97203	Pit	Multnomah.
Stone (1981):			
L. H. Cobb Crushed Rock Inc	21305 SW. Koehler Rd. Beaverton, OR 97005	Quarry	Washington.
Rogers Construction Co	11760 NE. Glisan Portland, OR 97220	do	Do.
U.S. Forest Service, Region VI	319 SW. Pine St. Portland, OR 97208	Quarries	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	Plant	Linn.
Zirconium:			
Teledyne Wah Chang Albany[2]	1600 NE. Old Salem Rd. Albany, OR 97321	do	Do.

[1]Also clays and stone.
[2]Also columbium and tantalum.

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 William Kebblish[1]

The value of Pennsylvania's nonfuel mineral production was $602.6 million in 1982, a $36.2 million decrease from that of 1981. The decline reflected poor economic conditions curtailing activities in nearly all mineral-related industries. Despite the depressed economy, Pennsylvania led the Nation in sales of iron and steel slag and regenerator iron oxides. The State ranked third in the production of expanded perlite and in shipments of cement and pig iron; and fourth in sales of lime, tripoli, and zinc. Nationally, Pennsylvania ranked 12th in value of total nonfuel mineral output.

Trends and Developments.—At yearend, improvement in the economy indicated possible reversal of the Nation's eighth post-World War II recession. Housing starts improved, industrial production increased, and the inflation rate declined.

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

Mineral		1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
Cement:					
Masonry	thousand short tons	293	$14,799	256	$14,048
Portland	do.	5,150	215,883	4,800	212,945
Clays[2]	do.	1,246	7,497	931	5,616
Gem stones		NA	5	NA	5
Lime	thousand short tons	1,690	85,418	1,297	70,902
Mica (scrap)	do.	3	134	W	W
Peat	do.	25	647	27	669
Sand and gravel:					
Construction	do.	e14,000	e61,100	13,081	55,527
Industrial	do.	W	W	969	13,589
Stone:					
Crushed	do.	53,258	207,821	p50,400	p200,900
Dimension	do.	51	7,193	p48	p6,354
Tripoli	short tons	1,263	W	W	W
Zinc (recoverable content of ores, etc.)	metric tons	24,732	24,293	24,762	21,001
Combined value of clays (kaolin) and values indicated by symbol W		XX	13,966	XX	998
Total		XX	r638,756	XX	602,554

eEstimated. pPreliminary. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Adams	$20,603	W	Lime, stone (crushed), clays, mica (scrap).
Allegheny	W	W	Cement, clays, sand and gravel (industrial), stone (crushed).
Armstrong	W	$1,674	Stone (crushed), clays.
Beaver	W	W	Clays.
Bedford	W	W	Stone (crushed).
Berks	W	W	Cement, stone (crushed), clays.
Blair	W	7,670	Stone (crushed).
Bradford	889	(3)	
Bucks	W	W	Stone (crushed), stone (dimension), clays.
Butler	29,295	W	Lime, stone (crushed), cement, stone (dimension).
Cameron	W	(3)	
Carbon	W	W	Stone (crushed).
Centre	35,609	W	Lime, stone (crushed), clays.
Chester	W	W	Stone (crushed), lime, stone (dimension), clays.
Clarion	W	(3)	
Clearfield	W	336	Clays.
Clinton	W	W	Clays, stone (crushed).
Columbia	W	W	Stone (crushed).
Crawford	667	(3)	
Cumberland	W	4,435	Stone (crushed).
Dauphin	W	3,174	Do.
Delaware	W	W	Stone (crushed), stone (dimension).
Elk	66	103	Stone (crushed).
Erie	4,484	61	Peat.
Fayette	W	W	Stone (crushed), clays.
Forest	W	(3)	
Franklin	W	W	Stone (crushed), stone (dimension).
Fulton	W	W	Stone (crushed).
Huntingdon	W	W	Sand and gravel (industrial), stone (crushed).
Jefferson	W	W	Clays, stone (crushed).
Juniata	W	366	Stone (crushed).
Lackawanna	828	W	Stone (crushed), peat.
Lancaster	W	W	Stone (crushed), clays.
Lawrence	W	W	Cement, stone (crushed), clays, peat.
Lebanon	W	W	Lime, stone (crushed).
Lehigh	W	W	Cement, zinc, stone (crushed), stone (dimension).
Luzerne	W	1,067	Stone (crushed), peat, clays.
Lycoming	W	W	Stone (crushed).
McKean	W	W	Stone (crushed), clays.
Mercer	W	W	Stone (crushed).
Mifflin	1,042	W	Stone (crushed), lime.
Monroe	W	W	Stone (crushed), clays, peat.
Montgomery	15,925	W	Stone (crushed), lime, stone (dimension).
Montour	W	W	Stone (crushed).
Northampton	120,043	W	Cement, stone (crushed), stone (dimension), clays.
Northumberland	W	W	Stone (crushed), clays, tripoli.
Perry	W	W	Stone (crushed).
Philadelphia	W	(3)	
Pike	1,025	377	Stone (crushed).
Potter	--	W	Stone (dimension).
Schuylkill	W	1,002	Stone (crushed).
Snyder	W	W	Do.
Somerset	3,766	3,207	Clays, stone (crushed).
Susquehanna	W	1,254	Stone (crushed), stone (dimension).
Tioga	W	W	Stone (crushed).
Union	W	W	Stone (crushed), clays.
Venango	1,035	W	Stone (crushed).
Warren	1,733	(3)	
Wayne	W	671	Stone (crushed), stone (dimension).
Westmoreland	W	9,934	Stone (crushed).
Wyoming	W	(3)	
York	52,430	45,848	Stone (crushed), cement, lime, clays.
Undistributed[4]	378,167	496,476	
Sand and gravel (construction)	XX	e61,100	
Total[5]	667,606	638,756	

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.

[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 that cannot be assigned to specific counties and values indicated by symbol W.

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

Table 3.—Indicators of Pennsylvania business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	5,482.0	5,482.0	--
Unemployment	do	458.0	599.0	+30.8
Employment (nonagricultural):				
Mining[1]	do	45.4	45.6	+.4
Manufacturing	do	1,299.0	1,167.1	-10.2
Contract construction	do	180.7	166.8	-7.7
Transportation and public utilities	do	258.6	248.0	-4.1
Wholesale and retail trade	do	989.1	970.0	-1.9
Finance, insurance, real estate	do	240.8	238.5	-1.0
Services	do	1,011.8	1,044.8	+3.3
Government	do	703.4	680.4	-3.3
Total nonagricultural employment[1 2]	do	4,728.9	4,561.3	-3.5
Personal income:				
Total	millions	$123,057	$129,844	+5.5
Per capita		$10,366	$10,943	+5.6
Construction activity:				
Number of private and public residential units authorized		24,495	20,912	-14.6
Value of nonresidential construction	millions	$1,285.6	$818.9	-36.3
Value of State road contract awards	do	$300.0	$275.0	-8.3
Shipments of portland and masonry cement to and within the State	thousand short tons	2,402	2,310	-3.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$638.8	$602.6	-5.7
Value per capita, resident population		$53	$51	-3.8
Value per square mile		$13,964	$13,292	-4.8

[p]Preliminary.
[1]Includes coal (anthracite and bituminous), gas, and oil 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.

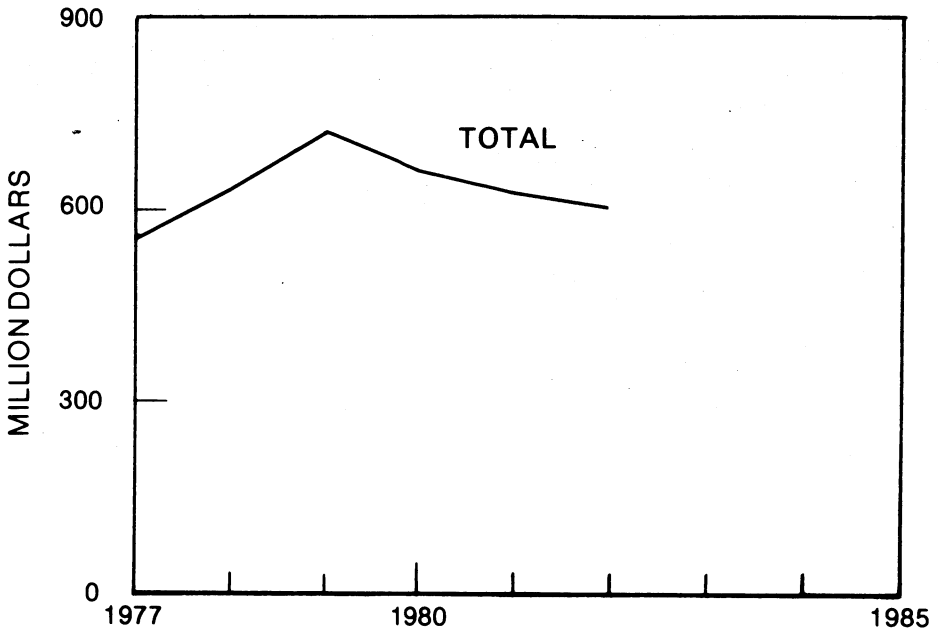

Figure 1.—Total value of nonfuel mineral production in Pennsylvania.

Pennsylvania's basic iron and steel industries, however, showed little improvement at yearend. Practically all steel companies showed deficits and reorganized to trim losses. United States Steel Corp., the Nation's largest steelmaker, reorganized all steel operations, resulting in closure of marginal operations and massive layoffs. At yearend, 19,530 employees, or two-thirds of the company's work force in western Pennsylvania, were idle.[2] Bethlehem Steel Corp., the second largest steel producer in the Nation, closed many of its operations in Johnstown and Bethlehem, while Jones & Laughlin Steel Corp. (J&L), a subsidiary of LTV Corp., the No. 3 producer, idled more than 6,000 employees at its Pittsburgh and Aliquippa Works. Other steps included reopening of contract negotiations between industry and labor officials. Although discussions were not finalized at yearend, many worker concessions, including wage reductions, were proposed, with resumption of benefits when steel operations again become profitable.

State officials, in an attempt to assist the ailing steel industry, formed a 43-member caucus consisting of government, labor, and industry leaders. Its main objective was to develop legislation to help the State's steel industry to survive.

Certain environmental requirements were modified by local governments to allow steel producers additional time for eventual compliance. The Allegheny County Board of Health approved the "bubble concept," a plan for plant compliance instead of individual source compliance.

State officials also approved a $10 million tax-free bond for modernization and expansion at the Allegheny Ludlum Steel Corp. plant in Westmoreland County.

A general trend among Pennsylvania companies was to improve productivity and product quality similar to that of many European and Asian countries, notably Japan. Westinghouse Electric Corp. adopted "quality circles" consisting of employees and their supervisors who meet voluntarily to discuss ways to improve products. United States Steel established labor-management teams at the Irvin Works south of Pittsburgh to improve steel products and increase productivity.

Water-related transportation occurrences included sale of United States Steel's three bargelines to Allen & Co. Inc. Two of the three bargelines operated in western Pennsylvania, moving steel, scrap, and aggregate to market. At Lake Erie, the 1,000-foot taconite ore carrier *Presque Isle* remained docked during the first part of the year owing to lack of iron ore demand at Pittsburgh steel plants. In the Pittsburgh area, the U.S. Army Corps of Engineers continued operation of locks and dams in navigable rivers, although Federal austerity measures indicated closure of certain facilities on the Allegheny River.

Other transportation-related occurrences included Standard Steel Co.'s development of a forged railroad wheel that is competitive with cast wheels; Bethlehem Steel's reopening of the railroad car shop in Johnstown for manufacture of 580 Coalporter gondola cars for System Fuels Inc. in addition to 350 open-top railroad cars for the Denver & Rio Grande Western Railroad Co.; reduction in tank car production by ACF Industries, Amcar Div., Milton, Northumberland County, from 3 to 2 cars per day; and closure in February of the Pullman Standard Inc. plant at Butler, Butler County, a large producer of freight cars, affecting 2,900 workers. GATX Corp. reduced production of tank cars at its Sharon plant in western Pennsylvania and Consolidated Rail Corp. (Conrail) closed its Altoona car repair shops for 5 weeks and sold 40.4 miles of track in the Wilkes-Barre and Scranton areas to Pocono Northeast Railway Inc. Conrail also reduced rail rates for steel sheet and strip in coils from eastern Pennsylvania to cities in the Mahoning Valley in Ohio.

Exploration Activities.—An international group of 17 geologists spent 6 days in Pennsylvania examining Upper Ordovician and Upper Devonian rocks in areas stretching from Kinzua Lake in Warren County to Delaware Water Gap in the eastern part of the State. The field trip followed an international symposium held in Ontario, Canada, in late August.

Exploration activity continued at a feverish pace throughout the State, especially in the Eastern Overthrust Belt, an area similar to the Western Overthrust Belt in the Rocky Mountains. The former belt parallels the Appalachian Mountains and consists of folded and faulted Lower and Middle Paleozoic strata. During the year, a record high 3,500 oil and gas wells were drilled. Quantities of oil and gas were located, and in some instances, drillers allegedly discovered traces of gold and other base minerals.

Legislation and Government Programs.—At midyear, the U.S. Department of the Interior approved Pennsylvania's surface mining regulations, including the

Abandoned Mined Land Reclamation Program, making available $39.5 million for reclamation programs within the State. The funds were collected by the U.S. Office of Surface Mining from coal mine operators for distribution to States having an approved regulatory program. Although the revised State mining regulations pertain mainly to coal, sections 97.31 to 97.35 and 97.72 of the Pennsylvania Code affect activities other than coal mining, such as river dredging and waste disposal.

Pennsylvania's revised solid waste management regulations, 25 Pennsylvania Code, chapter 75, became effective September 4, 1982. These revisions, which conform to Federal guidelines, allow for regulation of solid and hazardous waste within State boundaries. Excluded as hazardous wastes are cement kiln dust, drilling fluids associated with exploration development or production of certain fuels, mining overburden returned to the minesite, solid waste generated from extraction, beneficiation, processing of ores and minerals, and various others.

To assist the State's economy, the Governor signed H.B. 2344 into law on December 6, 1982, changing the Pennsylvania Science and Engineering Foundation to the Ben Franklin Partnership Board, establishing two technology centers in the State. At the Pittsburgh center, studies include bioengineering, coal technology, and new materials. At the Bethlehem center, research includes polymer materials, biotechnology and computer-aided design, and manufacturing.

The Governor also signed into law Senate bills 457 and 831 concerning revenues and repair or replacement of 979 bridges throughout the State, 522 of which are State-owned, 249 are owned by local government, and 208 are designated as "orphan" bridges or spans over railroads. The $1.4 billion program over the next 6 years means a boost to the State's depressed steel industry.

In fiscal year 1982, the Federal Government returned $1.09 million to the State for its share of funds generated by activities on national forest lands (timbering, minerals leasing, recreation, user fees, etc.). Allegheny National Forest is located in northwestern Pennsylvania and is under the jurisdiction of the U.S. Department of Agriculture. Extraction of minerals may be permitted on parts of the 510,000-acre forest and the Erie National Wildlife Refuge. To permanently protect parts of the national forest, Federal legislation was proposed reserving acreage as a wilderness and national recreation area. This designation would ban all types of mining and preserve the pristine nature of the land.

Active contracts and grants awarded to Pennsylvania organizations by the U.S. Bureau of Mines during the fiscal year totaled $7.2 million. The largest individual monetary contracts included $2.2 million for an exploratory drilling and pumped slurry back-filling project at Dunmore, Lackawanna County; $260,000 for field demonstration of aquifer dewatering coordinated with the planning and development of a new underground coal mine at Meadville, Crawford County; and $230,000 for mine demonstrations of longwall dust control techniques at Monroeville, Allegheny County.

The U.S. Bureau of Mines completed a new research facility known as the Lake Lynn Laboratory in Fayette County. The facility was dedicated September 1, 1982, primarily for explosive and mine fire research projects. The laboratory was constructed in an abandoned limestone mine approximately 60 miles south of Pittsburgh.

Basic research on sealing abandoned mine openings was done in various mines in Pennsylvania and Ohio as reported in U.S. Bureau of Mines Report of Investigations (RI) 8729, "Building Seals by Pneumatic Stowing in Mine Closure Operations," and RI 8730, "Sealing Openings in Abandoned Mines by Pneumatic Stowing."

The Mining and Mineral Resources and Research Institute at the Pennsylvania State University in University Park, which was created under title III of Public Law 95-87, received $150,000 from the U.S. Bureau of Mines in fiscal year 1982 for operations and research.

During the year, the Pennsylvania Bureau of Topographic and Geologic Survey maintained basic programs involving geologic and topographic mapping, mineral resource studies, ground water investigations, numerous oil- and gas-related activities, and responses to more than 2,900 major mineral-related requests. At yearend, State Survey engineers continued to map areas of Altoona, Lewisburg, Hazleton, Sunbury, and the Pocono Mountains. Work continued on a tectonic map of Pennsylvania, with a statewide correlation chart completed. Mineral studies included completion of a coal resource map of the Altoona area, coal-crop maps, a coal-sampling program, and entrance of all State-related coal data into the National Coal Resources Data Bank. Addi-

tionally, studies continued in the Reading-Prong area and the Devonian sediments of north-central Pennsylvania for uranium occurrences.

To meet basic exploration needs, the State Survey published an "Oil and Gas Fields Map of Pennsylvania" showing 1,077 oil and gas fields and pools up until July 1, 1981. A revised geologic map of Pennsylvania was also published the same year. Both publications were used by many of the exploration companies seeking minerals and particularly fuels in the Appalachian region.

Other completed projects included a study of the geology along the Appalachian Trail, engineering characteristics of Pennsylvania's rock formations, and ground water data collection of the Susquehanna River Basin.

The State Survey's August 1982 issue of "Pennsylvania Geology" lists 142 ongoing research projects, reports, and articles relating to the geology of the State, some of which were undertaken by State geological personnel. Subject matter covers nearly all aspects of Pennsylvania geology.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives (Manufactured).—Manufactured abrasives, consisting of steel shot and grit, were produced by Ervin Industries Inc. and Pangborn Co., both in Butler, Butler County, and Durasteel Abrasives Co. in Mount Pleasant, Westmoreland County. Shipments decreased in both quantity and value compared with 1981 levels. Finished products were used as abrasives. Silicon carbide, another manufactured product, was produced by Satellite Alloy Corp. in Springdale, Allegheny County, for nonabrasive applications.

Cement.—Despite decreased demand for cement in 1982, Pennsylvania continued to rank third nationally behind Texas and California in portland cement shipments and first in masonry cement shipments. Shipments of portland cement totaled 4.8 million tons valued at $212.9 million, a decrease of nearly 7% in quantity and a slight decrease in value compared with those of 1981. Portland cement was shipped from 14 plants in 7 counties; counties leading in tonnage shipped were Northampton and Lehigh. Principal producers were Société des Ciments Français, which owns the Coplay and Nazareth No. 1 and No. 2 plants, and Lone Star Industries Inc., which owns the Nazareth and Pittsburgh plants.

Masonry cement shipments in Pennsylvania totaled 256,000 tons valued at $14 million, a decrease of nearly 13% in quantity and 5% in value compared with 1981 levels. Shipments originated from 11 plants in 7 counties; counties leading in quantity shipped were Lehigh, Northampton, and Lawrence. Principal producers were Société des Ciments Français and Crane Co.

The drop in shipments of both portland and masonry cement was due mainly to curtailed residential, industrial, and commercial construction during the year. Raw materials used in cement manufacture were cement rock, limestone, and shale, with lesser amounts of clay, sand, iron ore, and gypsum.

During the year, many Pennsylvania cement companies were sold, closed, or made internal improvements to improve safety and/or plant efficiency.

Lehigh Portland Cement Co., Allentown, purchased Crane's Medusa Cement Co. white cement plant in West York, York County, while planning closure of its white cement plant in Northampton, Northampton County.

Lone Star Industries purchased the Marquette Co. cement plants—one in Pittsburgh, the others in five Central and Northeastern States—from Gulf + Western Industries Inc. (G+W).

Early in the year, National Gypsum Co. reconsidered and withdrew from sale its cement plant at Evansville, Berks County, owing to projected improvement in cement sales.

Louisville Cement Co. closed its plant at Bessemer, Lawrence County, during the year. The closure came 21 months after the firm announced a $16 million modernization program for the plant.

Penn-West Cement Co. Inc., West Winfield, Butler County, closed cementmaking operations in March and began purchasing clinker from Medusa Cement, Wampum, Lawrence County, for grinding at the Butler County plant. Grinding clinker with a small amount of gypsum added produces a cement in fine powder form.

At yearend, Martin Marietta Corp. planned closure of its Northampton plant. The

plant has been in continuous operation since 1889 and was formerly known as Dragon Cement Co.

Keystone Portland Cement Co., Bath, Northampton County, had excess cement inventory at yearend, with anticipated production cutbacks paralleling future sales.

Officials at Coplay Cement Co., Nazareth, Northampton County, redesigned and installed protective safety features for the coal-grinding and fuel injection system used for heating purposes. Summer electrical storms caused disruption to the system, resulting in dust explosions. Newly installed detection and suppression systems apparently have eliminated problems at the facility.

Whitehall Cement Manufacturing Co. (recently purchased by General Portland Inc.) and Keystone Portland Cement, both in eastern Pennsylvania, are using additives such as acetone, mixed with coal, to heat cement kilns.

Hercules Cement Co., Stockertown, Northampton County, is producing a sulfate-resistant cement for corrosive applications.

Clays.—Production of clay and shale in Pennsylvania decreased in both quantity and value compared with 1981 levels. Types produced were common clay and shale, fire clay, and kaolin. In 1982, 22 companies operated 54 clay and shale mines in 18 counties. Counties leading in output, in descending order, were Berks, Jefferson, and Adams.

The average unit value of all types of clay produced increased slightly to $6.90 per ton from 1981 to 1982. This increase in unit cost was due to a slight increase in kaolin production, which has a much higher unit value compared with that of other types of clay. Clay and shale and fire clay were used mainly in the manufacture of face brick and firebrick; kaolin was used for roofing granules and other general uses.

Glen-Gery Corp. was affected by the economic downturn, reducing output of brick from the operation at Watsontown, Northumberland County, which resulted in nearly 90% of employees being idled at the plant during the past 2 years.

General Refractories Co., Philadelphia, restructured operations owing to the economic recession, closing the Salina plant near Pittsburgh and relocating headquarters to the Pittsburgh district. General Refractories is one of the five largest refractory companies in the Nation.

Early in the year, Swank Refractories Co., Pittsburgh, was sold to Tokyo Yogyo Ltd. of Japan. Refractory plants that were sold included the operation at Irvona, Clearfield County, and the plant at Large, Allegheny County. Both plants produced clay-based refractory shapes and bricks.

Harbison-Walker Refractories Co., a division of Dresser Industries Inc., began producing tundish boards, a new refractory product used by the steel industry to line surge tanks holding molten metal. The tundish boards are produced at the company's plant at Clearfield, Clearfield County.

A new company, Bricemont & Associates, McMurray, Washington County, began refractory-testing services.

Allied Chemical Co., a subsidiary of Allied Corp., opened a refractory research center at State College, Centre County, to develop and improve refractory technology.

Envirosafe Inc. discussed plans for a waste landfill near Lancaster with local officials and residents. Plans included use of 135 acres of the 450-acre Narvon Mine property, the only producer of kaolin in the State. The waste treatment process involved mixture with fly and lime, eliminating contaminants prior to disposal.

Table 4.—Pennsylvania: Clays sold or used by producers, by use[1]

(Short tons)

Use	1981	1982
Common brick	29,617	33,341
Face brick	809,250	630,530
Firebrick, block and shapes	161,303	115,217
Flue linings	40,790	19,291
Mortar and cement, refractory	31,746	14,493
Portland and other cements	123,626	81,727
Tile: Drain, quarry, structural	34,409	32,034
Other[2]	15,310	4,031
Exports: Mortar, cement, other refractories	333	260
Total	1,246,384	930,924

[1]Excludes kaolin.
[2]Includes lightweight aggregates, paint, and sewer pipe (1981).

Fluorspar.—Although Pennsylvania had no production of fluorspar in 1982, the State ranked fourth nationally in consumption, using 51,955 tons, or nearly 10% of the Nation's total consumption of 530,565 tons. Compared with that of 1981, consumption dropped about 50% owing to a decline in steelmaking operations, which uses approximately 6 pounds of fluorspar per ton of steel produced. The fluorspar, when added to molten metal, assists in the desulfurization and dephosphorization of the metal, promotes slag fluidity, and enhances the solution of lime.

Gem Stones.—The value of gem stones collected in Pennsylvania in 1982 was estimated at $5,000, remaining unchanged from that of 1981. Specimens were collected mainly by amateurs and mineral dealers.

The Hillman Hall of Minerals and Gems at Carnegie Museum of Natural History, Pittsburgh, continued to be a popular tourist attraction. More than 2,500 mineral specimens are on display there, made possible by a grant by Hillman Foundation Inc.

Graphite (Synthetic).—Synthetic graphite production and value decreased in 1982 owing to the depressed economic conditions. Principal producers were located in Elk County in north-central Pennsylvania. Synthetic graphite is made from petroleum coke, lampblack, carbon black, and various amounts of natural graphite, mixed with carbonaceous binders and heated to high temperatures to produce the synthetic product.

Airco Speer Carbon Co. continued modernization of its electrode plant at St. Marys, even though the steel industry remained depressed. Graphite electrodes were used in electric furnaces to produce intense heat for steelmaking.

Other principal synthetic graphite producers included Keystone Carbon Co. (powdered metal parts, carbon brushes, and contacts), St. Marys Carbon Co. (powdered metal products and metal graphite parts), and The Stackpole Carbon Corp. (carbon products, electronic components, and motor brushes). The latter was the leading supplier of motor brushes to the U.S. automotive industry.

Gypsum (Calcined).—United States Gypsum Co. closed its gypsum calcining plant in Philadelphia owing to the poor housing market. Calcined gypsum was used mainly in the manufacture of prefabricated products, such as regular wallboard, type-X wallboard, and lath, for home construction.

Iodine.—Whitmoyer Laboratories Inc. in Lebanon County and West Agro-Chemical Inc. in Washington County brought in crude iodine for use in the manufacture of pharmaceuticals, catalysts, and sanitation products.

Iron and Steel Slag.—Pennsylvania ranked first nationally in 1982 in sales of iron and steel slag. Total slag processed amounted to 4.3 million tons valued at $21.8 million, a decrease of 9% in output but a slight increase in value compared with that of 1981. The decline in slag output reflected a drop in the State's pig iron production. Of the total slag produced, 86% was iron slag and the remainder was steel slag.

Types of iron slag sold included air-cooled, expanded, and granulated. Major uses of air-cooled slag were for asphalt and concrete aggregate and as a road base material and fill; expanded slag was used as lightweight aggregate; and granulated slag was used for road base material and fill. Steel slag was used mainly for road base material. Principal slag processors included Duquesne Slag Products Co. Inc., Dunbar Slag Co., and Standard Slag Co.

Lime.—Although lime production in Pennsylvania decreased 23% from that of 1981, the State ranked fourth nationally, accounting for 1.3 million tons, or about 9% of the national output. Lime was produced at 10 plants in 8 counties. Centre, with three plants, accounted for a substantial part of Pennsylvania's production. Other counties, in descending order of output, were Lebanon, Adams, Butler, York, Chester, Montgomery, and Mifflin.

Domtar Industries Inc., Centre County, closed its underground limestone mine and calcining plant near Bellefonte during the year. The mine is to be sold or closed permanently. Other lime-producing companies in Centre County included Marblehead Lime Co. in Pleasant Gap and Warner Co. with its operation in Bellefonte. During the year, Conrail proposed abandonment of a 17-mile section of track from Milesburg to Bellefonte. Permanent rail closure could impact lime producers in Centre County. Consumption of lime by the steel industry continued to decline, with decreases also noted for agriculture, sewage treatment, and acid water neutralization.

Table 5.—Pennsylvania: Lime sold or used by producers, by use

Use	1981		1982	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, basic oxygen furnace	620,542	$30,890	454,056	$23,207
Steel, electric	278,032	13,674	178,557	9,068
Sewage treatment	197,815	10,065	153,821	8,248
Water purification	110,531	5,930	104,468	5,685
Acid water neutralization	67,916	3,613	65,642	3,729
Steel, open-hearth	81,585	3,333	39,462	1,997
Mason's lime	49,433	2,261	49,329	3,716
Paper and pulp	20,657	991	18,123	880
Agriculture	29,456	1,562	12,837	782
Brick, sand-lime	3,991	234	3,517	215
Petroleum refining	3,408	187	2,481	137
Metallurgy, other	3,934	176	1,571	80
Other[1]	222,427	12,502	213,289	13,158
Total	1,689,727	85,418	1,297,153	70,902

[1]Includes alkalies, glass, oil well drilling, ore concentration, other chemical and industrial uses, paint, petrochemicals, precipitated calcium carbonate, refractories, silica brick, soil stabilization, sulfur removal from stack gases, tanning, and wire drawing.

Mica.—Only one company in the State produced crude mica in 1982. Gross Minerals Corp. near Aspers, Adams County, produced scrap and flake mica from an underground mining operation.

Mullite (Synthetic).—Only one company in Pennsylvania produced synthetic mullite. A. P. Green Refractories Co., Philadelphia County, heated an aluminum-silicate mixture to approximately 3,000° F, producing the heat-resistant material. Mullite in general is used in furnace linings, refractories, and glass products. Shipments of the synthetic product decreased in quantity from 1981 to 1982 owing to a general downturn in the economy.

Peat.—Pennsylvania ranked eighth of 20 States in peat sales in 1982 with 26,974 tons valued at about $669,000, a slight increase in both quantity and value compared with 1981 figures. Peat production occurred mainly in the eastern part of the State and, to a lesser extent, in the Erie vicinity. Principal producers were Gouldsboro Wayne Peat Co., Lackawanna County, and Corry Peat Products Co., Erie County. The processed peat was used mainly for agricultural and horticultural purposes.

Perlite (Expanded).—Crude perlite mined out of State was shipped into Pennsylvania and expanded at six plants by five companies. Expanded perlite sold and used in the State amounted to 38,600 tons valued at $5.8 million, reflecting an increase of 6% in production and 19% in value compared with those of 1981. Plants in western Pennsylvania were the Therm-O-Rock Div. of Allied Chemical in New Eagle, Washington County, and Perlite Manufacturing Co. of Pittsburgh Inc. in Carnegie, Allegheny County. Producers in eastern Pennsylvania were World Industries Inc., Pennsylvania Perlite Corp., and United States Gypsum. Most of the perlite plants were relatively small, employing 12 to 21 persons. Perlite was used mainly in plaster and cement aggregates and for horticulture purposes.

Pyrophyllite.—American Olean Tile Co. near Landsdale, Montgomery County, imported raw pyrophyllite from its Canadian mine. The amount of raw ore imported decreased in both quantity and value in 1982. The ground product was used in the manufacture of ceramic products.

Quartz Crystal (Synthetic).—Bliley Electric Co., at Erie, and P. R. Hoffman Co., a division of Norlin Corp., at Carlisle, used lasca, a nonelectronic-grade quartz material used as feedstock for growing cultured quartz crystal. All cultured quartz crystal produced was used internally by both companies. Other consumers of cultured crystal in Pennsylvania were Anderson Electronics Inc., Blair County; Dynamics Corp. of America, Cumberland County; Erie Frequency Div. of Erie Technological Products, Erie County; McCoy Electronics Co., Cumberland County; J. K. Miller Co. Inc., Allegheny County; and Piezo Crystal Co. Inc., Cumberland County. Major uses of cultured quartz was for oscillators used in the manufacture of timepieces, televisions, and citizens band radios.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were gener-

ated and are given in table 1. Construction sand and gravel was one of the principal nonfuel minerals produced in Pennsylvania, ranking fourth behind cement, stone, and lime in sales. Output totaled 13.1 million tons valued at $55.5 million, representing a decrease of 7% in quantity and 9% in value compared with 1981 estimated figures. Average unit value was $4.24 compared with an estimated $4.36 in 1981.

Construction sand and gravel was produced in 34 of the State's 67 counties, located northwest and east of the Appalachian Mountains. Counties leading in output in the western part of the State were Armstrong, Beaver, and Erie; in the eastern part, Bucks, Columbia, and Lycoming. There was no sand and gravel production in either the Philadelphia or Pittsburgh areas, but adjacent counties supplied needed quantities.

Leading producers were Davison Sand & Gravel Co., Dravo Corp., and Warner Co., all located near metropolitan areas. These three companies accounted for 32% of the State's production. A total of 98 sand and gravel companies operated 123 pits. Davison Sand & Gravel, Tionesta Sand & Gravel Co., and H. W. Copper & Sons Inc. constituted larger operations, producing from four deposits each in Armstrong, Warren, and Butler Counties, respectively.

One company in Pennsylvania produced more than 1 million tons in 1982 from a single operation. A total of 37 pits yielded from 100,000 to 1 million tons each and had a combined output of 9.1 million tons. The remaining 85 pits each produced less than 100,000 tons each, resulting in a total output of 2.7 million tons and accounting for 20% of the State's total production. The significance of a large number of sand and gravel companies accounting for only a fraction of the State's output can be traced to localized markets and high transportation costs for a low unit-valued commodity. In 1982, nearly 84% of the State's sand and gravel was transported to market by truck; the remainder, by railroad, waterway, and other means. Construction sand and gravel was used mainly for concrete aggregate, asphaltic concrete, and road base and coverings.

Table 6.—Pennsylvania: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,559	$20,676	$4.53
Plaster and gunite sands	363	1,694	4.66
Concrete products	1,107	5,482	4.95
Asphaltic concrete	2,413	12,550	5.20
Road base and coverings[1]	3,346	11,263	3.37
Fill	891	2,195	2.46
Snow and ice control	168	645	3.84
Railroad ballast	24	84	3.50
Other	208	938	4.50
Total or average	[2]13,081	55,527	4.24

[1]Includes road and other stabilization (cement).
[2]Data do not add to total shown because of independent rounding.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	5,044	$22,989	$4.56
Gravel	NA	NA	NA	7,189	30,402	4.23
Sand and gravel (unprocessed)	NA	NA	NA	849	2,136	2.52
Total or average	e14,000	e$61,100	e$4.36	[1]13,081	55,527	4.24
Industrial sand	W	W	13.18	969	13,589	14.02
Grand total or average	W	W	e4.93	14,050	69,116	4.92

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

Industrial.—In 1982, industrial sand in Pennsylvania sold for $14.02 per ton compared with $4.24 for construction sand and gravel.

From 1981 to 1982, production of industrial sand in Pennsylvania remained about the same. Industrial sand was produced by four companies. Airport Sand & Gravel Co. Inc., Luzerne County, operated one deposit; Glacial Sand & Gravel Co., Armstrong County, one deposit; McGrady Inc., Allegheny County, two deposits; and Pennsylvania Glass Sand Corp., Huntingdon County, two deposits. Industrial sand was used mainly for glass products, with lesser amounts used for molds and cores, in refractories and fillers, and for other purposes.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Sulfur (Recovered).—Elemental sulfur was recovered from desulfurization of refinery gases and treatment of natural gas at three petroleum refineries, two in Philadelphia County and one in Delaware County. A steel company in Allegheny County recovered byproduct sulfur from coke production. Shipments of recovered sulfur in Pennsylvania during 1982 amounted to 56,513 metric tons valued at $4.8 million, nearly the same figures as those of 1981. Principal uses were in the manufacture of sulfuric acid, for leaching of ores, and in chemicals, fibers, paints, and explosives.

Tripoli.—The Keystone Filler & Manufacturing Co. Sheddy Mine in Northumberland County produced tripoli, which was used as an abrasive and filler. Both production and value increased from 1981 to 1982. Also known as rottenstone, tripoli consists of fine-grained silica resulting from decomposition of siliceous limestone.

Vermiculite (Exfoliated).—Beneficiated vermiculite mined in other States was shipped into Pennsylvania and exfoliated by A-Tops Corp. in Allegheny County and W. R. Grace & Co. in Lawrence County. Sales of exfoliated vermiculite dropped nearly 13% in quantity and 30% in value from 1981 to 1982. Unit value of exfoliated vermiculite was nearly $203 per ton, a decrease of $52 from that of 1981. Major uses were for lightweight concrete aggregate, loose fill insulation, horticultural purposes, and soil conditioning.

METALS

Aluminum.—Although primary aluminum is not produced in Pennsylvania, secondary plants continued to modernize operations. United States Aluminum Corp., a subsidiary of United States Reduction Co. and owned by American Can Co., began implementation of environmental programs relating to noise and dust abatement at the aluminum scrap smelting plant at Marietta, Lancaster County.

Aluminum Co. of America (Alcoa) completed a $60 million expansion at its plant at Lebanon, Lebanon County, consisting of two continuous casters, a cold-rolling mill, and support furnaces. In western Pennsylvania, a new continuous ball mill at the Logans Ferry plant was nearing completion at yearend, designed to increase output of powder and pigment products. Alcoa continued its aluminum can recycling program. Beverage cans collected in Pennsylvania contributed to Alcoa's 205,000 metric tons of used beverage cans recycled nationwide.[3]

Beryllium.—The Cabot Berylco Div. of Cabot Corp. produced beryllium copper and other beryllium alloys at its plant at Reading, Berks County. Plant modernizations that include annealing and finishing equipment will allow production of thin beryllium copper strip up to 50 inches wide and down to two-thousandths of an inch thick. The thin strips allow for selective plating methods or improved inlay products.

Cadmium.—The New Jersey Zinc Co. Inc., Lehigh County, produced cadmium, a byproduct of zinc smelting. Cadmium was used for electroplating, plastic stabilizers, and pigments.

Ferroalloys.—In 1982, ferroalloy shipments in Pennsylvania totaled 4,029 tons valued at $29.7 million, reflecting decreases in both quantity and value compared with 1981 figures. Seven ferroalloy plants were located in the State—two in Lawrence County, two in Washington County, and one each in Berks, Bucks, and Chester Counties. Ferroalloys of aluminum, boron, columbium, molybdenum, and vanadium were produced. Ferroalloys were added to molten iron and steel for specific product characteristics.

During the year, ferroalloy companies modernized to become more competitive. Reading Alloys Inc., Robesonia, Berks County, lowered the price of ferrocolumbium to compete with foreign imports. AMAX Inc.,

Climax Molybdenum Div., Langeloth, Washington County, reduced its work force by 33% and at yearend temporarily closed operations until ferroalloy markets improve. Molycorp Inc., Washington County, dedicated a new molybdenum roaster and samarium ingot facility. Ore from the company's mine at Questa, N. Mex., is processed at the Washington County facility. Reactive Metals & Alloys Corp., West Pittsburgh, Lawrence County, operated a new $4 million submerged-arc furnace and a crucible for development of new alloys.

Other ferroalloy companies based in Pennsylvania with plants in other States included Elkem Metals Co., Pittsburgh, owned by Norwegian interests and formed in 1981 when certain plants were purchased from Union Carbide Corp., making Elkem the Nation's largest supplier of ferroalloys; and Foote Mineral Co., Exton, Chester County, the Nation's third largest producer of ferroalloys.

Iron Oxide Pigments.—In 1982, Pennsylvania led the Nation in shipment of regenerator iron oxides produced from steel plant waste and ranked second behind Illinois in shipments of finished iron oxide pigments. Pennsylvania regenerator iron oxide shipments totaled 7,802 tons valued at $419,000, a decline of 30% in quantity and 37% in value compared with 1981 figures. Finished iron oxide pigments totaled 24,663 tons valued at $27.8 million, a decrease of 22% in quantity with value remaining essentially the same.

Regenerator iron oxides were produced in Bucks County; finished iron oxide pigments, in Carbon, Chester, Montgomery, and Northampton Counties. Producers included Chemalloy Co. Inc., Foote Mineral, Pfizer Inc., Prince Manufacturing Co., Reichard-Coulston Inc., and United States Steel. Iron oxide pigments were used mainly in paints and coatings, construction materials, and ferrites and other magnetic and electronic applications.

Iron and Steel.—The year 1982 was disastrous for Pennsylvania steel producers. Raw steel production remained at approximately 25% of capacity, causing the State to drop from first to third place behind Indiana and Ohio. Pennsylvania blast furnaces shipped 5.5 million tons of pig iron valued at $1.2 billion, a decrease of nearly 63% in quantity and 61% in value compared with 1981 figures. To keep production in line with demand, steel companies reduced work forces and closed or curtailed marginal operations. United States Steel, the Nation's largest steelmaker, had more than 50% of its work force of 81,000 workers idled throughout the Nation, with only one of six blast furnaces operating in the Pittsburgh area. Bethlehem Steel, the second largest steel producer in the Nation, reduced its work force and closed operations in Johnstown and Bethlehem. J&L experienced similar circumstances, as did all other integrated steel producers. To trim expenses further, contract negotiations between union and company representatives reopened early with talks of worker concessions and givebacks, including productivity changes leading to profitable operations. At yearend, contract talks continued, with labor agreeing to tentative contract changes to insure job stability and security.

Although the steel industry was particularly affected by the national economic recessions, many steel mill operators were looking beyond 1982, expecting a modest growth in subsequent years. Companies continued to modernize but on a more conservative level.

Allegheny Ludlum, a specialty steel producer at West Leechburg, Westmoreland County, planned an $11.1 million modernization program to include improvements to productivity equipment for the annealing line. Patented during the year was a new stainless alloy for catalytic converters.

American Shear Knife Div. of Asko Inc., Homestead, Allegheny County, developed a disposable knife used for cutting scrap metal. The knife has four cutting edges and is discarded when all cutting edges are dull.

Armco Inc., Butler, Butler County, began operating a second continuous caster as part of a $55 million expansion program.

Babcock & Wilcox Co. Tubular Products Group began installation of a slot furnace and heat-treating equipment at its Koppel plant at Beaver Falls, Beaver County.

The new Bethlehem Steel product, galvalume, was being produced worldwide by eight firms under licensing agreements. Galvalume is an aluminum-zinc, alloy-coated sheet steel used in construction of preengineered buildings.

Carpenter Technology Corp., Reading, Berks County, was constructing a $112 million hot-rolling steel mill on Route 61, a few miles from the current plant.

Champ Corp. purchased from G+W two malleable iron foundries at Landisville and Lancaster, both in Lancaster County. Improvements were planned for the Landisville plant.

Colt Industries Inc.'s Crucible Stainless &

Alloy Div. plant at Midland, Beaver County, which officially closed October 15, 1982, may be purchased, according to a yearend announcement, by J&L.

Continental Copper & Steel Industries Inc. planned installation of saws and mill furnaces at its Braeburn Alloy Steel Div., Hanover, York County.

Cyclops Corp. began a $2.4 million improvement project at its plant at Titusville, Crawford County. Modernization is to include installation of high-speed rolling mills, grinding machinery, and annealing furnaces, with completion slated for late 1983.

Dynamet Inc., Washington County, opened a specialty steel alloy plant during the year. The new bar and rod mill will produce high-temperature alloys and specialty steels for aerospace industries.

Empire Steel Castings Inc., Reading, Berks County, was acquired by private interests early in the year. Products included stainless, carbon, and low-alloy steel castings for the pump and valve industries.

International Metals Reclamation Co. Inc. (INMETCO), Ellwood City, recycles approximately 40,000 tons of waste annually, converting flue dust, mill scale, and swarf (oily grindings) into a useful remelt alloy for the stainless steel industry. Pittsburgh Pacific Processing, a unit of INMETCO, recycles spent catalysts from the production of edible fats and oils by thermal decomposition. The Pittsburgh plant became operational in 1982, with a capacity to process 25 million pounds of catalysts annually.

J&L acquired Cannonsburg Metal Service Inc., an independent stainless steel coil polishing facility located south of Pittsburgh. J&L converted a billet caster at its Aliquippa Works to a seamless tube rounds caster with the option for easy conversion back to a billet caster. If the purchase of Colt Industries' Crucible Stainless and Alloy Div. is completed, J&L will have the facilities to become the Nation's largest producer of stainless sheet and strip, surpassing Allegheny Ludlum, the current leading producer.

Samuel G. Keywell Co. planned to relocate a specialty steel scrap-processing facility from Warren, Mich., to Midland owing to possible startup of stainless steel operations at the Crucible plant currently for sale.

Lansdowne Steel & Iron Co., Norton, Delaware County, received Department of Defense equipment to produce artillery shells for training purposes. At yearend, company officials pondered plant expansion or relocation to another State.

Lukens Inc., Coatesville, Chester County, a major producer of carbon, alloy, clad plate steels, and plate steel shapes, purchased General Steel Industries Inc. of St. Louis, Mo., a diversified firm providing machinery, equipment, and services to industrial and energy markets.

Sandvik Specialty Steel Co., a division of Sandvik Inc., Sweden, opened a new wire mill at Clarks Summit near Scranton. The wire products are to be used by health and industrial concerns.

Tippins Machinery Co., Etna, near Pittsburgh, received a turnkey contract for design and construction of a 112-inch plate and hot strip mill for Highveld Steel & Vanadium Corp. Ltd., Republic of South Africa. Completion of the plant was expected in mid-1983.

United States Steel announced formation of a new Mon Valley Works to include the Homestead, Edgar Thomson, National, Duquesne, and Clairton facilities, all in the Pittsburgh area along the Monongahela River. Not included was the Irvin plant, which previously was merged into the Gary, Ind., Works. Galvalume is to be produced at the Irvin plant under a licensing arrangement with Bethlehem Steel. United States Steel also announced addition of five new machine centers at its Johnstown plant; preliminary plans for possible conversion of foreign steel slabs into finished products at its Fairless Hills plant near Philadelphia; sale of three marine subsidiaries to Allen & Co.; and sale of the United States Steel building in Pittsburgh, with retention as corporate headquarters. Company sales of assets are to be redeployed to strengthen company operating structure.

Wheeling-Pittsburgh Corp. officials completed a new labor contract with union representatives late in 1982, reducing worker benefits but providing other guarantees as profitability returns.

A Bessemer converter was dedicated as a historic symbol of steel technology in late 1982. The 10-ton converter was the last to operate in the Nation and is on display in downtown Pittsburgh. The converter was superseded by more productive processes such as the open-hearth, basic-oxygen, and electric furnaces.

A film documentary entitled "Labor Day" was completed in the summer of 1982 portraying the steel industry and effects on steel-dependent communities. The documentary was filmed in steel towns such as

Brackenridge, Butler, and various Monongahela Valley cities, all situated near Pittsburgh.

Coke.—Coke production in Pennsylvania decreased owing to the depressed steel industry. Coke is used as a fuel and a reducing agent in steelmaking. During the year, two large steel producers in western Pennsylvania reduced coke output. United States Steel scheduled a 4-week shutdown of its huge Clairton plant, south of Pittsburgh, while Bethlehem Steel, Johnstown, Cambria County, closed its last coke oven after producing coke for 87 years in the area. Coke is to be produced at other, more modern Bethlehem Steel facilities, with the coke shipped by Conrail under a 5-year agreement involving lower freight rates owing to specially designed cars built by Bethlehem Steel at the Johnstown plant.

Although all beehive coke ovens have closed, one is being relit. Alverton Coke Co. fired up one beehive coke oven as part of the Scottsdale Coal & Coke Heritage Festival. The oven, in Fayette County, was closed after the festival.

Titanium.—A. Johnson & Co., a division of Axel Johnson Group, a Swedish company, began operating an electron-beam furnace, converting scrap titanium and other metals into ingot, strip, and slab. The furnace is located in Morgantown, Berks County.

Allegheny Ludlum and Sumitomo Metal Industries Ltd., Japan, formed a partnership to market titanium products. Titanium is to be imported and processed into plate, strip, and sheet at plants near Pittsburgh. The new partnership will be known as ALS Metals Co.

Zinc.—Pennsylvania ranked fourth nationally in 1982 in zinc mine production with 24,762 metric tons, or 8% of the national output. Zinc was used for galvanizing and in alloys and brass products; zinc oxides, for rubber products and in paints, ceramics, and other products.

G+W anticipated closure of its underground zinc mine in Friedensville, south of Allentown, owing to economic conditions. At yearend, the mine continued to operate, producing approximately 4,000 tons of concrete per month.[4]

New Jersey Zinc, Palmerton, Carbon County, reduced its work force and production of zinc oxides owing to poor market conditions. This plant was purchased for G+W in 1981.

St. Joe Resources Co., Monaca, Beaver County, reopened its smelter and zinc refinery several years ago with raw material derived from a large zinc ore body discovered in St. Lawrence County, N.Y. Concentrates from the new mine and mill were shipped by rail to the Monaca facility for further processing. Modernization at the plant included new Larvik furnaces, with a fourth furnace scheduled in 1983; other equipment was installed to recycle waste material. Current capacity of the smelter is 75,000 tons of zinc annually.

Other Metals.—New Jersey Zinc and Indium Corp. formed a joint venture company known as NJZ Alloys Inc. to produce indium. Concentrate from the New Jersey Zinc plant at Palmerton, Carbon County, was shipped to Indium for further processing. Indium is used in electronic and electrical products.

Imported pollucite and lepidolite from Canada and Zimbabwe was used by the Cabot Corp., KBI Div., in Revere, Bucks County. The ores were used to produce cesium and rubidium used in the production of high-voltage rectifier tubes and various light and bulb products.

The General Services Administration agreed to purchase from Johnson Matthey Inc., at Malvern, 600 troy ounces of iridium for the National Defense Stockpile. Industry sources estimate the selling price at $320 per troy ounce. Iridium, when added to platinum, produces an alloy withstanding high temperatures.

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[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.
[2]Pittsburgh Post-Gazette. USS Layoffs Total 19,530. Jan. 4, 1983.
[3]Aluminum Co. of America. 1982 Annual Report. P. 22.
[4]Wall Street Journal. G&W Set To Suspend Some Zinc Operations, Idling 147 Employees. Dec. 14, 1982, p. 4.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives (manufactured):			
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:			
Crane Co	300 Park Ave. New York, NY 10022	do	Lawrence.
Louisville Cement Co	501 South 2d St. Louisville, KY 40202	do	Do.
Penn-West Cement Co. Inc	R.D. 2 Cabot, PA 16023	do	Butler.
Société des Ciments Français	Tour Général, Quartier Villon Cédex 22 192088 Paris, La Défense France	do	Lehigh and Northampton.
Clays:			
Glen-Gery Corp	Box 1542 Reading, PA 19603	Pit	Adams, Berks, Northumberland, Union, York.
Harbison-Walker Refractories Co	2 Gateway Center Pittsburgh, PA 15222	Pit	Clearfield and Somerset.
Narvon Products Inc	Narvon, PA 17555	Pit	Lancaster.
Graphite (synthetic):			
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 Carbon 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	1421 Mauch Chunk Rd. Bethlehem, PA 18018	do	Northampton.
Iron and steel slag:			
Bethlehem Mines Corp.[1 2]	701 East 3d St. Bethlehem, PA 18016	do	Cambria.
Dunbar Slag Co	Box 666 Sharon, PA 16146	do	Mercer.
Standard Slag Co	1200 Stambaugh Bldg. Youngstown, OH 44503	do	Cambria.
Lime:			
Bethlehem Steel Corp	Martin Tower Bethlehem, PA 18016	do	Adams and Lebanon.
Marblehead Lime Co	300 West Washington St. Chicago, IL 60606	do	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	do	Lehigh and York.
Perlite Manufacturing Co	Box 478 Carnegie, PA 15106	do	Allegheny.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Philadelphia.
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	Dredge	Westmoreland.
Dravo Corp	4800 Grand Ave. Pittsburgh, PA 15222	do	Beaver.
Erie Sand Steamship Co	Box 153 Erie, PA 16512	do	Erie.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Construction —Continued			
Shippingport Sand & Gravel Co	355 5th Ave. Pittsburgh, PA 15222	Pit	Armstrong.
Warner Co.[1 2 3]	699 Briston Pike Morristown, PA 19067	Pit	Bucks.
Industrial:			
Glacial Sand & Gravel Co	Box 10 Kittanning, PA 16201	Pit	Armstrong.
McCrady Inc	Box 11566 Pittsburgh, PA 15238	Pits	Allegheny.
Pennsylvania Glass Sand Corp	Box 187 Berkeley Springs, WV 25411	do	Huntingdon.
Stone:			
Corson Lime Co.[2]	Box 177 Cleburn, TX 76031	Quarry	Montgomery.
General Crushed Stone Co	Box 231 Easton, PA 18042	do	Bucks, Chester, Delaware, Lancaster, Luzerne, Perry.
Glasgow Inc	Box 248 Glenside, PA 19038	do	Montgomery.
Martin Marietta Corp	Box 30013 Raleigh, NC 27612	do	Centre, Chester, Fayette, Northampton.
New Enterprise Stone & Lime Co. Inc	New Enterprise, PA 16664	do	Bedford, Blair, Cumberland, Franklin, Huntingdon, Somerset.
Sulfur (recovered):			
Atlantic Richfield Co	3144 Passyunk Ave. Philadelphia, PA 19145	Plant	Philadelphia.
British Petroleum Corp. Ltd	Box 428 Marcus Hook, PA 19061	do	Delaware.
Gulf Oil Corp	Box 7408 Philadelphia, PA 19101	do	Philadelphia.
Tripoli:			
Keystone Filler & Manufacturing Co	Muncy, PA 17756	Pit	Northumberland.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Lawrence.

[1]Also stone.
[2]Also lime.
[3]Also iron and steel slag.

The Mineral Industry of Puerto Rico, the Virgin Islands, and Pacific Island Possessions

The Puerto Rico section of 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 of the Commonwealth of Puerto Rico for collecting information on all nonfuel minerals.

By Doss H. White, Jr.[1]

PUERTO RICO

The value of Puerto Rico's nonfuel mineral output, excluding stone and sand and gravel, was $84 million in 1982, down $25.8 million from the value reported for cement, clays, and lime in 1981. Most of the island's mineral production was used by the construction industry. The depressed economy, prevalent throughout the Northern Hemisphere, forced construction activity to a virtual standstill.

Table 1.—Nonfuel mineral production in Puerto Rico[1]

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement, portland thousand short tons	1,226	$105,420	986	$81,822
Clays do.	200	474	162	298
Lime do.	34	3,884	37	1,906
Sand and gravel do.	NA	NA	NA	NA
Stone:				
Crushed do.	20,473	96,223	NA	NA
Dimension do.	105	2,040	NA	NA
Total[2]	XX	208,041	XX	84,026

NA Not available. 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	1980	1981	Minerals produced in 1981 in order of value
Aguadilla	$1,084	$977	Stone (crushed), stone (dimension).
Arecibo	4,692	2,196	Stone (crushed).
Guayama	336	W	Do.
Humacao	1,099	1,819	Do.
Mayaguez	3,141	2,221	Do.
Ponce	W	W	Cement, stone (crushed), lime, clays.
San Juan	W	W	Cement, stone (crushed), clays, stone (dimension).
Undistributed[1]	201,508	200,829	
Total[2]	211,859	208,041	

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 totals shown because of independent rounding.

Trends and Developments.—The trend of reduced construction activity and demand for construction mineral commodities continued throughout 1982. To add to the gloom surrounding the construction minerals industry, the U.S. Congress passed legislation in 1982 (Tax Equity and Fiscal Responsibility Act) that would reduce fiscal advantages to companies located on the island and could have a negative effect on the recovery of the construction industry.

In the 1950's, the Federal Government began "Operation Bootstrap" to encourage corporations to locate in Puerto Rico and other Caribbean countries. The program, which provided tax incentives to those firms locating in the Caribbean region, attracted hundreds of U.S. firms and provided over 150,000 jobs in Puerto Rico. As companies realized the advantages of locating facilities on the island, the construction industry prospered, as did the island's mineral producers, which provided mineral construction materials—cement, sand and gravel, and stone. From 1950 to 1981, the Commonwealth gross national product grew from $755 million to $11.8 billion.[2]

However, in 1982, Congress passed the Tax Equity and Fiscal Responsibility Act, which sharply reduced the income that companies could shelter in their Puerto Rican subsidiaries, thus attenuating major incentive to locate in Puerto Rico. This legislation could deter recovery by the island's construction industry, which would also affect the recovery of Puerto Rico's mineral producers.

Perhaps the single greatest problem facing the mining industry in Puerto Rico is the controversy over statehood versus continuing Commonwealth status versus island independence. A major issue in this controversy is the projected development of Puerto Rico's mineral resources. Several groups, El Comite de Arte y Cultura de Adjustos, Puerto Rico, Movimiento de Liberacion Nacional, and The New Movement in Solidarity with the Puerto Rican and Mexican Revolutions, oppose mineral development, and through speeches and publications have spread questionable information about the effects of mining.[3]

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—The slump in construction lessened demand for cement, and Puerto Rico's two cement companies decreased production for the second consecutive year. Output in 1982 was 496,000 tons below the 1980 record.

During 1982, Puerto Rico Cement Co. Inc. continued conversion of the Ponce cement plant kilns from fuel oil to coal. Three of the six wet-process kilns will be converted to dual firing capacity with coal as the primary fuel and oil as an auxiliary fuel. Included in the project is a pneumatic pump system for coal handling and a 40-ton-per-hour-capacity milling facility. The project, scheduled for completion in mid-1983, is expected to save the company approximately $6 million per year.[4]

San Juan Cement Co. Inc., San Juan, completed work on converting their plant at Dorado from oil to coal. The company also completed a successful test using graphite

dust, an industrial waste from the Union Carbide Corp.'s Yabucoa graphite facility, as a complementary energy source. The test objective was the burnability of the dust, the effects on operations, and clinker quality.

The two cement companies funded a $45,000 study on the effects of decontrolling the price of cement. The Consumer Affairs Department is expected to act on the study findings in 1983.

Clays.—Both Puerto Rico Cement and San Juan Cement mined clay as a raw material for cement manufacture. Paralleling the slump in cement production, clay output fell 38,000 tons below the previous year's level.

Graphite (Synthetic).—Union Carbide produced synthetic graphite electrodes at the company's Yabucoa plant. Petroleum coke, the principal raw material in electrode manufacture, was obtained from the company's Penuelas facility.

Lime.—Chemical-grade lime was produced by Puerto Rico Cement at the Ponce facility. Lime sales, primarily in Puerto Rico and the Virgin Islands, were for alumina production from bauxite, water purification, and S-type mason's lime.

Sulfur.—Puerto Rico Sun Oil Co. recovered elemental sulfur during the desulfurization step in oil refining.

U.S. VIRGIN ISLANDS

The U.S. Virgin Islands, consisting of 3 large and 62 smaller islands, is located approximately 34 miles east of Puerto Rico. The Virgin Islands nonfuel mineral industry consists of a bauxite-to-alumina complex owned by Martin Marietta Alumina Corp., two stone quarries, and an intermittent sand pit. Sulfur is recovered during oil refining by the Hess Oil Virgin Island Corp.

PACIFIC ISLAND POSSESSIONS AND TRUST TERRITORY OF THE PACIFIC ISLANDS

Stone and sand and gravel are the only two mineral commodities produced in the Pacific Island Possessions and Trust Territory of the Pacific Islands. Data are not available to document production and value.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, Ala.
[2]Chicago Tribune. Sept. 16, 1982.
[3]Close the Mines in Puerto Rico. Circular sponsored by Movemiento de Liberacion Nacional and The New Movement in Solidarity with the Puerto Rican and Mexican Revolutions.
[4]Rock Products. December 1982, p. 47.

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 was $4.8 million in 1982. This marked the third consecutive year that mineral sales declined, with the 1982 value $3.1 million below the record of $7.9 million in 1979.

Rhode Island's mineral production remained dependent primarily on conditions in the construction industry. Sand and gravel and stone were the only commodities mined in the State, and demand weakened with the downturn in construction activity in 1982.

Table 1.—Value of nonfuel mineral production in Rhode Island, by county[1]

(Thousands)

County	1981	1982	Minerals produced in 1982 in order of value
Kent	W	W	Sand and gravel (construction).
Newport	W	W	Stone (crushed), sand and gravel (construction and industrial).
Providence	W	W	Sand and gravel (construction), stone (crushed and dimension).
Washington	W	W	Stone (dimension).
Undistributed[2]	$5,164	[p]$4,841	
Total	5,164	[p]4,841	

[p]Preliminary. 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 and values indicated by symbol W.

Table 2.—Indicators of Rhode Island business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	479.0	482.0	+0.6
Unemployment	do.	36.0	49.0	+36.1
Employment (nonagricultural):				
Mining	do.	(1)	(1)	--
Manufacturing	do.	127.7	117.1	-8.3
Contract construction	do.	11.7	11.5	-1.7
Transportation and public utilities	do.	13.1	13.2	+.8
[2]Wholesale and retail trade	do.	81.0	79.5	-1.8
Finance, insurance, real estate	do.	21.0	21.1	+.5
Services[2]	do.	88.4	90.4	+2.3
Government	do.	58.5	57.8	-1.2
Total nonagricultural employment	do.	401.4	390.6	-2.7
Personal income:				
Total	millions	$9,678	$10,284	+6.3
Per capita		$10,156	$10,730	+5.7
Construction activity:				
Number of private and public residential units authorized		3,187	2,486	-22.0
Value of nonresidential construction	millions	$79.9	$69.4	-13.1
Value of State road contract awards	do.	$51.0	$23.6	-53.7
Shipments of portland and masonry cement to and within the State	thousand short tons	122	133	+9.0
Nonfuel mineral production value:				
Total crude mineral value	millions	$5.2	$4.8	-7.7
Value per capita, resident population		$6	$5	-16.7
Value per square mile		$4,348	$3,988	-8.3

[p]Preliminary.
[1]Included with "Services."
[2]Includes mining.

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.—Despite the general economic slowdown in 1982, several positive developments were reported in the State's metal manufacturing industry. Technical Materials Inc., Lincoln, developed an alloy that reduces the amount of gold needed for the manufacture of contacts and connectors in the electronics industry. According to the company, the new alloy, which basically combines a palladium-silver alloy with a small amount of gold, functions on an equivalent basis to gold with a savings of more than 80% of the cost of pure gold. Technical Materials boosted production capacity of the alloy, designated TMI 305, because of an expected increase in sales to electrical connector firms. Late in the year, Brush Wellman Inc., Cleveland, Ohio, purchased Technical Materials for about $46 million.[2]

Rhode Island Forging Steel Inc., Providence, announced plans to begin production of steel ingot in June 1983. The firm purchased the former facilities of the Washburn Wire Co. early in 1982. The minimill is designed for small-scale output of about 50,000 tons per year and employment of 50 to 75 workers. The firm plans to specialize in small ingot sizes for use by the defense and aerospace industries.[3]

Arconium Corp., Providence, began production of indium in October, becoming the fourth domestic producer. Indium is used primarily in a variety of low-melting-point alloys by the primary metals and instrument industries.

Tanury Bros. Inc., Lincoln, completed a reorganization-expansion program to broaden the base of industries the company serves. Under the program, Tanury Bros., an electroplater of instruments and jewelry, became one of three divisions of Tanury Industries. One of the new divisions, Electronic Surface Coatings Inc., an electroplater for the computer, defense, and electronic manufacturing industries, was formed in September when the Lincoln facility was expanded from 7,200 to 24,000 square feet. Also in September, the third division, Recovery Systems Inc., East Providence, a precious metal refiner that recycles scrap to bullion, was acquired.[4]

The Gorham division of Textron Inc. resumed production of stainless steel flatware at Providence in September. Production of stainless steel was phased-out at Gorham in the early 1970's and for the past

5 years the firm purchased stainless steel from Japan. The major problem with the Japanese imports, according to company officials, was long lead times on shipments that resulted in continuous inventory problems.[5]

Precision Industries Inc., Providence, a cutting tool maufacturer, announced expansion plans after purchasing machinery and equipment from the Greystone plant formerly operated by Brown & Sharpe Manufacturing Co. The plans included hiring up to 200 workers, increasing high-speed and carbide tool production, and restarting heat treatment operations.

Also during the year, New England Malleable Iron Co. filed for protection under Chapter 11 of the Federal Bankruptcy Code but continued in operation. New England Malleable was 1 of 10 gray iron foundries in Rhode Island with an estimated total employment of about 1,500 according to the "Directory of New England Manufacturers."

These developments were somewhat overshadowed by the State's high unemployment rate and depressed construction industry. The unemployment rate in Rhode Island was the highest among the six New England States, increasing 2.2% in 1982 to equal the U.S. average of 9.7%. Nationally, unemployment increased 2.1% in 1982; in the New England region, the rate increased 1.4%.[6]

Output of sand and gravel and stone declined primarily because of a downturn in construction. In 1982, 1.1 million tons of sand and gravel was mined, the lowest tonnage since 1959; housing units, a key indicator of construction activity, totaled 2,486. In 1979, when a record 3.5 million tons of sand and gravel was produced, housing units totaled 5,304.[7] The demand for crushed stone was similarly affected during this period with output decreasing from 249,000 tons in 1979 to 130,000 tons in 1982. Another indicator of construction activity, the value of contracts awarded as measured in dollars, dropped $112 million, or nearly 31% in 1982, compared with 1981 figures, and $146 million compared with 1979 figures.[8]

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Gem Stones.—Collection of gem stones by hobbyists added an estimated minor amount to the State's value of mineral production.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 3.

Again in 1982, construction sand and gravel was the leading mineral commodity produced in Rhode Island in terms of both quantity and value. The number of active pits declined from 22 in 1980 to 15 in 1982 as production plummeted to the lowest level in 23 years. The average price per ton of sand and gravel increased from $2.99 per ton in 1981 to $3.20 per ton in 1982. Of the State's five counties, Providence County was the leading producer followed by Washington County.

Industrial.—One company in Providence County produced industrial sand sold for molding and foundry applications.

Table 3.—Rhode Island: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	417	$1,744	$4.18
Gravel	NA	NA	NA	493	1,436	2.91
Sand and gravel (unprocessed)	NA	NA	NA	236	492	2.08
Total or average	e1,332	e$3,985	e$2.99	1,146	[1]3,671	3.20
Industrial sand	W	W	3.00	5	52	10.00
Grand total or average	W	W	e2.99	1,151	3,723	3.23

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

Table 4.—Rhode Island: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	W	W	$2.90
Plaster and gunite sands	W	W	4.59
Concrete products	W	W	4.50
Asphaltic concrete	115	$295	2.56
Road base and coverings	229	688	3.01
Fill	277	609	2.20
Snow and ice control	W	W	3.64
Other	525	2,079	3.96
Total	1,146	3,671	3.20

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

Stone.—To reduce reporting burdens and costs, the Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and finalized the following year.

Crushed.—Output dropped for the fourth consecutive year based on the estimated data.

Dimension.—Two companies, one in Providence County and the other in Washington County, quarried minor amounts of dimension stone.

[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.
[2]American Metal Market. Aug. 16, 1982, p. 27.
[3]———. Jan. 28, 1983, pp. 1, 16.
[4]———. Nov. 22, 1982, p. 10.
[5]———. Dec. 16, 1982, pp. 1, 7.
[6]Federal Reserve Bank of Boston. New England Economic Indicators. March 1983, p. B6.
[7]U.S. Department of Commerce, Bureau of Census. Construction Review. March-April 1983, p. 31.
[8]Rhode Island Department of Economic Development. Rhode Island Economic Trends—December and Year 1982. March 1983.

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	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	Box 101 Pawtucket, RI 02861	Pit	Do.
J. Santoro Inc	11 Herbert St. Providence, RI 02900	Pit	Do.
South County Sand & Gravel Co. Inc.	North Rd. Peace Dale, RI 02878	Pit	Do.
Stone:			
The Conklin Limestone Co. Inc	R.F.D. 1 Lincoln, RI 02865	Quarry	Do.
G.J.T. Realty Inc	Tiverton, RI 02878	____do	Newport.
Peckham Bros. Co. Inc	Box 193 Newport, RI 02840	____do	Do.
Tilcon Inc	875 Phoenix Ave. Cranston, RI 02920	____do	Providence.

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]

The value of mineral production in South Carolina in 1982 was $194.5 million, $11.2 million below that of 1981. The decrease in value resulted from a reduced demand for mineral commodities, which is traceable to the nationwide recession. However, despite the weakened economy, South Carolina continued to rank second nationally in the production of kaolin and vermiculite and third in mica (sericite). The State also ranked in the top 10 in ferroalloys, fuller's earth, and masonry cement production. In 1982, the State's extractive mineral industry consisted of 157 mining companies operating 383 mines, 10 more mines than in 1981.

Table 1.—Nonfuel mineral production in South Carolina[1]

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement (portland)	thousand short tons	1,765	$79,407	1,624	$66,385
Clays[2]	do.	1,632	28,600	1,535	28,166
Gem stones		NA	10	NA	10
Manganiferous ore	thousand short tons	r22	W	15	W
Sand and gravel:					
Construction	do.	e5,131	e13,240	4,727	13,170
Industrial	do.	803	10,531	720	10,902
Stone:					
Crushed	do.	14,825	49,830	p14,000	p53,000
Dimension	do.	18	1,109	p14	p904
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	21,936
Total		XX	r205,716	XX	194,473

eEstimated. pPreliminary. 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 South Carolina, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Abbeville	$2,173	$1,172	Stone.
Aiken	19,722	24,493	Clays.
Anderson	1,206	W	Stone.
Berkeley	W	W	Do.
Charleston	W	(3)	
Cherokee	3,769	3,054	Stone, clays, manganiferous ore, gold, silver, copper.
Chesterfield	W	W	Stone.
Colleton	W	(3)	
Dillon	W	(3)	
Dorchester	52,926	52,771	Cement, stone, clays.
Edgefield	W	84	Clays.
Fairfield	W	1,143	Stone.
Florence	W	(3)	
Georgetown	W	W	Stone.
Greenville	W	W	Do.
Greenwood	W	W	Stone, clays.
Horry	W	W	Do.
Jasper	W	(3)	
Kershaw	5,604	W	Sand and gravel (industrial), stone, clays.
Lancaster	W	W	Mica, clays.
Laurens	W	W	Vermiculite, stone.
Lexington	W	W	Sand and gravel (industrial), stone, clays.
Marion	W	W	Clays.
Marlboro	W	W	Do.
Oconee	318	495	Stone.
Orangeburg	41,501	43,715	Cement, stone, clays.
Pickens	W	W	Stone.
Richland	W	W	Stone, clays.
Saluda	71	W	Clays.
Spartanburg	3,303	3,206	Stone.
Sumter	W	W	Clays.
Union	W	(3)	
York	W	W	Stone, clays.
Undistributed[4]	64,187	62,342	
Sand and gravel (construction)	XX	e13,240	
Total[5]	194,779	205,716	

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, Lee, McCormick, Newberry, and Williamsburg.

[2]County distribution for construction sand and gravel are 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 values indicated by symbol W.

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

Trends and Developments.—Development of South Carolina's abundant mineral resources dates from early colonial times when clays, stone, and sand and gravel were used in the construction of homes and businesses. As early as 1773, local iron ore deposits were developed to provide raw material for iron manufacture in a series of Catalan forges situated along the Piedmont Slope. Prior to the beginning of the Revolutionary War, a blast furnace was operated on Allison's Creek in York County.[3] The State's fledgling iron industry was destroyed by the British, and rebuilding began in the 1780's.[4] In the 1800's, gold was discovered and several deposits were extensively developed.

Over the centuries, both the iron and gold industries waned as resources were depleted or became uneconomical to mine. However, the State's nonmetallic mineral industry continued to expand as the South Carolina Geological Survey became a leading factor in the discovery, testing, and reporting on the large variety of industrial minerals occurring in-State. Over the past two decades, mineral sales have added more than $1.5 billion to the economy of the State and have provided thousands of jobs in mining and processing to citizens of South Carolina.

During 1960-80, the value of South Carolina mineral output increased annually. However, the mineral industry, along with segments of South Carolina's industrial community, experienced significant short-term problems in demand and sales resulting from the national recession, which began in mid-1981. There has been a moderate decline in the State's economic activity since 1979, and mineral output has paralleled this decline. Although inflated unit prices have caused the value of mineral sales to increase during the past 5 years, output of mineral commodities (table 1) has decreased for 5 consecutive years.

Table 3.—Indicators of South Carolina business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,421.0	1,486.0	+4.6
Unemployment	do	119.0	161.0	+35.3
Employment (nonagricultural):				
Mining	do	1.9	1.7	-10.5
Manufacturing	do	389.8	362.2	-7.1
Contract construction	do	70.5	64.9	-7.9
Transportation and public utilities	do	54.0	53.9	-.2
Wholesale and retail trade	do	232.0	230.8	-.5
Finance, insurance, real estate	do	48.7	49.5	+1.6
Services	do	166.3	169.9	+2.2
Government	do	233.0	229.1	-1.7
Total nonagricultural employment	do	[1]1,196.1	1,162.0	-2.9
Personal income:				
Total	millions	$25,456	$27,123	+6.5
Per capita		$8,039	$8,468	+5.3
Construction activity:				
Number of private and public residential units authorized		19,652	17,237	-12.3
Value of nonresidential construction	millions	$237.3	$227.8	-4.0
Value of State road contract awards	do	$122.0	$87.7	-28.1
Shipments of portland and masonry cement to and within the State	thousand short tons	994	836	-15.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$205.7	$194.5	-5.4
Value per capita, resident population		$66	$61	-7.6
Value per square mile		$6,616	$6,262	-5.4

[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.

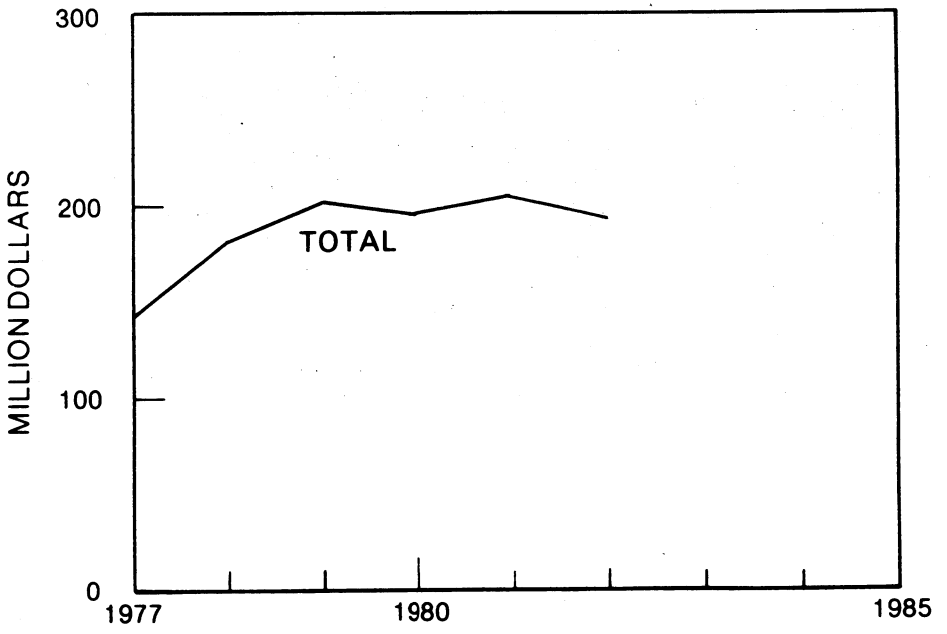

Figure 1.—Total value of nonfuel mineral production in South Carolina.

Also affected have been the State's primary metal producers. In 1982, Georgetown Steel Corp. orders slumped as steel demand fell and problems with the surface quality of steel products developed. Startup trouble with the facility's continuous caster and rolling mill forced traditional customers to buy elsewhere. At yearend, Korf Industries Inc. of the Federal Republic of Germany, the parent company, was successful in winning a $20 million extension from the U.S. Economic Development Administration to ensure the loan guarantee for the financially troubled steel corporation.

During the year, the State's primary ferroalloy producer, Macalloy Corp., filed for protection under chapter 11 of the Federal Bankruptcy Code. The worldwide reduction in steel output and competition from low-priced imports resulted in reduced prices and lower profits for U.S. ferroalloy producers. Nationally, the ferroalloy industry was operating at 28% of capacity in 1982.[5]

Despite the faltering economy and drop in demand for raw mineral commodities, the Port of Charleston continued as a major import point on the eastern seaboard for bulk mineral shipments. During the year, alumina, bauxite, colemanite, gypsum, and pumice were imported and clays (primarily kaolin) were exported through the port.

Legislation and Government Programs.—The South Carolina Geological Survey continued its role to encourage responsible economic development of the mineral and fuel resources of South Carolina through collection and interpretation of basic geoscience data.

During September, the South Carolina Geodetic Survey was transferred to the South Carolina Geological Survey. The former organization, the Office of Geographic Statistics, under the Division of Research and Statistical Sciences, was disbanded.

At the end of calendar year 1982, the combined staffs consisted of eight geologic, seven geodetic, and three secretarial employees. In addition to the permanent, full-time staff, seven temporary, part-time project geologists and assistants and one geodetic consultant aided considerably in the overall program.

Approximately 45 geologic field and laboratory projects were continued, initiated, or participated in by survey personnel, project geologists, and consultants during 1982. The two major projects of 1982 centered around (1) preparation of the Carolina Geological Society field trip guidebook, and (2) continuation of the U.S. Geological Survey CRIB (Computerized Resources Information Bank) Program.

Projects completed and in preparation for publication were (1) Geology of the Hartwell Dam, Iva and Antreville Quadrangles, Anderson and Abbeville Counties, South Carolina, by V. S. Griffin, Jr. (to be published in the map series), (2) Geology of the Salem Quadrangle, Oconee and Pickens Counties, South Carolina, by R. D. Hatcher, Jr. (to be published in the map series), (3) Geology of the Dongola Quadrangle, Horry and Marion Counties, South Carolina, by J. R. DuBar (to be published in the map series), and (4) Directory of South Carolina Mineral Producers, Sixth Edition, compiled by S. K. Mittwede (to be published as Circular 2). These completed projects have not been published because of budget cuts imposed on all State agencies in South Carolina.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

As in previous years, nonmetallic minerals comprised the majority of mineral commodities extracted or processed in South Carolina. The State's nonmetallic major nonfuel mineral production, in decreasing order of value, consisted of cement, stone, clays, and sand and gravel.

Cement.—Three companies, Giant Portland & Masonry Cement Co., Gifford-Hill & Co. Inc., and Santee Portland Cement Corp., comprised the State's cement producers. Two companies, Giant and Gifford-Hill, have cement manufacturing facilities in Dorchester County, and Santee is located in Orangeburg County.

All three companies manufactured portland types I and II cement; Giant and Santee also manufactured masonry cement.

Giant completed work at its Harleyville plant to use coal for kiln fuel rather than natural gas. The company will obtain coal from the Tennessee-Kentucky fields for the wet-process, four-kiln facility.

Santee, owned by Dundee Cement Co., a subsidiary of Holderbank Financiere Glarus S.A. of Switzerland, completed construction of a cement mill and clinker storage and handling system at its Holly Hill plant.

The new mill raises the company's rated capacity to 1.2 million tons of cement per year.

Clays.—The State's clay producers mined kaolin, common clay and shale, fuller's earth, and fire clay. During the year, the industry consisted of 20 companies operating 38 mines in 16 counties.

South Carolina ranked second in the output of kaolin or "china clay," a white clay with important applications in the manufacture of quality paper products, as well as fillers and carriers. A small amount was also sold unprocessed for use in refractory brick manufacture. Kaolin was mined from surface operations and processed by either dry or wet methods, depending on the desired end product.

Dry processing results in a lower cost, lower value product used as a paper filler, in ceramics and fiberglass, as a filler in adhesives and rubber, and as an insecticide carrier. Dry processing includes crushing, drying, pulverizing, and air-floating to remove coarse particles.

Wet processing produces a high-quality product used in paper coatings, inks, high-gloss paints, special ceramic applications such as whiteware and refractories, rubber, and other industrial applications. Wet processing includes fractionating a kaolin slurry with centrifuges or hydroseparators to produce a coarse and fine product. The coarse fraction has many applications similar to dry-processed kaolin. The fine fraction is bleached and dewatered. Sales are in both bagged and bulk form.

During 1982, South Carolina's kaolin industry consisted of 10 firms operating 17 mines in Aiken, Cherokee, Chesterfield, Kershaw, Lexington, and Richland Counties in the southwestern part of the State.

Table 4.—South Carolina: Kaolin sold or used by producers, by kind and use

(Short tons)

Kind and use	1981	1982
Airfloat:		
Adhesives	17,766	12,522
Animal feed and pet waste absorbent	--	2,193
Ceramics[1]	117,941	27,477
Fertilizers	15,444	7,929
Fiberglass	98,427	76,969
Paint	841	410
Paper coating and filling	3,292	2,799
Pesticides and related products	17,075	14,424
Plastics	13,966	11,075
Rubber	122,625	158,819
Other refractories[2]	5,202	4,737
Other uses[3]	50,744	81,708
Exports[4]	50,747	40,632
Total	514,070	441,694
Unprocessed: Face brick; firebrick, block and shapes; miscellaneous	210,654	174,052
Grand total	724,724	615,746

[1]Includes floor and wall tile, pottery, roofing granules, and sanitary ware.
[2]Includes refractory grogs and crudes and refractory mortar and cement.
[3]Includes common brick; catalysts (oil-refining); chemical manufacturing; animal oil; medical, pharmaceutical, and cosmetic; sewer pipe and roofing tile (1981); and miscellaneous.
[4]Includes ceramics, paper filling, pesticides and related products, rubber, and miscellaneous.

Common clay was produced by 14 companies operating 21 mines in 12 counties. The industry, located primarily in the northern and west-central part of the State, continued to experience a slump in sales as the construction industry, the principal market for common clay products, was depressed.

Fuller's earth, a nonplastic, opaline-bearing clay with a low bulk density and absorptive properties, was produced by South Carolina SCA Services Inc. in Sumter County. The material is extracted by open pit methods, dried, crushed, and calcined to produce absorbent products for oil, grease, and pet litter.

Fire clay was produced by one company in Cherokee County for face brick manufacture.

Colemanite.—Colemanite, a calcium borate mineral, was imported from mines in Turkey for use in fiberglass manufacture. Shipments were through the Port of Charleston and by rail to Kings Creek, S.C., where it was processed by Industrial Minerals Inc. under contract to Owens-Corning Fiberglas Corp. After crushing and grinding, the material was shipped, in bulk, to Owens-Corning in Anderson, S.C., and PPG

Industries Inc. in Shelby, N.C.

Feldspar.—Flotation tailings from the Lithium Corp. of America spodumene processing complex at Cherryville, N.C., were trucked to Spartan Minerals Corp. at Pacolet, S.C. The material was processed into a feldspar-silica mixture and marketed to the glass, ceramic whiteware, and fillers industries. During the year, the company completed installation of an additional ball mill and air classifier.

Mica.—Spartan Minerals at Pacolet used dry grinding to process mica trucked from the Lithium Corp. processing facility at Cherryville, N.C. The mica was recovered from the Cherryville flotation circuit during the processing of spodumene, a lithium mineral. Ground mica was sold for use in joint compound.

Sericite was produced by open pit mining by Mineral Mining Corp. in Lancaster County in the northern part of the State. The ore, a sericitic schist, is mined by open pit methods with dozers and front-end loaders. Dry grinding is used to produce a micaceous product used by the paint industry as an inert filler, in expansion joint cement, and by the electronics industry. The material is bagged and trucked to Kershaw for rail shipment.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

In 1982, 35 companies produced construction sand and gravel from 41 operations in 19 counties. Marlboro, Lexington, and Lancaster Counties were the leading producers, accounting for approximately 1.7 of the 4.7 million tons produced. Primary uses were as concrete and asphaltic aggregates and for fill.

Industrial.—Sand for industrial uses was produced at seven locations in Kershaw and Lexington Counties by five companies. Principal sales were to the fiberglass, foundry, and container glass industries.

Table 5.—South Carolina: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,353	$6,915	$2.94
Plaster and gunite sands	30	W	W
Concrete products	362	1,280	3.54
Asphaltic concrete	928	3,478	3.75
Road base and coverings	113	136	1.20
Fill	843	1,130	1.34
Railroad ballast	W	W	1.59
Other	98	231	2.36
Total or average	4,727	13,170	2.79

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

Table 6.—South Carolina: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	2,376	$4,717	$1.99
Gravel	NA	NA	NA	1,522	7,333	4.82
Sand and gravel (unprocessed)	NA	NA	NA	829	1,120	1.35
Total or average	e5,131	e$13,240	e$2.58	4,727	13,170	2.79
Industrial sand	803	10,531	13.11	720	10,902	15.14
Grand total or average	e5,934	e23,771	e4.01	5,447	24,072	4.42

eEstimated. NA Not available.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Vermiculite.—South Carolina is one of three States producing vermiculite, a hydrated sheet silicate similar to mica, which exfoliates to a low-density, bulky material when heated. In 1982, the State's vermiculite industry was composed of W. R. Grace & Co. and Patterson Vermiculite Co. in Laurens County. Both companies have mines in the Enoree district, approximately 70 miles northwest of Columbus. W. R. Grace operated two exfoliating plants, and Patterson operated one exfoliating facility.

The Enoree district is in the Inner Piedmont province, and the deposits are a series of deeply weathered pods, which can extend for several hundred feet. The weathered nature of the pods allows mining by bulldozers equipped with rippers.

After the ore is trucked to the mill, it is blended, broken by hydraulic monitors, deslimed, and dewatered. Processing includes delamination and comminution followed by wet concentration, commercial-grade separation, and storage.

Principal sales by W. R. Grace were for lightweight aggregate, loose fill insulation, and horticultural applications, while Patterson's output was used to produce its own horticultural products.

In 1982, W. R. Grace shipped both crude and exfoliated vermiculite; shipments of vermiculite at the Patterson operation were limited to the exfoliated product.

During the year, Moody Products Co. Inc. applied for multiple mining permits in the Enoree district. The company planned to begin plant construction in 1983.

METALS

For the past several years, metal mining in the State has been restricted to manganiferous ore and, more recently, a small amount of gold, silver, and copper from reworked tailings at a former gold mine. However, various metallic ores and ore concentrates from Florida, Australia, and South America were shipped into the State for the production of aluminum, ferroalloys, and iron and steel.

Aluminum.—Alumax Inc. operated a primary reduction facility in Berkeley County. Alumina for the 179,000-metric-ton-per-year capacity plant was imported from Australia through the Port of Charleston. The company operates two potlines to produce billets, slabs, and ingots.

Jim Walter Corp. began operating an aluminum rolling mill at Mount Holly in 1981 to produce aluminum coil. The mill was operating at full capacity in 1982.

Ferroalloys.—Macalloy Corp. produced ferrochrome alloys at a plant in Charleston. The corporation's Charleston plant, the only domestic producer of 50% to 55% charge chrome, filed for reorganization under chapter 11 of the Federal Bankruptcy Act. To control expenditures, the company scaled down plans for a heat recovery project with the U.S. Navy at Charleston. Originally, two furnaces were to be upgraded to recover steam as energy; plans were modified to convert a single furnace, reducing the cost by $39 million.

During 1982, the 120,000-ton-per-year capacity plant operated at a reduced capacity using only one of two furnaces. The company operated under an ore conversion agreement with Phibro Corp., Macalloy's largest creditor.

Gold.—Work continued on recovering gold, silver, and copper from tailings on the former Old Southern gold minesite in Cherokee County in northern South Carolina. Production and value data were unavailable for 1982.

Iron and Steel.—Georgetown Steel Corp., a subsidiary of Korf Industries Inc., operated a steel mill at Georgetown, and Nucor Corp., Charlotte, N.C., operated a mill at Darlington. The melt shop at Georgetown Steel is equipped with three 18-foot-diameter electric furnaces. In 1981, the MIDREX direct-reduction facility was closed, and in 1982, plant feed was limited to scrap. The recession, which slackened the industry's requirements for steel, along with initial startup problems with a new continuous caster and rolling mill, severely reduced output. Nucor's Darlington minimill is equipped with five electric furnaces with a total capacity of 500,000 tons of steel per year.

Manganiferous Ore.—Three companies in Cherokee County mined a manganiferous schist by open pit methods. The material was ground and sold in South Carolina and North Carolina for use as a coloring agent in brick manufacture.

Zircon.—M & T Chemicals Inc. ground zircon concentrate (zirconium silicate) at a plant in Andrew, Georgetown County. Crude zircon was shipped from Florida and Australia where it was recovered as a by-product of titanium mineral processing. Fine ground zircon was sold for foundry, wall tile, whiteware, and general ceramic applications.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, Ala.
[2]State geologist, South Carolina Geological Survey, Columbia, S.C.
[3]Wallace, D. D. South Carolina: A Short History. University of North Carolina Press, Chapel Hill, N.C., 1951, pp. 454-455.
[4]Mulholland, J. L. A History of Metals in Colonial America. University of Alabama Press, University, Ala., 1981, p. 147.
[5]Metals Week. Special Report: The Nonferrous Metals Industry in Mothballs (Part 2). Aug. 23, 1982, p. 9.

Table 7.—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.
Richtex Corp.[1]	Box 3307 Columbia, SC 29230	do	Kershaw, Richland, Sumter.
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 55 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.
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:			
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.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Granite (dimension):			
Comolli Granite Co	R.F.D. 2, Box 297 Kershaw, SC 29067	Quarry	Kershaw.
Matthews International Corp	Penn Circle East Pittsburgh, PA 15206	do	Do.
Limestone (crushed):			
Martin Marietta Aggregates	Box 1758 Columbia, SC 29202	Quarry and plant	Berkeley and Georgetown.
Vulcan Materials Co	Drawer 8834 Greenville, SC 29604	do	Cherokee.
Ware Bros. Construction Co	Box 626 Moncks Corner, SC 29461	Quarry	Berkeley.
Marl (crushed):			
Giant Portland & Masonry Cement Co.	Box 218 Harleyville, SC 29448	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 had 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]

The value of nonfuel minerals produced in South Dakota during 1982 was $135.7 million, the lowest level since 1978, and a 30% decrease from that of 1981. The main cause of this decrease was the drop in gold output effected by a 118-day miners' strike at the Homestake gold mine at Lead. Gold dropped an average of $84 per ounce from the 1981 level, and the quantity produced was the least of any year this century, except for a period during World War II when the Federal Government curtailed gold mining nationwide.

The State's nonfuel mineral output was derived from 3 metallic and 11 nonmetallic mineral commodities. Gains in quantity and value over those of 1981 were recorded in the production of beryllium concentrate, cement, common clay and shale, and gypsum. Gold, the leading commodity in value, accounted for 51% of the State total, followed by cement, 21%; dimension stone, 12%; sand and gravel, 6%; and beryllium concentrate, clays, feldspar, gem stones, gypsum, lime, scrap mica, silver, and crushed stone accounted for the remainder.

Accounting for less than 1% of the U.S. total, the State was ranked 34th in value of nonfuel mineral production.

Table 1.—Nonfuel mineral production in South Dakota[1]

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	6	$454	4	$383
Portland do.	450	23,290	520	27,978
Clays[2] do.	116	209	128	346
Gem stones	NA	70	NA	70
Gold (recoverable content of ores, etc.) troy ounces	278,162	127,854	185,038	69,558
Sand and gravel (construction) thousand short tons	e4,285	e9,224	3,816	8,604
Silver (recoverable content of ores, etc.) thousand troy ounces	56	587	26	209
Stone:				
Crushed thousand short tons	2,985	9,085	p2,600	p7,400
Dimension do.	50	17,543	p48	p16,270
Combined value of beryllium, clays (bentonite), feldspar, gypsum, lime, and mica (scrap)	XX	6,382	XX	4,855
Total	XX	r194,698	XX	135,673

eEstimated. pPreliminary. rRevised. 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.

Among the various mineral commodities produced during the year, the value of gold produced in South Dakota ranked 2d among 12 States; dimension stone, 3d of 38; feldspar, 6th of 6; mica, 6th of 7; silver, 14th of 16; gypsum, 19th of 22; cement, 27th of 40; clays, 29th of 44; lime, 29th of 39; crushed stone, 39th of 48; and construction sand and gravel, 42d of 50.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Beadle	$54	(3)	
Brookings	463	(3)	
Brown	278	(3)	
Brule	W	(3)	
Butte	W	W	Clays.
Campbell	W	(3)	
Charles Mix	227	(3)	
Clark	76	(3)	
Clay	48	(3)	
Codington	W	(3)	
Corson	10	(3)	
Custer	W	$647	Stone (crushed), feldspar, mica, beryllium.
Davison	246	(3)	
Day	82	(3)	
Deuel	95	(3)	
Douglas	W	(3)	
Fall River	433	470	Stone (crushed).
Faulk	67	(3)	
Grant	W	17,543	Stone (dimension).
Gregory	218	(3)	
Hamlin	W	(3)	
Hand	W	(3)	
Hanson	W	W	Stone (crushed).
Hughes	W	(3)	
Hutchinson	W	(3)	
Hyde	50	(3)	
Jerauld	43	(3)	
Jones	31	(3)	
Kingsbury	W	(3)	
Lake	222	(3)	
Lawrence	166,606	W	Gold, silver, stone (crushed).
Lyman	49	(3)	
McPherson	W	(3)	
Marshall	W	(3)	
Meade	W	15	Stone (crushed).
Miner	35	(3)	
Minnehaha	3,586	2,995	Stone (crushed).
Moody	W	(3)	
Pennington	W	32,807	Cement, lime, stone (crushed), clays, gypsum, mica.
Perkins	W	(3)	
Potter	67	(3)	
Roberts	W	(3)	
Sanborn	W	(3)	
Spink	W	(3)	
Sully	347	(3)	
Tripp	220	(3)	
Turner	74	(3)	
Union	79	(3)	
Walworth	43	(3)	
Yankton	W	W	Stone (crushed).
Undistributed[4]	54,109	130,998	
Sand and gravel (construction)	XX	e9,224	
Total[5]	227,854	194,698	

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, Bon Homme, Buffalo, Dewey, Edmunds, Haakon, Harding, Jackson, Lincoln, McCook, Mellette, Shannon, Stanley, Todd, and Ziebach.

[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, sand and gravel that cannot be assigned to specific counties (1980) and values indicated by symbol W.

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

Table 3.—Indicators of South Dakota business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	335.0	328.0	-2.1
Unemployment	do.	17.0	18.0	+5.9
Employment (nonagricultural):				
Mining[1]	do.	2.9	2.3	-20.7
Manufacturing	do.	25.9	25.0	-3.5
Contract construction	do.	9.7	7.8	-19.6
Transportation and public utilities	do.	12.8	12.5	-2.3
Wholesale and retail trade	do.	63.9	61.8	-3.3
Finance, insurance, real estate	do.	11.4	11.8	+3.5
Services	do.	51.6	52.3	+1.4
Government	do.	57.8	56.6	-2.1
Total nonagricultural employment[1]	do.	236.0	230.1	-2.5
Personal income:				
Total	millions	$6,059	$6,564	+8.3
Per capita		$8,837	$9,506	+7.6
Construction activity:				
Number of private and public residential units authorized		1,502	1,360	-9.5
Value of nonresidential construction	millions	$69.9	$54.2	-22.5
Value of State road contract awards	do.	$60.5	$78.0	+28.9
Shipments of portland and masonry cement to and within the State	thousand short tons	243	197	-18.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$194.7	$135.7	-30.3
Value per capita, resident population		$280	$196	-30.0
Value per square mile		$2,510	$1,761	-29.8

[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.

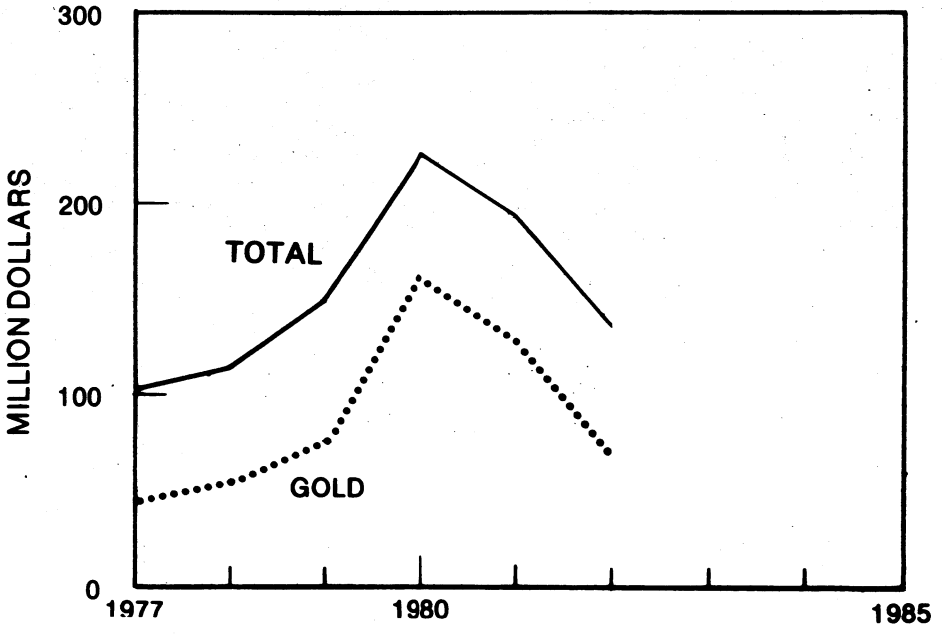

Figure 1.—Value of mine production of gold and total value of nonfuel mineral production in South Dakota.

Trends and Developments.—In late March, Homestake Mining Co. reduced its work force at the gold mining operation in Lead; the elimination of 33 jobs marked the first time since 1942 that anyone had been laid off at the mine. The company indicated that the reduction was due to falling gold prices and the company's attempt to keep the mine at a break-even point.

Near midyear, Homestake announced plans for an open pit gold mine near the surface facilities of its current underground mine. Known locally as the "opencut," the site was the original gold discovery area and was worked to shallow depths by both open pit and underground methods in earlier years. Ore is to be crushed at the site and hauled to the company's nearby mill in Lead for processing. About 25 million tons of waste rock must be removed to reach the ore at a depth of about 450 feet.

In early spring, the State-owned cement plant in Rapid City, the only cement-manufacturing facility in South Dakota, cut its production in half because of slow sales. The "wet process" side of the plant, which accounts for about one-half of the plant's production capacity, was shut down; however, production continued on the "dry process" side.

A slowdown in oilfield activities and in the steel industry caused American Colloid Co., which mines and processes bentonite near Belle Fourche, to cut back production and lay off workers during the year. About midyear, the company started operating on a reduced workweek. In early August, the austerity went one step further when the company laid off a substantial number from its work force.

The National Sand & Gravel Association honored Birdsall Sand & Gravel Co. Inc., Rapid City, for its safety accomplishments. The company's Wasta plant was the national winner of the Association's 1981 safety contest for Class F size operations (those producing less than 60,000 tons annually).

A 118-day strike by about 1,300 production and maintenance workers at the Homestake gold mine ended on September 26 when members of United Steelworkers of America Union Local 7044 and Homestake agreed on a new 44-month contract. Over the next 3 years, the contract gives miners raises of 6%, 7%, and 8%, plus an improved gold bonus, pension plan, and better vacation and insurance benefits than the previous contract provided. The strike, the second and longest in the mine's 106-year history, caused an economic pinch in the northern Black Hills where Homestake has a monthly payroll of about $3 million. The strike also cost South Dakota an estimated $2 million in lost gold severance taxes.

Exploration activities for nonfuel minerals remained at nearly the same level as in 1981. In 1982, the State issued 14 permits to firms interested in nonfuel mineral exploration, principally for precious metals.

Additionally, the State issued approximately 50 mining permits to various firms and government agencies planning mining operations within South Dakota. Except for three permits—two to mine gold, one each in Custer and Lawrence Counties, and another to mine tin, tantalum, and mica in Lawrence County—all others were for extracting rock and aggregate-related materials.

Employment.—According to figures from the South Dakota Department of Labor in its monthly Labor Bulletin, average employment in the State's mining industry during 1982 totaled 2,300 workers, a decrease of approximately 21% compared with that of 1981. On the average, mining-industry workers accounted for about 1% of the State's total nonagricultural work force. Average weekly earnings of mining employees during the last quarter of 1982 were approximately $398, a 4% decrease from the average weekly earnings during the same period of 1981.

Legislation and Government Programs.—The South Dakota Legislature enacted a number of bills during its 1982 session that affect the mining industry and mineral-resource development in the State. Highlights of the legislation were a comprehensive rewriting of the State's mining laws, added protection for surface owners without mineral rights to their land, and the moderation of requirements for permits and hearings to encourage mineral exploration. Bill numbers and titles covering this legislation included the following: HB 1001—Mineral Mining and Milling; HB 1002—Mineral Exploration; HB 1003—Uranium Exploration; and HB 1004—Compensation to Property Owners.

In the Federal fiscal year 1982, the State received nearly $1.3 million from the U.S. Department of the Interior as its 50% share of receipts that the Federal Government collected within the State under the Mineral Leasing Act of 1920. The monies were derived from mineral leasing rents, royal-

ties, and bonuses on Federal lands.

Effective July 1, 1982, all reponsibility for administering the State's oil and gas activities was transferred from the South Dakota Geological Survey to the State's Office of Minerals and Mining, Department of Natural Resources. The transfer was designed to consolidate State regulatory functions.

The Mining and Mineral Resources and Research Institute at the South Dakota School of Mines and Technology in Rapid City, which was created under title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Beryllium.—Three producers in Custer County reported hand-cobbed beryllium concentrate output. Although the quantity and value of the 1982 production exceeded that of 1981 by more than 200%, total output remained small.

Gold.—South Dakota gold produced during 1982 decreased 33% in quantity and 46% in value compared with 1981 figures. Accounting for 13% of the total U.S. gold production in 1982, the State's entire reported output came from Homestake's underground mining operation at Lead. The recovery grade of gold from the 1.1 million metric tons of lode mine ore milled during the year increased from 0.15 ounce per ton in 1981 to 0.16 ounce per ton.

According to the Homestake 1982 annual report, ore reserves at the Homestake Mine in Lead were 17,518,000 tons with an average grade of 0.22 ounce per ton. The average cost per ounce of gold produced during the 8 months of operation in 1982 was reduced to about $300, compared with $342 in 1981. Standby costs of almost $9 million during the strike increased the overall cost per ounce of gold production by $48 to $348 per ounce. Exploration work at Homestake's Lead operation in 1982 was intensified in the old opencut workings to define low-grade reserves that offer potential benefits through surface mining. A $4.8 million drilling program was undertaken to confirm reserves in the opencut area. All permits required to conduct surface mining operations at the site were obtained near midyear. The company said commercial development would depend on the results of additional engineering studies.

Work that began during the year to raise Homestake's Grizzly Gulch tailings disposal dam 50 feet to increase its storage capacity is to be completed by mid-1983. An additional 50 feet of lift is contemplated by 1992, with the option of adding yet another 50 feet after the turn of the century.

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)
1978	1	--	1,442	285,512	$55,261	53	$287
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
1876-1982	NA	NA	NA	37,993,771	1,746,669	13,531	14,810

NA Not available.
[1]Excludes placer gravel.

Silver.—Compared with 1981 figures, silver production, all obtained as a coproduct with gold produced at the Homestake Mine at Lead, decreased 54% in quantity and 64% in value. The average price of silver dropped to $7.95 per ounce in 1982, $2.57 per ounce less than in 1981.

NONMETALS

Cement.—All cement manufactured in South Dakota during 1982 came from the State-owned plant in Rapid City. This output, consisting of three types of portland cement and a prepared masonry cement, decreased 9% in quantity and 6% in value from that of 1981. The unit price of the portland and masonry cement marketed rose to record highs of $53.77 and $88.66 per ton, respectively. With a rated production capacity of about 1.1 million tons per year when utilizing its three wet-process and one dry-process kilns, the plant operated at less than one-half of capacity for the year. Most of the 1982 production was from the dry-process side of the plant. Approximately 1.1 million tons of State-produced nonfuels—including clay and shale, gypsum, iron ore, limestone, and sand—was consumed in manufacturing the cement produced.

During the year, plant officials opened new sales and distribution terminals in Casper, Wyo., and Denver, Colo., and developed a new rail distribution plant in North Dakota.

Ready-mix companies were the largest end users of the portland cement manufactured, accounting for approximately 55% of the 1982 shipments. Shipments of portland cement from the plant were handled 91% by truck and the remainder by rail. Approximately 96% of these shipments were in bulk form.

Clays.—Crude bentonite, from South Dakota and out of State, was processed at American Colloid Co.'s plant near Belle Fourche in Butte County. Output of the processed material decreased both in quantity and value compared with that of 1981, mainly because of reduced activities within the oil and steel industries, principal consumers of the processed material. Other uses of the material marketed in 1982 included animal feed, waterproofing, and a host of miscellaneous uses. Among the various types of clay mined and/or processed in South Dakota during 1982, bentonite accounted for most of the total clay value credited to the State.

Common clay and shale was mined in Pennington County by the State for use in manufacturing cement and by Dakota Block Co. to make an expanded aggregate used in concrete blocks and structural concrete products. The quantity and value of the 1982 production rose modestly over that of 1981. The unit value of the material produced increased to a record high of $2.70 per ton.

Feldspar.—Production of hand-cobbed feldspar dropped both in quantity and value from the 1981 level. The crude ore, obtained from several small mining operations in the pegmatite district of the southern Black Hills area, was processed at a grinding mill that Pacer Corp. operated in Custer. Shipments of the processed material went to markets in a dozen or more States, Canada, and Mexico. The bulk of the ground product was used in pottery with lesser amounts used in enamels.

Gem Stones.—No commercial gem stone mining operations were reported in South Dakota during 1982. The value shown in this chapter represents an estimate for material collected by rockhounds, mineral collectors, and other hobbyists.

Gypsum.—A single mine in Pennington County accounted for South Dakota's entire gypsum output in 1982. The State-operated mine produced crude material that was used exclusively in manufacturing cement at the State-owned cement plant in Rapid City. The quantity and value of the material mined increased significantly over that of 1981.

Lime.—Pete Lien & Sons Inc., the sole producer of lime in the State, produced hydrated lime and quicklime at a plant in Rapid City. Lime output during the year decreased moderately both in quantity and value compared with that of 1981. The average unit price of the lime marketed during 1982 remained at approximately the same level as that of 1981.

During 1982, 21,000 tons of lime, obtained from all domestic sources, was consumed within the State.

Mica.—Concepts West Inc. and Pacer Corp. produced a small amount of hand-cobbed mica from operations in Custer County. The average unit price of the material marketed in 1982 increased approximately 4% above the 1981 level.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted

for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

The quantity and value of construction sand and gravel produced in 1982 decreased 11% and 7%, respectively, from levels attained in 1981. During the year, 86 firms and government agencies operated at 108 sites throughout 48 of the State's 66 counties. Eight companies, operating in 16 locations, produced in excess of 100,000 tons each during 1982 and collectively accounted for 47% of the State's output. Meade, Minnehaha, and Pennington Counties each recorded production in excess of one-quarter million tons and collectively accounted for 29% of the State total.

Sand and gravel produced by individual companies during 1982 varied widely. Forty-one firms produced less than 25,000 tons; 36, between 25,000 and 100,000 tons; 6, between 100,000 and 200,000 tons; and 3, in excess of 200,000 tons.

In 1982, sand and gravel was predominantly used for road base and coverings, accounting for approximately 52% of the total. Other uses, in descending order of amount consumed, were for concrete aggregate, asphaltic concrete and other bituminous mixtures, fill, and other miscellaneous uses.

Table 5.—South Dakota: Construction sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	NA	NA	NA	690	$2,245	$3.26
Gravel	NA	NA	NA	2,844	5,980	2.10
Sand and gravel (unprocessed)	NA	NA	NA	283	378	1.34
Total[1] or average	e4,285	e$9,224	e$2.15	3,816	8,604	2.25

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Table 6.—South Dakota: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	808	$3,153	$3.90
Plaster and gunite sands	6	29	4.58
Concrete products	W	10	W
Asphaltic concrete	640	1,334	2.09
Road base and coverings[1]	1,983	3,483	1.76
Fill	266	338	1.27
Snow and ice control	65	155	2.36
Railroad ballast	W	78	W
Other	47	24	1.28
Total or average	[2]3,816	8,604	2.25

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (cement).
[2]Data do not add to total shown because of independent rounding.

Table 7.—South Dakota: Construction sand and gravel sold or used by producers, by county

County	1980			1982		
	Number of mines	Quantity (thousand short tons)	Value (thousands)	Number of mines	Quantity (thousand short tons)	Value (thousands)
Beadle	1	36	$54	1	23	$23
Bon Homme	--	--	--	1	33	35
Brookings	3	144	463	1	W	W
Brown	6	146	278	2	70	182
Butte	2	W	W	1	24	36
Charles Mix	3	130	227	3	79	156
Clark	1	W	76	1	54	75
Clay	1	32	48	1	23	30
Corson	1	6	10	1	5	10
Custer	1	14	16	--	--	--
Davison	5	134	246	1	W	W
Day	3	62	82	1	48	89
Deuel	3	84	95	3	94	204
Dewey	--	--	--	1	26	49
Fall River	2	76	285	2	39	181
Faulk	1	41	67	1	19	33
Gregory	5	128	218	4	81	142
Haakon	--	--	--	1	9	16
Hamlin	2	W	W	3	37	40
Hanson	1	22	29	2	3	3
Harding	--	--	--	2	40	40
Hughes	2	24	W	1	3	9
Hyde	1	50	50	3	54	100
Jerauld	2	32	43	3	22	31
Jones	1	29	31	1	70	90
Lake	2	W	222	2	93	317
Lyman	1	34	49	--	--	--
Meade	1	W	W	5	517	1,165
Miner	2	32	35	2	W	W
Minnehaha	8	595	864	6	331	516
Pennington	5	182	679	5	270	963
Potter	1	67	67	--	--	--
Roberts	2	W	W	9	120	292
Sully	2	84	347	1	80	509
Tripp	1	172	215	--	--	--
Turner	3	50	74	2	W	W
Union	3	70	79	3	68	76
Walworth	2	38	43	1	37	55
Yankton	4	275	675	4	94	203
Undistributed[1]	r25	1,421	2,579	27	1,350	2,931
Total[2]	109	4,209	8,243	108	3,816	8,604

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]Includes Brule (1980), Campbell, Codington, Douglas, Grant, Hand, Hutchinson, Kingsbury (1980), Lawrence, McPherson, Marshall, Moody, Perkins, Sanborn, and Spink Counties, sand and gravel that cannot be assigned to specific counties, and data indicated by symbol W.

[2]Data may not add to totals shown because of independent rounding.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its survey of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and finalized the following year.

Crushed.—The estimated quantity of crushed stone produced during the year was slightly less than that of 1981 and 33% below the record level set in 1979.

Dimension.—Output of dimension granite in 1982 was estimated to have decreased 4% in quantity and 7% in value from the 1981 levels.

[1]State Liaison Officer, Bureau of Mines, Minneapolis, Minn.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Beryllium concentrate:			
Bland Mining	Route 3, Box 18 Custer, SD 57730	Mines	Custer.
Stratton Mining Co	Box 252 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.
Dakota Block Co	Box 2920 Rapid City, SD 57709	do	Pennington.
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Open pit mine	Do.
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.
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.
Mica:			
Concepts West Inc	Box 706 Rapid City, SD 57709	Mine and dry-grinding plant.	Custer.
Pacer Corp	Box 912 Custer, SD 57730	do	Do.
Sand and gravel (construction):			
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, 1981):			
Limestone:			
Centennial Quarry Co	Box 311 Spearfish, SD 57783	Quarry and plant	Do.
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, Meade, Pennington.
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Quarry and plant	Pennington.
Sandstone:			
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.
Stone (dimension, 1981):			
Granite:			
Cold Spring Granite Co	Cold Spring, MN 56320	Quarries	Grant.
Dakota Granite Co	Box 1351 Milbank, SD 57252	Quarry	Do.
Delano Granite Works Inc	Delano, MN 55328	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 Donald K. Harrison[1] and Robert W. Johnson[2]

The value of Tennessee's nonfuel mineral production in 1982 was $378.8 million, $42.4 million less than that of 1981. Commodities produced in 1982 were barite, cement, clays, copper, lime, phosphate rock, pyrites, sand and gravel, stone, zinc, and byproduct silver and germanium. Mineral commodities processed or manufactured in the State included alumina, ferroalloys, graphite, perlite, manganese, rare earths and thorium, titanium dioxide, and vermiculite.

The State was the Nation's leading producer of zinc, ball clay, and pyrites, ranked third in synthetic graphite production, fourth in phosphate rock production, and fifth in ferroalloy shipments.

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

Mineral	1981 Quantity	1981 Value (thousands)	1982 Quantity	1982 Value (thousands)
Cement:				
Masonry thousand short tons	66	$3,209	W	W
Portland do.	974	39,378	763	$36,689
Clays do.	1,047	23,134	766	20,107
Gem stones	NA	5	NA	5
Phosphate rock thousand metric tons	1,328	16,201	897	11,596
Sand and gravel:				
Construction thousand short tons	e8,830	e24,130	5,051	15,917
Industrial do.	1,142	5,610	468	4,826
Stone (dimension) do.	11	1,063	p10	p1,012
Zinc (recoverable content of ores, etc.) metric tons	117,684	115,597	121,306	102,882
Combined value of barite, copper, gold (1981), lime, pyrites, silver, stone (crushed), and value indicated by symbol W	XX	r192,822	XX	185,718
Total	XX	r421,149	XX	378,752

eEstimated. pPreliminary. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Anderson	W	W	Stone (crushed), clays.
Bedford	W	W	Stone (crushed).
Benton	W	W	Stone (crushed), sand and gravel (industrial).
Bledsoe	$114	--	
Blount	W	W	Stone (crushed), stone (dimension).
Bradley	W	W	Stone (crushed).
Campbell	W	$4,082	Stone (crushed), sand and gravel (industrial).
Cannon	W	179	Stone (crushed).
Carroll	W	W	Sand and gravel (industrial), clays.
Carter	W	W	Stone (crushed).
Claiborne	W	W	Do.
Clay	W	W	Do.
Cocke	219	167	Do.
Coffee	W	W	Do.
Cumberland	W	5,779	Stone (crushed), stone (dimension).
Davidson	W	W	Stone (crushed), clays.
Decatur	W	2,383	Stone (crushed).
DeKalb	W	W	Do.
Dickson	W	W	Do.
Dyer	364	(3)	
Fayette	W	(3)	
Fentress	811	866	Stone (crushed), stone (dimension).
Franklin	W	3,557	Stone (crushed).
Gibson	W	W	Clays.
Giles	W	W	Phosphate rock, stone (crushed).
Grainger	W	W	Zinc, stone (dimension), stone (crushed).
Greene	W	921	Stone (crushed).
Grundy	186	--	
Hamblen	W	W	Do.
Hamilton	28,502	19,644	Cement, stone (crushed), clays.
Hardeman	W	(3)	
Hardin	W	W	Stone (crushed).
Hawkins	W	W	Do.
Henry	7,687	7,475	Clays.
Hickman	W	W	Phosphate rock.
Humphreys	W	327	Stone (crushed).
Jackson	W	W	Do.
Jefferson	58,959	75,631	Zinc, stone (crushed).
Johnson	W	W	Stone (crushed).
Knox	r45,508	47,494	Cement, zinc, stone (crushed), clays.
Lauderdale	W	(3)	
Lawrence	685	W	Stone (crushed).
Lincoln	W	1,245	Do.
Loudon	W	W	Stone (crushed), barite.
McMinn	W	W	Lime, stone (crushed).
McNairy	W	(3)	
Macon	W	W	Stone (crushed).
Madison	51	(3)	
Marion	8,955	W	Cement, stone (crushed).
Marshall	430	W	Stone (crushed).
Maury	W	W	Phosphate rock, stone (crushed).
Meigs	W	W	Stone (crushed).
Monroe	1,438	1,489	Do.
Montgomery	W	W	Do.
Moore	669	612	Do.
Morgan	54	54	Do.
Obion	578	(3)	
Overton	W	W	Stone (crushed).
Pickett	75	71	Do.
Polk	40,170	70,265	Pyrites, copper, zinc, silver, gold.
Putnam	W	1,226	Stone (crushed).
Rhea	W	W	Do.
Roane	W	W	Do.
Robertson	W	W	Do.
Rutherford	2,504	3,346	Do.
Sequatchie	W	W	Do.
Sevier	W	W	Do.
Shelby	8,113	(3)	
Smith	W	W	Zinc, stone (crushed).
Stewart	W	W	Stone (crushed).
Sullivan	18,239	W	Cement, stone (crushed), clays.
Sumner	W	W	Stone (crushed).
Tipton	1,318	(3)	
Unicoi	W	W	Stone (crushed).
Union	r11,641	W	Lime, stone (crushed).

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Van Buren	$110	$124	Lime, stone (crushed).
Warren	W	W	Do.
Washington	W	W	Stone (crushed), clays.
Wayne	W	(3)	
Weakley	13,295	13,500	Clays.
White	W	W	Stone (crushed).
Williamson	W	W	Phosphate rock, stone (crushed).
Wilson	992	W	Stone (crushed).
Undistributed[4]	142,169	136,280	
Sand and gravel (construction)	XX	e24,130	
Total[5]	393,835	421,149	

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: Cheatham, Chester, Crockett, Hancock, Haywood, Henderson, Houston, Lake, Lewis, Perry, Scott, and Trousdale.

[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 industrial sand and gravel and gem stones that cannot be assigned to specific counties and values indicated by symbol W.

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

Table 3.—Indicators of Tennessee business activity

	1981	1982p	Change, percent
Employment and labor force, annual average:			
Total civilian labor force thousands	2,118.0	2,131.0	+0.6
Unemployment do	193.0	252.0	+30.6
Employment (nonagricultural):			
Mining[1] do	10.0	9.8	-2.0
Manufacturing do	508.6	468.0	-8.0
Contract construction do	76.2	71.1	-6.7
Transportation and public utilities do	86.7	83.0	-4.3
Wholesale and retail trade do	379.9	367.5	-3.3
Finance, insurance, real estate do	79.6	79.9	+.4
Services do	304.4	313.7	+3.1
Government do	311.7	295.3	-5.3
Total nonagricultural employment[1] do	1,757.1	1,688.3	-3.9
Personal income:			
Total millions	$38,969	$41,156	+5.6
Per capita	$8,450	$8,849	+4.7
Construction activity:			
Number of private and public residential units authorized	11,839	15,088	+27.4
Value of nonresidential construction millions	$531.5	$644.4	+21.2
Value of State road contract awards do	$169.0	$229.5	+35.8
Shipments of portland and masonry cement to and within the State thousand short tons	1,300	1,154	-11.2
Nonfuel mineral production value:			
Total crude mineral value millions	$421.1	$378.8	-10.0
Value per capita, resident population	$91	$81	-11.0
Value per square mile	$9,886	$8,966	-9.3

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.

Trends and Developments.—Nationally, the construction and metals industries were particularly hard hit during the continuing recession. Because Tennessee had an above average number of businesses related to these industries, the State's economy suffered more than the national average during 1982.[3] This continuing decline in construction was mirrored in the State's lower output of most construction mineral commodities (sand and gravel, stone, cement, and clays).

Tennessee's manufacturing sector was generally oriented toward construction, with more than 11% of manufacturing employment related to that job category. Di-

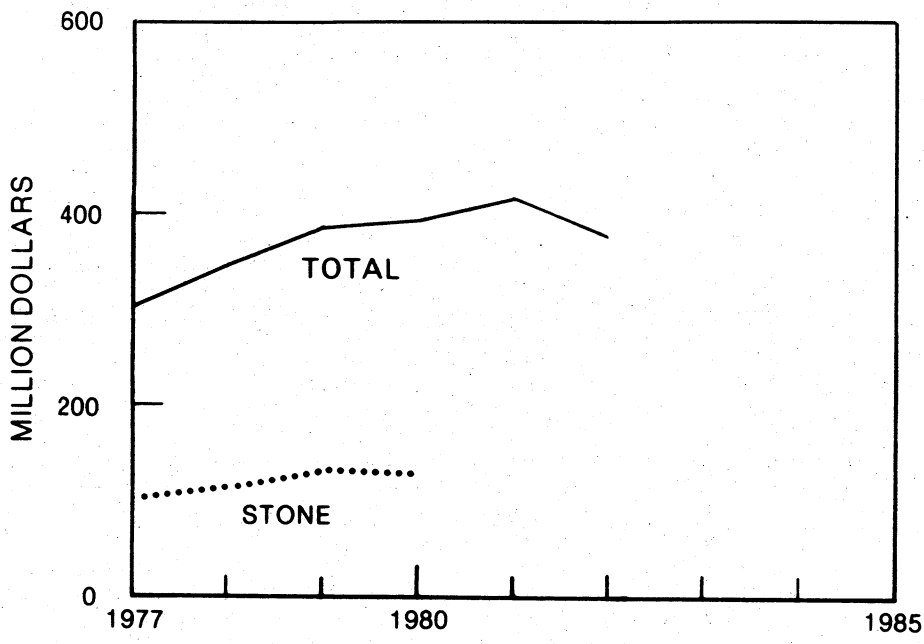

Figure 1.—Value of stone and total value of nonfuel mineral production in Tennessee.

rect construction jobs, Tennessee Valley Authority construction, and construction-linked manufacturing contributed over 10% of Tennessee's nonfarm jobs. Also, more than 40% of the fabricated metal employment was in structural steel products.[4]

Depressed markets for aluminum and zinc resulted in shutdowns and closings in both industries. During the year, Consolidated Aluminum Corp. (Conalco) shut down 75% of the last remaining potline at its New Johnsonville primary aluminum smelter, reducing the plant's capacity to less than 7% of its annual rated capacity of 146,000 tons per year. Aluminum Co. of America (Alcoa) also shut down a 55,000-ton-per-year potline at its 220,000-ton-per-year Alcoa, Tenn., plant.

Several zinc producers were also affected by weak demand. In late 1981, Gulf + Western Industries Inc. (G+W) shut down the Idol Mine in Grainger County, and in May 1982, closed the Jefferson City Mine in Jefferson County. Also, the company announced on December 13, 1982, that it would indefinitely suspend operations at its Beaver Creek Mine and nearby Jefferson City mill on January 28, 1983. In October 1982, United States Steel Corp. shut down its zinc mine operations at Jefferson City following a second rejection by union workers of company-sought concessions.

Legislation and Government Programs.—In August, the U.S. Office of Surface Mining approved Tennessee's proposed surface mining laws and granted primacy to the State for regulation and enforcement of the laws. The transfer of reponsibilities was the final step in a process that began in 1980 with passage of the State's surface mine law and later publication of a 1,300-page regulatory document drafted by the State's Division of Surface Mining.

The State is prepared to hire 27 additional inspectors and technicians to carry out enforcement. The Federal Government will assist the State by funding $2.4 million for inspection, $750,000 for small operator assistance, and $1.1 million for abandoned mine reclamation. Tennessee and Ohio were the last 2 of the country's 24 coal-producing States to receive primacy from the Federal Government.

A bill raising tandem truck weight limits for coal and other natural resource haulers was passed during the year. The bill allows haulers of coal, gravel, building materials, and other natural resource products to haul more than 52,000 pounds on State highways in their tandem rigs. Existing tandems would be allowed to haul up to 66,000 pounds if they purchase a special permit for $150. All new tandem trucks licensed after passage of the bill will remain under the

previous weight limit restriction of 52,000 pounds. Triaxle truck weight limits remained unchanged at 73,280 pounds.

The Tennessee Geological Survey, Department of Conservation, continued its geological mapping at the 1:24,000 scale throughout 1982. Fieldwork continued in upper east Tennessee and on a strategic coalfield area in Morgan County. The Division of Geology was also involved in a program of research and interagency cooperation in environmental geology. Current and historic earthquake data were entered into a computer data base, and an environmental geology atlas for Maury County was being printed. The Division, in cooperation with the U.S. Geological Survey (USGS), continued to study ground water conditions in an area of major lignite reserves in west Tennessee. The Division also was actively involved with other State and Federal agencies in evaluating and revising proposed rules and regulations for control of underground injection, specifically as related to brine disposal and enhanced oil recovery.

In accordance with the provisions of the Wilderness Act (Public Law 88-577), the Eastern Wilderness Act (Public Law 93-622), and U.S. Department of Agriculture RARE II program, the mineral resource potential of two areas in Tennessee were jointly investigated by the U.S. Bureau of Mines and USGS. Two reports were published during 1982—a "Geologic Map of the Little Frog Roadless Area, Polk County, Tennessee,"[5] and "Mineral Resources of the Big Frog Wilderness Study Area and Additions, Polk County, Tennessee, and Fannin County, Georgia."[6]

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—One company, A. J. Smith Co., mined barite in Tennessee in 1982. The company operated open pit mines and a plant in Loudon County in the Sweetwater district. The Sweetwater district has been and remains the principal source of barite in the State, accounting for at least 90% of the State's production since 1870 when barite mining began.[7] The barite occurs in clays that overlie limestones and dolomites of the Knox Group. In 1982, production and value from the A. J. Smith operation increased 52% and 79%, respectively, compared with those of 1981. The run-of-mine barite was shipped out of State for use primarily in the manufacture of paints and chemicals.

Cement.—Three companies operated four cement plants in 1982. Dixie Cement Co. Inc., a subsidiary of Moore McCormack Cement Inc., produced portland cement at plants in Kingsport and Richard City. Both portland and masonry cement were produced at a plant operated by General Portland Inc. (GPI), a subsidiary of Canada Cement Lafarge Ltd., in Chattanooga and by Ideal Basic Industries Inc. at a plant in Knoxville. All the plants used the wet process except for Ideal's plant in Knoxville, which used the dry process.

Shipments of both portland and masonry cement were again lower in 1981 because of reduced residential and nonresidential construction and fewer road construction projects. Portland cement shipments decreased 22% in quantity and 7% in value compared with 1981 shipments. Average value per ton increased from $40.43 in 1981 to $48.09 in 1982. Masonry cement shipments were also lower. Most of the cement was sold to ready-mix concrete companies, concrete product manufacturers, building material dealers, and highway and other contractors.

Table 4.—Tennessee: Portland cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	4	4
Production	1,049,411	600,660
Shipments from mills:		
Quantity	973,594	762,635
Value	$39,378,495	$36,689,264
Stocks at mills, Dec. 31	104,726	85,432

Canada Cement Lafarge, which purchased a majority interest of GPI in 1981, sold its 477,000-ton-per-year Chattanooga plant to Signal Mountain Cement Co., a European-controlled company. The sale of the plant, which represented about 8% of the annual cementmaking capacity of GPI, was completed in September 1982.

Clays.—In 1982, ball clay, common clay, and fuller's earth were mined in the State. Compared with 1981 levels, total clay production and value decreased 27% and 13%, respectively, reflecting a weaker demand by both the construction and ceramic industries.

Tennessee continued to lead the Nation

in the production of ball clay, accounting for more than two-thirds of the Nation's total. Ball clay was mined by 4 companies at 20 operations in Carroll, Gibson, Henry, and Weakley Counties in the northwestern part of the State. Both airfloat and unprocessed ball clay was produced by Kentucky-Tennessee Clay Co. (nine operations), H. C. Spinks Clay Co. Inc. (eight operations), Old Hickory Clay Co. (two operations), and Cyprus Industrial Minerals Co. (one operation). Total State production decreased nearly 25% in 1982. Principal uses were for the manufacture of pottery, floor and wall tile, sanitary ware, and china dinnerware.

Table 5.—Tennessee: Clays sold or used by producers

Year and type	Quantity (short tons)	Value	
		Total	Average per ton
1981:			
Ball clay	559,468	$17,964,171	$32.11
Common clay and shale	403,330	939,808	2.33
Total	962,798	18,903,979	XX
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

XX Not applicable.

Table 6.—Tennessee: Ball clay sold or used by producers, by kind and use

(Short tons)

Use	1981			1982		
	Airfloat	Unprocessed	Total	Airfloat	Unprocessed	Total
Fine china and dinnerware	28,967	--	28,967	20,811	W	20,811
Electrical porcelain	17,295	--	17,295	9,591	--	9,591
Floor and wall tile, ceramic	W	W	61,056	18,095	W	18,095
Pottery	W	W	152,218	88,119	W	88,119
Sanitary ware	W	W	60,908	32,852	78,050	110,902
Other[1]	257,143	171,280	[2]154,241	33,266	77,881	111,147
Exports	13,751	71,032	84,783	35,923	25,969	61,892
Total	317,156	242,312	559,468	238,657	181,900	420,557

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes adhesives (1981); common brick; 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; animal feed (1982); rubber; roofing granules (1982); asphalt tile (1981); asphalt emulsion (1982); unknown and other uses; 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	1981	1982
Brick	217,222	135,538
Portland cement	186,108	54,760
Other	--	33,544
Total	403,330	223,842

Common clay and shale was produced by three companies in five counties. Both production and value decreased nearly 45% in 1982, the result of the continuing national recession and its effects on the construction industry. Leading counties, in descending order of output, were Sullivan, Knox, Hamilton, Washington, and Anderson. Common clay was used principally in the production of face and common brick, portland cement, and as a lightweight aggregate for concrete.

One company, Lowes Inc., mined fuller's earth at an operation in Henry County. The clay was used as oil and grease absorbents, as carriers for insecticides and fungicides, and as pet litter.

Fluorspar.—United States Borax & Chemical Corp., a subsidiary of Rio Tinto Zinc Corp. p.l.c. of the United Kingdom, continued assessing its fluorite-barite zinc ore body near Sweetwater in eastern Ten-

nessee.

Graphite (Synthetic).—Synthetic graphite was manufactured by Union Carbide Corp. at plants near Columbia, Maury County, and Clarksville, Montgomery County. Most of the graphite was manufactured as electric-furnace electrodes. High-modulus graphite fibers were produced by the Great Lakes Carbon Corp. at a plant in Elizabethton in Carter County.

Lime.—Two companies produced lime in Tennessee in 1982. Tenn-Luttrell Lime Co., the largest producer, produced both quicklime and hydrated lime at Luttrell, near Knoxville, and Bowaters Southern Paper Corp. produced quicklime at Calhoun, McMinn County. Total lime output and value increased 6% and 11%, respectively, over 1981 levels. The lime was used principally by the paper and pulp and steel industries, and for water purification.

Perlite (Expanded).—Chemrock Corp., the State's only producer, expanded perlite at its Nashville plant from crude perlite shipped by rail from New Mexico. Principal uses for the expanded perlite were for horticultural purposes, lightweight masonry, cavity fill insulation, concrete and plaster aggregate, and as a filter aid.

Phosphate Rock.—Tennessee continued to rank fourth in the Nation in tonnage and value of phosphate rock. The ore was mined by three companies from surface operations in four counties (Hickman, Maury, Giles, and Williamson) in the Columbia-Mount Pleasant district of south-central Tennessee. Production of marketable phosphate rock has declined steadily since 1979. In 1982, output in Tennessee amounted to 0.9 million metric tons compared with the record production of 1.9 million metric tons in 1979. Average ore grade of run-of-the-mine ore was 20.3% P_2O_5.

Occidental Chemical Corp. (formerly Hooker Chemical Co.), Stauffer Chemical Co., and Monsanto Industrial Chemicals Co. mined and beneficiated phosphate rock for reduction to elemental phosphorus in electric furnaces near Columbia and Mount Pleasant. The phosphorus was subsequently converted into a wide variety of industrial chemicals.

Pyrites.—Tennessee continued to lead the Nation in the output of pyrites, producing most of the U.S. total. Cities Service Co., the sole producer, operated underground mines, a surface mine, and a chemical complex at Copperhill, Polk County. The ores are massive sulfide deposits contained within highly folded and metamorphosed late Precambrian metagraywackes and schists. The massive ore consists of approximately 60% pyrrhotite, 30% pyrite, 4% chalcopyrite, 4% sphalerite, 2% magnetite, and traces of silver and gold. The sulfur content is more than 20%.

Table 8.—Tennessee: Phosphate rock sold or used by producers

Year	Quantity (thousand metric tons)		Value	
	Rock	P_2O_5 content	Total (thousands)	Average per ton
1978	1,688	434	$13,833	$8.19
1979	2,140	545	17,008	7.95
1980	1,665	432	13,330	8.01
1981	1,379	357	17,401	12.62
1982	960	248	12,972	13.51

Table 9.—Tennessee: Production of phosphate rock

Year	Mine production (thousand metric tons)		Marketable production (thousand metric tons)		Value, marketable production	
	Rock	P_2O_5 content	Rock	P_2O_5 content	Total (thousands)	Average per ton
1978	3,052	646	1,709	442	$14,047	$8.22
1979	3,211	670	1,873	467	14,770	7.89
1980	2,981	602	1,582	410	12,765	8.07
1981	2,547	516	1,328	340	16,201	12.20
1982	1,597	324	897	229	11,596	12.93

In September, Cities Service sold the Copperhill operations to the Tennessee Chemical Co. Included in the sale were the mining, metallurgical, and chemical complex. The primary products produced at Copperhill are sulfuric acid and sulfur diox-

ide, accounting for 60% of the company's sales. Other products produced include blister copper, copper sulfate chemicals, zinc concentrates, and other miscellaneous inorganics.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Output of construction sand and gravel decreased nearly 43% in 1982 compared with 1980 levels because of high interest rates and the downturn in the construction industry. Construction sand and gravel was produced by 44 companies from 54 operations in 28 counties. Leading counties in descending order of output were Shelby, Decatur, Benton, Hamilton, and Coffee. Average value per ton increased from $2.63 in 1980 to $3.15 in 1982. Principal uses were for concrete aggregate, road base and coverings, asphaltic concrete, and fill.

Industrial.—Industrial sand and gravel was produced by five companies from six operations in six counties. Leading counties in order of output were Carroll, Benton, and Hamilton. Main uses were for containers, roofing granules, mold and core, and coal washing. Average value per ton of construction and industrial sand and gravel increased from $2.79 in 1980 to $3.76 in 1982.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	1,345	$4,845	$3.60
Gravel	NA	NA	NA	3,138	9,718	3.10
Sand and gravel (unprocessed)	NA	NA	NA	569	1,355	2.38
Total[1] or average	e8,830	e$24,130	e$2.74	5,051	15,917	3.15
Industrial sand and gravel	1,142	5,610	4.91	468	4,826	10.30
Grand total[1] or average	e9,972	e29,740	e2.98	5,520	20,743	3.76

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Table 11.—Tennessee: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,716	$5,818	$3.39
Plaster and gunite sands	W	W	5.53
Concrete products	224	568	2.54
Asphaltic concrete	1,136	3,942	3.47
Road base and coverings	1,275	3,257	2.56
Fill	370	855	2.31
Snow and ice control	W	W	5.56
Other	332	1,476	4.45
Total[1] or average	5,051	15,917	3.15

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Data may not add to totals shown because of independent rounding.

Unimin Corp. of New Canaan, Conn., leased about 40 acres in Hawkins County as a possible silica sand plantsite for use in fiberglass manufacture. No announcement was made as to when a plant would be built.

The Chattanooga Glass Co., a subsidiary of the Dorsey Corp., was sold for about $40 million to members of the firm's current management and a group of outside investors. The plant, one of the major employers in the area, operates a bottlemaking plant in Alton Park. Dorsey announced the sale was necessary for the company to continue investment opportunities.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Crushed.—Based on preliminary estimates, stone production declined slightly in 1982, compared with 1981 levels. A large proportion of the crushed limestone was derived as a byproduct from zinc mines in eastern and middle Tennessee. Principal uses were for road base and coverings; concrete, bituminous, and macadam aggregates; and agricultural limestone.

At midyear, site preparation began for a new $2 million asphalt plant near the Jersey Minière Zinc Co. (JMZ) Gordonsville Mine. Ralph Rogers Corp., a division of Mid-South Corp., will operate the plant. Terms of the agreement between the two companies require JMZ to continue supplying Ralph Rogers with crushed limestone as a byproduct of its zinc ore processing.

Dimension.—Dimension sandstone was also produced in the State. Based on preliminary estimates, production decreased nearly 5% in 1982 compared with 1981 levels.

Vermiculite (Exfoliated).—Construction Products Div. of W. R. Grace & Co. exfoliated crude vermiculite shipped in from out of State at its plant in Nashville. Vermiculite sold or used declined nearly 20% in 1982 compared with 1981 levels. Principal uses were for block insulation, concrete aggregate, and loose-fill insulation.

METALS

Aluminum.—Two companies, Alcoa, Blount County, and Conalco, Humphreys County, produced primary aluminum from alumina shipped in from out of State.

Early in the year, Alcoa shut down a 55,000-ton-per-year potline at its 220,000-ton-per-year Alcoa plant. The closing of the smelter unit and poor market conditions also necessitated layoffs at the plant during the year. Near yearend, the company announced 175 additional layoffs, raising the number of furloughed employees at the facility to 385.

In August, Conalco shut down 75% of the last remaining potline at its New Johnsonville primary aluminum smelter. The shutdown reduced smelting capacity at the facility to 9,125 tons per year, or less than 7% of the annual rated capacity of 146,000 tons. Reduced demand for aluminum products and high energy costs necessitated the curtailed production.

Copper.—Tennessee Chemical, (formerly owned by Cities Service), the State's only copper producer, operated two underground mines (Cherokee and Calloway), an ore beneficiation plant, and a metallurgical-chemical complex at Copperhill, Polk County. Two of the company's other mines were recently closed. The underground Boyd Mine was closed in 1981, and an open pit mine (Cherokee) was shut down in January 1982.

Table 12.—Tennessee: Mine production (recoverable) of gold, silver, copper, and zinc

		1980	1981	1982
Mines producing: Lode		11	11	10
Material sold or treated:				
Ore:				
Copper-zinc	thousand metric tons	1,901	1,784	1,604
Zinc	do.	4,335	4,512	4,446
Total[1]	do.	6,237	6,295	6,050
Production:				
Quantity:				
Gold	troy ounces	--	W	--
Silver	do.	W	W	W
Copper	metric tons	W	W	W
Zinc	do.	111,754	117,684	121,306
Value:				
Gold	thousands	--	W	--
Silver	do.	W	W	W
Copper	do.	W	W	W
Zinc	do.	$92,218	$115,597	$102,882

W Withheld to avoid disclosing company proprietary data.
[1]Data may not add to totals shown because of independent rounding.

In September 1982, Tennnessee Chemical purchased the Copperhill operations from Cities Service. Included in the purchase were the three underground mines, the ore beneficiation plant, and the metallurgical-chemical complex. Full production capacity at Copperhill is estimated to be 2.2 million tons of ore per year. Sulfur content of the ore is more than 20%. From this, Tennessee Chemical extracts iron pyrite and copper concentrate, which are roasted to produce sulfur dioxide, iron oxide, and crude copper oxide. Although 60% of the company's sales are from sulfuric acid and liquid sulfur dioxide, basic copper accounts for 15% of sales, with another 15% from copper sulfate and copper carbonate. Remaining revenues are generated from zinc and magnetite concentrates and miscellaneous inorganics.[8]

Ferroalloys.—Although Tennessee ranked 5th of 18 States that reported ferroalloy shipments in 1982, shipments declined nearly 69% from 181,148 tons to 56,867 tons compared with 1981 levels. The decline reflected the continuing depressed conditions of the automotive, steel, and foundry industries, and competition from foreign, low-priced imports. During the year, seven companies shipped ferrophosphorus, ferrosilicon, ferromanganese, silicomanganese, manganese metal, and ferrochromium from plants in the State.

The decline in demand resulted in several firms shutting down plants or reducing operating output. In October, Roane Alloys Div., a subsidiary of South Africa Manganese Amcor Ltd., halted all ferromanganese and silicomanganese operations at its Rockwood, Tenn., facility, and in November, International Minerals & Chemical Corp. ceased ferrosilicon production at its Kimball plant.

The Chromium Mining & Smelting Corp., which had not produced chromium or silicon ferroalloys at the Woodstock furnaces since July 1980, ceased all manufacturing operations in December 1982.

Gold.—No gold production was reported in 1982. A small amount of gold was reported in 1981 from Cities Service copper refining operations at Copperhill.

Iron and Steel.—Florida Steel Corp., which began production at its new minimill in Jackson in 1981, continued to produce a wide range of merchant and special quality bars, as well as rebars, at the plant. During 1982, the company began water cooling its electric furnaces and completed installation of oxyfuel burners at the plant. The Jackson minimill, the largest of the company's five operating plants, has access to markets in Illinois, Indiana, and Missouri, as well as States to the south.

Tennessee Forging Steel Corp., Harriman, completed modernization and expansion plans to increase rolling mill capacity from 100,000 tons to 150,000 tons per year. The company's steelmaking capacity remained unchanged at 180,000 tons per year.

Manganese.—During 1982, Foote Mineral Co. completed construction and began operation of a $500,000 pilot plant on a process to produce electrolytic manganese dioxide (EMD) for the alkaline battery market. The facility in New Johnsonville can potentially utilize much of the existing equipment in the new process. At the conclusion of the pilot plant operations, expected by mid-1983, the engineering phase will begin in order to develop a capital cost estimate to convert a portion of the electrolytic manganese metal plant to the production of EMD.

Rare Earths and Thorium.—Davison Specialty Chemical Co., a subsidiary of W. R. Grace, processed Australian monazite at its Chattanooga facilities to produce rare-earth catalysts and compounds. Although thorium was extracted from monazite, no thorium compounds were produced for sale. The thorium residues, stored at the plant-site, contained about 5.316 metric tons of thorium oxide equivalent at yearend.

Silver.—Silver was recovered from concentrates produced during copper refining at the Cities Service operations in Polk County.

Titanium Dioxide.—E. I. du Pont de Nemours & Co. Inc. continued to produce titanium dioxide pigment at its New Johnsonville plant from domestic and imported ilmenite concentrates. The plant, which utilizes the chloride process, has the capacity to produce 228,000 tons of titanium dioxide per year. The New Johnsonville plant has nearly one-half of the company's titanium dioxide capacity; Du Pont has a total capacity of 523,000 tons per year from its four plants in the United States and one in Mexico.

Zinc.—Tennessee continued to be the Nation's leading producer of zinc, accounting for nearly 40% of the U.S. total output. In 1982, there were 10 active mines, 2 less than in 1981. Depressed zinc markets and high operating costs were contributing factors in the mine closures. Although zinc output increased 3%, value decreased 11%, the result of lower zinc prices.

In the Mascot-Jefferson City zinc district in the eastern part of the State, ASARCO

Incorporated continued to operate four underground mines (Coy, Immel, New Market, and Young). The New Jersey Zinc Co., owned by G+W, operated the Jefferson City Mine and nearby Beaver Creek Mine in Jefferson County. In May, however, G+W closed the Jefferson City Mine, idling nearly 30 workers. The company cited depressed zinc markets, high operating costs, and depletion of ore reserves as the reasons for the closing. The 26-year-old mine had been producing 3,500 tons of crude zinc ore weekly.

In December, G+W announced that it would indefinitely suspend operations at its Beaver Creek zinc mine and nearby Jefferson City mill on January 28, 1983. G+W had proposed closing the two operations in June 1982 because of depressed market conditions; however, union workers approved a series of concessions in July, and the company decided to continue both operations for at least 6 months. At yearend, the mine and mill were producing about 2,500 tons of zinc concentrate per month. Approximately 147 workers would be affected by the shutdown.

In October, United States Steel shut down its zinc mine operations at Jefferson City following a second rejection by union workers of company-sought concessions. In August, workers rejected a similar concession request, and United States Steel implemented a 3-day workweek. Approximately 175 workers were affected by the closure.

In April, JMZ, jointly owned by G+W and the Belgian company, Union Minière S.A., brought onstream its new mine and mill at Gordonsville in the middle Tennessee zinc district. The new 9,000-short-ton-per-day mill replaced the 3,000-ton-per-day Elmwood mill and has a capacity to produce 6,000 to 7,000 tons of concentrate per month from the Elmwood-Gordonsville ore, with about 52,000 short tons per year of contained zinc. The concentrates are then refined to zinc metal at the company's 90,000-ton-per-year refinery at Clarksville.

The Clarksville refinery also produced germanium-rich residues from the Gordonsville and Elmwood zinc ores. These residues were shipped to Métallurgie Hoboken-Overpelt S.A. in Belgium for germanium recovery and refining.

In September, Tennessee Chemical purchased the Copperhill mining and chemical complex from Cities Service, Polk County. In addition to copper and various chemicals produced, zinc sulfide concentrate was also recovered at the Copperhill plant.

Pacific Smelting Co. began production in March of zinc oxide and galvanizing grades of zinc metal at its new plant in Memphis. Shipments of both French-process zinc oxide, produced mainly from zinc diecasting scrap from the automotive industry, and zinc metal, primarily Prime Western grade material, also commenced in March. No plant capacities or production levels were cited, but zinc oxide production at Memphis will depend on demand by the rubber industry, which accounts for about 50% of domestic zinc oxide consumption.

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[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.
[2]Chief geologist, Tennessee Division of Geology, Knoxville, Tenn.
[3]The Tennessee Journal. Jan. 3, 1983, v. 9, No. 1, p. 3.
[4]Federal Reserve Bank of Atlanta. Economic Review. February 1983, p. 33.
[5]Force, E. R. Geologic Map of the Little Frog Roadless Area, Polk County, Tennessee. U.S. Geol. Survey Map MF-1338-A, scale 1:24,000, 1982.
[6]Slack, J. F., G. C. Gazdik, and M. L. Dunn, Jr. Mineral Resources of the Big Frog Wilderness Study Area and Additions, Polk County, Tennessee, and Fannin County, Georgia. U.S. Geol. Survey Bull. 1531, (9360-02034), 1982, 25 pp.
[7]Maher, S. M. Barite Resources of Tennessee. Tenn. Div. of Geol. RI 28, 1970, 40 pp.
[8]Chemical Week. Tennessee: A New Player in Sulfuric. Nov. 24, 1982, pp. 55-56.

Table 13.—Tennessee: Tenor of zinc ore milled and concentrates produced

		1981	1982
Total material	metric tons	4,511,557	6,049,814
Metal content of ore:[1] Zinc	percent	2.56	2.01
Concentrates produced and average content: Zinc	metric tons	193,747	197,007
Average zinc content	percent	62.99	63.37

[1]Figure represents recoverable metal of crude ore as contained in the concentrate.

Table 14.—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:			
General Portland Inc.[1 2]	1300 American National Bank Bldg. Chattanooga, TN 37402	Plant	Hamilton.
Ideal Basic Industries Inc.[1 2]	Box 6238 Knoxville, TN 37238	do	Knox.
Moore McCormack Cement Inc.,[1 2] a subsidiary of Moore McCormack Resources Inc.	One Landmark Sq. 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.
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:			
Bowaters 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 Industrial Chemicals Co.[4]	Columbia, TN 38401	do	Do.
Occidental Chemical Corp.[4]	Box 591 Columbia, TN 38401	do	Do.
Stauffer Chemical Co.[4]	Box 472 Mt. Pleasant, TN 38474	do	Do.
Sand and gravel:			
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.
Ralph Rogers Corp.[2]	Box 25250 Nashville, TN 37202	do	Tipton.
Standard Construction Co. Inc	Box 38289 Germantown, TN 38138	Pit	Shelby.
Stone (1981):			
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	801 Bluff 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.

See footnotes at end of table.

Table 14.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
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 Albert E. Ward[1]

Total value of nonfuel minerals produced in Texas in 1982 was $1.6 billion, an 11% decrease from that of 1981, compared with a 4.4% decline in 1981 and an increase of nearly 24% in 1980. The output of construction materials declined moderately, whereas iron ore, sodium sulfate, and sulfur declined sharply. Texas was the Nation's leading producer of cement, gypsum, magnesium chloride, native asphalt, stone, and sulfur, and number two in clays and salt.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	229	$15,699	236	$16,440
Portland	do.	10,262	567,391	9,732	545,679
Clays	do.	4,172	29,135	4,193	26,497
Gem stones		NA	200	NA	200
Gypsum	thousand short tons	1,783	14,900	1,954	16,681
Helium (Grade-A)	million cubic feet	238	6,188	458	15,572
Lime	thousand short tons	1,393	67,158	1,125	62,277
Salt	do.	8,397	84,240	7,421	82,805
Sand and gravel:					
Construction	do.	e46,000	e150,000	45,527	154,515
Industrial	do.	2,242	36,992	2,623	45,007
Stone:					
Crushed	do.	72,454	219,086	p68,000	p205,000
Dimension	do.	42	5,543	p50	p5,822
Sulfur (Frasch)	thousand metric tons	3,674	W	2,360	W
Talc	thousand short tons	282	4,127	205	3,024
Combined value of asphalt (native, 1981), fluorspar (1981-82), helium (crude), iron ore, magnesium chloride, magnesium compounds, sodium sulfate, and values indicated by symbol W		XX	r551,751	XX	374,913
Total		XX	r1,752,410	XX	1,554,432

eEstimated. pPreliminary. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Angelina	W	W	Clays.
Armstrong	$2,844	(3)	
Atascosa	1,580	W	Stone (crushed), sand and gravel (industrial).
Bailey	W	--	
Bandera	--	W	Stone (crushed).
Bastrop	W	$770	Clays.
Bell	3,726	2,753	Stone (crushed).
Bexar	W	W	Cement, stone (crushed), lime, clays.
Borden	W	(3)	
Bosque	W	W	Lime, stone (crushed).
Bowie	547	(3)	
Brazoria	W	132,855	Magnesium chloride, salt, magnesium compounds.
Brazos	W	(3)	
Brewster	262	W	Fluorspar.
Brown	W	W	Stone (crushed), clays.
Burleson	W	288	Stone (crushed).
Burnet	W	12,373	Stone (crushed), stone (dimension).
Calhoun	W	W	Stone (crushed), lime.
Callahan	124	--	
Camp	W	--	
Cass	W	W	Iron ore.
Chambers	W	W	Salt, clays.
Cherokee	1,153	666	Clays.
Coke	W	(3)	
Coleman	W	W	Clays.
Collin	329	299	Stone (crushed).
Colorado	30,478	W	Sand and gravel (industrial).
Comal	W	W	Cement, stone (crushed), lime.
Comanche	26	28	Stone (crushed).
Cooke	W	W	Do.
Coryell	1,152	W	Do.
Crockett	W	2,486	Do.
Crosby	W	--	
Culberson	W	W	Sulfur, talc.
Dallas	W	W	Cement, stone (crushed), clays.
Deaf Smith	W	W	Lime, stone (crushed).
Denton	W	W	Clays.
Duval	W	W	Salt.
Eastland	W	W	Clays, stone (crushed).
Ector	W	W	Cement, stone (crushed).
Edwards	W	(3)	
Ellis	W	W	Cement, stone (crushed), clays.
El Paso	W	W	Cement, stone (crushed), stone (dimension).
Fannin	W	(3)	
Fayette	W	W	Clays.
Fisher	W	W	Gypsum, clays.
Floyd	385	--	
Fort Bend	W	W	Sulfur, clays, salt.
Freestone	W	W	Stone (crushed), clays.
Gaines	W	W	Sodium sulfate, stone (crushed).
Galveston	W	W	Clays.
Gillespie	W	W	Gypsum, stone (dimension), stone (crushed).
Gonzales	W	W	Clays.
Grayson	W	W	Stone (crushed).
Gregg	W	(3)	
Grimes	W	(3)	
Guadalupe	W	W	Clays.
Hall	W	(3)	
Hansford	W	W	Helium.
Hardeman	W	W	Gypsum.
Hardin	W	--	
Harris	136,814	132,737	Cement, salt, lime, clays, sand and gravel (industrial).
Harrison	W	W	Clays.
Haskell	464	--	
Hays	W	W	Cement, stone (crushed).
Henderson	W	W	Clays.
Hidalgo	W	2,966	Stone (crushed).
Hill	W	W	Lime, stone (crushed).
Hood	411	548	Stone (crushed).
Hopkins	W	--	
Howard	W	(3)	
Hudspeth	W	W	Talc, stone (crushed), gypsum.
Hutchinson	W	W	Salt.
Jack	W	W	Stone (crushed).
Jasper	220	399	Do.
Jefferson	W	W	Salt.
Jim Wells	57	W	Stone (crushed).
Johnson	W	W	Lime, sand and gravel (industrial), stone (crushed).

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Jones	W	$38	Stone (dimension).
Karnes	$2,126	--	
Kaufman	1,903	2,316	Stone (crushed).
Kerr	W	(3)	
Kimble	W	(3)	
Lamb	W	W	Stone (crushed).
Lampasas	W	(3)	
Liberty	W	W	Sulfur.
Limestone	W	W	Stone (crushed), clays, sand and gravel (industrial).
Lipscomb	--	84	Stone (crushed).
Live Oak	W	W	Sand and gravel (industrial), stone (crushed).
Llano	741	549	Stone (dimension), stone (crushed).
Lubbock	442	207	Stone (crushed).
Lynn	386	--	
McCulloch	W	W	Sand and gravel (industrial).
McLennan	W	W	Cement, stone (crushed), clays.
McMullen	W	W	Stone (crushed).
Marion	W	W	Clays.
Martin	W	--	
Mason	--	6	Stone (dimension).
Matagorda	W	W	Salt.
Maverick	W	(3)	
Medina	W	W	Stone (crushed), clays.
Midland	W	941	Stone (crushed).
Mitchell	W	(3)	
Montague	260	--	
Montgomery	W	(3)	
Moore	805	6,188	Helium.
Morris	W	W	Iron ore.
Motley	269	W	Stone (crushed).
Nacogdoches	W	W	Clays.
Navarro	W	W	Do.
Newton	W	W	Sand and gravel (industrial).
Nolan	43,979	47,628	Cement, gypsum, stone (crushed), clays.
Nueces	W	W	Cement.
Oldham	2,554	(3)	
Orange	W	W	Cement, clays.
Palo Pinto	W	200	Clays.
Parker	W	3,115	Stone (crushed), clays.
Pecos	W	W	Sulfur.
Polk	161	(3)	
Potter	W	W	Cement, stone (crushed), clays.
Randall	1,201	W	Stone (crushed).
Reeves	W	(3)	
Runnels	W	(3)	
Rusk	W	1,633	Clays.
San Patricio	W	W	Stone (crushed), clays.
San Saba	2,622	1,711	Stone (crushed).
Smith	W	W	Clays.
Somervell	W	(3)	
Stonewall	W	W	Gypsum.
Tarrant	W	W	Cement, stone (crushed).
Taylor	W	W	Stone (crushed).
Terry	W	W	Sodium sulfate.
Tom Green	W	W	Stone (crushed).
Travis	W	W	Lime, stone (crushed).
Upshur	20	(3)	
Uvalde	W	W	Stone (crushed), asphalt.
Val Verde	W	W	Stone (crushed).
Van Zandt	W	W	Salt, clays.
Victoria	W	(3)	
Walker	W	2,164	Stone (crushed), clays.
Ward	W	(3)	
Washington	--	166	Stone (crushed).
Webb	W	W	Do.
Wharton	W	W	Sulfur.
Wichita	6	(3)	
Williamson	26,070	28,042	Stone (crushed), stone (dimension).
Wilson	W	--	
Winkler	W	W	Salt.
Wise	W	W	Stone (crushed), clays.
Wood	W	148	Clays.
Yoakum	W	W	Salt.

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Young	W	W	Stone (crushed).
Undistributed[4]	$1,470,531	$1,218,102	
Sand and gravel (construction)	XX	[e]150,000	
Total[5]	1,734,651	1,752,410	

[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, Baylor, Bee, Blanco, Briscoe, Brooks, Caldwell, Cameron, Carson, Castro, Childress, Clay, Cochran, Collingsworth, Concho, Cottle, Crane, Dallam, Dawson, Delta, De Witt, Dickens, Dimmit, Donley, Erath, Falls, Foard, Franklin, Frio, Garza, Glasscock, Goliad, Gray, Hale, Hamilton, Hartley, Hemphill, Hockley, Houston, Hunt, Irion, Jackson, Jeff Davis, Jim Hogg, Kendall, Kenedy, Kent, King, Kinney, Kleberg, Knox, Lamar, La Salle, Lavaca, Lee, Leon, Loving, Madison, Menard, Milam, Mills, 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, Zapata, and Zavala.

[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 values indicated by symbol W.

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

Table 3.—Indicators of Texas business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	7,071.0	7,353.0	+4.0
Unemployment	do	373.0	505.0	+35.4
Employment (nonagricultural):				
Mining[1]	do	296.1	311.6	+5.2
Manufacturing	do	1,115.3	1,060.2	-4.9
Contract construction	do	429.1	423.6	-1.3
Transportation and public utilities	do	382.3	386.1	+1.0
Wholesale and retail trade	do	1,511.2	1,547.9	+2.4
Finance, insurance, real estate	do	351.0	364.3	+3.8
Services	do	1,094.0	1,157.1	+5.8
Government	do	1,000.8	1,023.0	+2.2
Total nonagricultural employment[1]	do	6,179.8	6,273.8	+1.5
Personal income:				
Total	millions	$158,462	$173,459	+9.5
Per capita		$10,731	$11,352	+5.8
Construction activity:				
Number of private and public residential units authorized		135,971	203,230	+49.5
Value of nonresidential construction	millions	$6,180.9	$5,811.7	-6.0
Value of State road contract awards	do	$307.7	$895.4	+191.0
Shipments of portland and masonry cement to and within the State	thousand short tons	9,421	9,428	+.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,752.4	$1,554.4	-11.3
Value per capita, resident population		$117	$102	-12.8
Value per square mile		$6,203	$5,814	-6.3

[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.

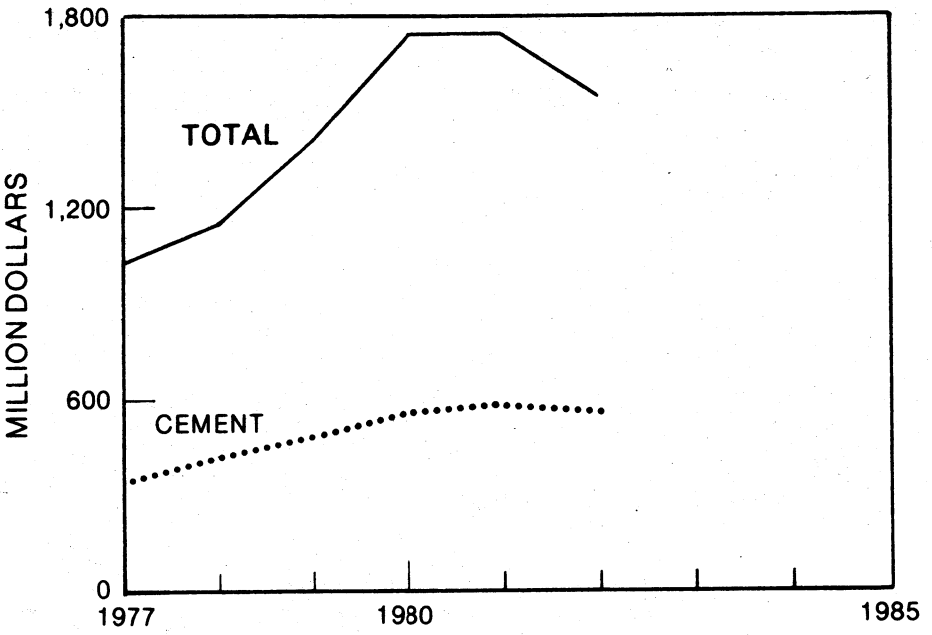

Figure 1.—Value of cement and total value of nonfuel mineral production in Texas.

Trends and Developments.—The Texas economy was stronger than the national economy from the beginning of the recession in June 1981 to December 1982 when the downturn may have been near its trough. On the basis of employment and related earnings data, the State's economy peaked in March 1982 when employment and earnings hit a cyclic peak and unemployment dipped to a 5.7% low. The subsequent sharp decline in economic activity in Texas is generally attributed to three factors: (1) a precipitous decline in oil- and gas-drilling activity early in 1982, (2) a general nationwide slowdown owing to high interest rates and slow economic growth, and (3) the Mexican peso devaluation in February and (more sharply) in August 1982 (trade with Mexico was severely cut—the purchasing power of 5,000 pesos during 1982 fell from $185 in January to $33 in December).

The sharp downturn in the State's economy seemed to have been short lived as employment in September and earnings in November appeared to have marked cyclic lows; unemployment was 8.0% in September.

With more than 200,000 housing starts in 1982, Texas accounted for more than one-fifth of the housing starts in the United States. The Houston and the Dallas-Fort Worth metropolitan areas ranked number one and two, respectively, in volume of housing construction nationwide in 1982 for the fourth straight year, and both were projected to retain these positions in 1983. (In 1981, Houston became the first city in the Nation to issue more than $3 billion in building permits.) Production of construction materials—cement, clays, lime, sand and gravel, and stone—mirrored the construction trends in the State. Commercial construction generally remained firm through the year, propped up by long-term financial underpinnings. Industrial construction was cut as capital investment was handicapped by persistent high interest rates early in the year. Residential housing, off early in 1982, revived in later months of the year in response to falling interest rates. Anticipating renewed strength in the Texas economy, several construction materials producers continued or initiated capital investments in plant and equipment

during 1982.

In contrast to the general strength in construction materials, the metals sector generally recorded sharp downturns in 1982. Primary smelters, refineries, and reduction plants generally were operated below capacity, and temporary closures or cutbacks were common; one aluminum operation was closed permanently. In the last half of the year, collapsed demand for drilling pipe and casing for the petroleum industry resulted in cutbacks and then closure of the Lone Star Steel Co. operations. During the year, there were efforts to check output and work off inventories of aluminum, steel, and base metals at processing plants in the State.

Exploration Activities.—High interest rates, declining prices, and slack demand for many minerals undercut mineral exploration in Texas during 1982. Nebraska Mines Ltd. conducted a five-hole drilling program to explore the Tee Pee Prospect in west Texas; the property has anomalous values of fluorspar, molybdenum, and uranium. Results of the exploration program were not announced. All known base- and precious-metal exploration programs in west Texas were shelved. Gold Fields Mining Corp., a U.S. subsidiary of the British firm Consolidated Gold Fields PLC, ceased all exploration and development work at its silver mine near Shafter in Presidio County.

Legislation and Government Programs.—Although the Texas Legislature, which meets biennially in odd-numbered years, was not in regular session in 1982, two special sessions were called during the year; however, no legislative action taken applied specifically to nonfuel minerals production.

The Texas Energy and Natural Resources Advisory Council funded studies of deep-basin lignite at several locations in east Texas. The Bureau of Economic Geology, The University of Texas at Austin, conducted a drilling program that was expected to continue through the summer of 1983. The U.S. Bureau of Mines participated in the study through its clay-testing cooperative agreement with Texas. Clays enclosing deep-basin lignite that may be subject to in situ gasification in the future were cored and then analyzed at the Bureau's Tuscaloosa Research Center in Alabama.

The Texas Bureau of Economic Geology updated its computer-generated list of nonpetroleum mineral producers of Texas. The Bureau continued research on the origin of silver-copper-lead deposits in Trans-Pecos clastic rocks and on base and precious metals in Trans-Pecos volcanic craters. Work on several map series on the State of Texas also continued.

For many years some surface owners of State land have refused to allow anyone holding a prospecting permit or mining lease access to the area covered by the permit or lease. More recently, as precious and base metals climbed to cyclic peaks in value, the access problems became acute. Almost 7 million acres of State mineral lands was involved, and nearly 90% of that acreage was in nine counties west of the Pecos River. The Texas Mining Council, reacting to what some members called landowners' "blackmail" and "extortion," adopted recommendations on August 4 to step up mineral production on State land. The council sent seven recommendations to the Governor to help create an economic climate that would encourage exploration and development of State mineral lands.

The Mining Council's recommendations apply to base, ferrous, and precious metals, but not to uranium, oil, or gas. The first recommendation would grant the General Land Office and holders of prospecting permits and mineral leases full rights of ingress-egress to the permitted or leased lands. Prospecting permits would be extended to 10 years from the present 5 years. Mining leases would be extended at least 10 years from expiration of the first lease. Royalty rates for the State would be fixed, and the holder of the mining lease would pay a percentage of profits to the surface owner, in addition to damages mining operations caused.

Bills to improve conditions for exploring and developing hard-rock mineral resources on State lands were being prepared at yearend for introduction to the 68th Legislature, early in 1983; enactment was generally believed to be highly probable. One factor that lent support to this forthcoming legislative action was the State's reduced tax revenue from oil and gas production in 1982. Taxes derived from oil and gas output had been in a strong uptrend for years, as sharply rising unit prices for oil and gas more than offset declining output of these fuels. In 1982, both output and unit prices fell. Tax revenues from more accessible hard-rock minerals produced from State lands were seen as an offset to reduced taxes from declining oil and gas output in future years.

The Mining and Mineral Resources and Research Institute at The University of Texas at Austin, which was created under title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—PIP Minerals Co. began grinding barite ore at its new Kingsville plant using crude barite ores imported from China and Morocco through the Port of Corpus Christi, about 25 miles northeast. The $3.2 million, 180,000-ton-per-year, 20-employee plant will serve the oil- and gas-drilling industry in south Texas. All Minerals Inc. constructed a grinding plant at Monahans in Ward County to meet oil- and gas-drilling needs in west Texas and southeast New Mexico. Coastal and Western Minerals Inc. completed its first year of operations at its grinding plant at Knippa, Uvalde County, where it produced filler and extender-grade barites for the paint and coatings industry.

Carbon Dioxide.—Airco Industrial Gases acquired the Texas-based carbon dioxide operations of Liquid Air of North America, including storage and distribution equipment at Baytown and Victoria. Carbon dioxide is used in chemical manufacturing and food processing; increasingly, carbon dioxide has been piped into Texas from Colorado for use in secondary recovery operations in certain oilfields and gasfields.

Cement.—Total cement shipments, declined 5% in 1982, reversing the uptrend of the late 1970's and early 1980's. Portland and masonry cement production both declined, and stocks at mills increased for both cements. High interest rates, particularly in early 1982, crimped construction; however, housing construction turned up in the last half of 1982, and a recent gasoline tax increase earmarked for highway and bridge repairs foreshadowed a prompt increase in highway construction projects. Cement plants in Texas generally operated below capacity during the year. Demand for portland cement from concrete product manufacturers was up moderately, but building materials dealers, ready-mix companies, and contractors all took less cement. With demand relatively weak all year, the average price of portland cement was almost unchanged from that of 1981, and the masonry cement price was up only 2%. Portland cement constituted 97.6% of total cement output, down slightly from that of 1981. Although portland stocks at mills were up 17% at yearend, they represented only 3 1/2 weeks of normal shipments. During the year, 13 companies operated 22 cement plants in the State, unchanged from activity in 1981.

Alamo Cement Co., in the year 1880, began producing 10 barrels of portland cement per day at its San Antonio plant. In 1980, Alamo Cement broke ground for its 2,400-ton-per-day plant in Bexar County, just outside of metropolitan San Antonio, and went onstream in 1981; it completed its first calendar year of operations in 1982. Limestone and shale are produced from Anacacho Limestone, Austin Chalk, and Eagleford Shale in nearby Alamo Cement quarries. Cement is produced in a 2,400-ton-per-day rotary kiln, driven by a 450-horsepower direct-current motor, fired by a coal-coke mixture, with natural gas as supplementary fuel.

At midyear, construction began on the expansion of Texas Cement Co.'s plant at Buda, 12 miles south of Austin. The project, scheduled for completion in March 1983, will nearly double plant capacity to 6 million barrels per year (about 1.13 million short tons). Texas Cement, a subsidiary of Centex Corp. of Dallas, opened the Buda plant in 1978. The Alpha Portland Industries Inc. cement plant at Orange was sold to River Cement Co. for $6.5 million. Southwestern Portland Cement Co., a subsidiary of Los Angeles-based Southdown Inc., completed a $6.3 million, gas-to-coal fuel conversion at its Odessa facility. Southwestern also completed a process modification project at its Amarillo plant and converted to coal as the primary kiln fuel. Ideal Basic Industries Inc. completed permanent closure of its Houston cement-production facilities early in the year. Ideal will continue operating a cement-distribution terminal in Houston to meet the needs of its customers in east and south Texas.

Table 4.—Texas: Portland cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	20	20
Production	9,951,936	9,448,176
Shipments from mills:		
Quantity	10,261,852	9,731,972
Value	$567,390,926	$545,678,788
Stocks at mills, Dec. 31	551,199	656,443

Table 5.—Texas: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1981	1982
Number of active plants	13	13
Production	229,298	217,829
Shipments from mills:		
Quantity	229,346	235,524
Value	$15,698,648	$16,439,773
Stocks at mills, Dec. 31	21,746	22,254

Clays.—Total clay output inched up about 0.5% in 1982 over that of 1981 and, by a narrow margin of 4,000 tons, exceeded the recent peak output established in 1978. Most clay markets were firm in 1982, and prices were little changed; however, because of the cutback in oil and gas drilling, demand for bentonite weakened considerably, and the price fell precipitously. Total value of all clays mined was off about 9%; however, if the bentonite figure was removed from the 1981 total, Texas clay miners managed a 2% increase in clay value during the lackluster year.

Thirty-five companies produced clay at 85 mines in 36 counties during 1982. The 4 leading producers mined more than one-half of the clay from 24 mines valued at more than one-third of the statewide total. Nine companies mined more than 100,000 tons each, 6 produced 50,000 to 100,000 tons, and 16 turned out 10,000 to 50,000 tons each.

Elgin-Butler Brick Co. was developing a small-stage, lignite-to-gas facility to fire a kiln at its brick plant in Bastrop County about 30 miles east of Austin. The company currently fires two brick kilns using costly natural gas and foresees sharp price increases for gas in the long-term future. Substantial reserves of high-quality lignite in the Wilcox Formation exist in Bastrop County; the company expects to fire one kiln with low-British-thermal-unit (Btu) gas from these lignite beds, beginning about September 1983. The fuel-cost saving is expected to be about 30%. Gas from lignite commonly is rated at 125 Btu per cubic foot, whereas natural gas is about 1,000 Btu per cubic foot. On Houston's west side, Castone Brick Co., a division of Castone Development Corp., expects to complete its $2 million plant expansion in early 1983 at the firm's Clodine facility. In Rusk County, General Refractories Co. sold its ball clay deposits at Henderson to Henderson Brick Co.

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
1978	128	4,944	56	1,101	50	273	3,955	13,500	4,189	19,818
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

[1]Data may not add to totals shown because of independent rounding.

Fluorspar.—D. & F. Minerals Co. produced fluorspar from the Paisano Mine north of Terlingua in Brewster County. The fluorspar occurs as limestone replacement bodies associated with rhyolite intrusions, Cretaceous limestone, and Tertiary intrusives. Shipments of the metallurgical-grade fluorspar were off about two-thirds from those of 1981.

Graphite.—Southwestern Graphite Co. has produced no natural graphite from its mine near Burnet in Burnet County since its closure in 1979. The company ground and sized some imported crystalline flake in the company mill. Although graphite ore remains in the open pit, a flooded pit and

the excessive overburden preclude economic recovery under present market conditions.

Gypsum.—Demand for gypsum was firm in 1982, up almost one-tenth following the modest 6% rise in 1981. Gypsum mining in Texas has been increasing since 1976, except for a 12% decline in 1980. Average price per ton of crude gypsum moved up about 2% to $8.54 in 1982 from $8.36 in 1981. Calcined gypsum tonnage was up about 6%; however, its price continued to slide, falling another 20% in 1982, following a 14% decline in 1981 and a more precipitous 32% drop in 1980.

Again leading the Nation in crude gypsum mined, Texas moved up from number two in calcined gypsum production in 1981 to number one in 1982. Texas produced almost one-fifth of the Nation's total gypsum in 1982, up from about one-sixth in 1981. Six companies mined gypsum in six counties, and four companies calcined gypsum in four counties.

Gold Bond Building Products, a subsidiary of National Gypsum Co., began operations at its new Harper open pit gypsum mine in northeast Kimble County. Gypsum from the mine largely was used in the company's Rotan wallboard plant; a small amount was trucked to cement plants in the San Antonio area for use as a set retarder. Windsor Gypsum Co. began constructing a 500-million-square-foot-per-year, gypsum-wallboard facility in McQueeney, Guadalupe County; startup was scheduled for mid-1983. Southwest Gypsum Co.'s Longworth Mine and wallboard plant in Fisher County, formerly owned by Three Rivers Gypsum Co., was closed in 1981 and offered for sale in 1982.

Helium.—Separation and recovery of crude helium from natural gas continued at about the same low rate in the Texas Panhandle as in 1981. Grade-A helium production almost doubled, as Texas made up for no production from Oklahoma and decreased output in Kansas and New Mexico. Total U.S. output was up only slightly.

Air Products and Chemicals Inc. completed and operated the world's largest single-train, liquid-helium plant about 90 miles north of Amarillo. The $40 million plant, with an annual capacity of 250 million cubic feet, employs about 40 people and produces liquid helium for the electronics, research, and welding industries. Near Dumas, Phillips Petroleum Co. was constructing a plant at yearend to recover crude helium and liquid hydrocarbons from natural gas. Startup was scheduled in 1983.

U.S. Bureau of Mines functions in Texas include operation of the Exell helium plant, about 35 miles north of Amarillo; the Amarillo helium plant, near Amarillo; and the Cliffside helium storage field, about 17 miles northwest of Amarillo.

The Bureau's helium conservation program is supplying about 80% of the annual U.S. helium market. The Bureau has conserved Federal and private helium by purchase and storage underground in Cliffside Field and by providing low-cost helium storage to private industry. Private extraction of helium has declined to less than market requirements because some plants have temporarily shut down and the richer sources of helium-bearing natural gas available to the operating plants are depleting. To meet this market shortage, the Bureau withdrew about 1 billion cubic feet of stored helium this year to meet Federal helium requirements and to meet commercial demand by redelivering privately owned helium to the private plants using the Government-owned pipeline system. Additionally, 50 million cubic feet of private helium was purified for private industry to relieve a shortage of purification capacity.

Major domestic end uses of helium were cryogenics, welding, and pressurizing and purging. Helium is used also in synthetic breathing mixtures, chromatography, leak detection, heat transfer, controlled atmospheres, and as a lifting gas. Federally produced helium was used in support of the space shuttle launches and in projects for national defense, advanced medical research, and high-energy physics.

Lime.—Because of weak demand from the aluminum industry and from most of the construction industry in Texas, lime production fell by about one-fifth in 1982. Although demand continued to decline from the cyclic peak of 1980, average value of lime remained in a long-term uptrend, increasing to $55.36 per ton in 1982, up 15% from $48.21 in 1981. As in 1981, the same 10 operators produced quicklime in 9 counties. Six of the companies also produced hydrated lime, also unchanged from that of 1981.

Because of a $34 million capital investment in 1982, United States Gypsum Co.'s lime operation in New Braunfels became Texas' largest producer of industrial and construction lime. Ground was broken in December 1981 for a new rotary kiln and other new plant facilities to produce 600 tons per day of lime, almost doubling the

plant capacity. The operation produces high-calcium lime and is the State's only dolomitic lime producer. United States Gypsum operated other Texas plants in Corsicana, Dallas, Houston, and Sweetwater. In Clifton, Chemical Lime Co. Inc.'s new coal-fired, 600-ton-per-day vertical kiln went on-stream in October. It is the Nation's first coal-fired vertical kiln. Energy consumption is 3.2 million Btu per ton of quicklime, less than one-half the industry average. Operation of the kiln was a featured topic at the National Lime Association's October meeting in Fort Worth, and the new Chemical Lime facility, in Bosque County, 75 miles south of Fort Worth, was a showcase tour. Chemical Lime was constructing a second coal-fired, 600-ton-per-day vertical kiln at Marble Falls for calcining magnesium-rich limestone beginning late in 1983.

Table 7.—Texas: Lime sold or used by producers, by use

Use	1981		1982	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Road stabilization	313,659	$14,871	325,420	$17,484
Soil stabilization	154,554	7,827	150,164	9,430
Paper and pulp	156,424	7,728	138,405	7,175
Steel, electric	209,092	9,670	117,509	6,374
Water purification	126,171	6,346	113,723	6,328
Aluminum and bauxite	126,804	7,001	89,829	4,966
Sewage treatment	62,773	2,881	27,704	1,385
Oil well drilling	17,090	904	14,755	1,067
Mason's lime	13,084	647	11,695	811
Food, animal and human	3,194	148	3,028	160
Other[1]	209,889	9,135	132,657	7,097
Total	1,392,734	67,158	1,124,889	62,277

[1]Includes acid-water neutralization, basic oxygen furnace steel, finishing lime, glass, magnesium, oil and grease, oil well drilling, open-hearth steel, other chemical and industrial uses, petroleum refining, and sugar refining.

Magnesium Compounds.—Production of magnesium compounds in Texas during 1982 increased 10% in quantity and 29% in value from that of 1981.

Perlite (Expanded).—Seven companies—operating plants in Bexar, Comal, Dallas, Harris, and Nolan Counties—continued to produce expanded perlite from out-of-State ores in 1982. Texas, ranked fifth among 32 States that produced expanded perlite, turned out 7.0% of the Nation's total, down from 8.3% in 1981. Average price per short ton in Texas in 1982 was $200, up from $181 in 1981.

Salt.—Texas continued to rank second in salt output among 16 producing States, yielding about one-fifth of the Nation's 37.9 million tons in 1982. Texas output fell about one-eighth, and the national total decreased slightly as slack demand prevailed and reasonable inventories generally were maintained throughout most of the year. Most prices were firm during the year as the average price rose 11% from $10.03 in 1981 to $11.16 in 1982. Ten companies recovered salt at 12 operations in 11 counties.

Sand and Gravel.—Total sand and gravel output was nearly unchanged in 1982 from the estimated production in 1981. Industrial sand output continued in a strong uptrend, but construction sand and gravel declined slightly.

Construction.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. Texas was the only State with firm and substantial sand and gravel output in 1982. While Texas' output was virtually unchanged, total national production declined by about one-eighth. In national figures, Texas returned to the number two ranking, with 7.6% of the construction sand and gravel production.

Construction sand and gravel was mined from 154 deposits in 73 counties in 1982. Colorado County, with 11.1 million tons of output, largely for the Houston and gulf coast markets, was the leading producer—about 23% of the State's total. Other million-ton-plus counties, in order of output, were Dallas, Victoria (mainly for the gulf coast market), Travis, McLennan, Fayette (mostly for Houston and the gulf coast), Denton, and Hidalgo.

Vulcan Materials Co. of Birmingham, Ala., completed the first year at its Boyd (Wise County) sand and gravel plant. The plant, about 25 miles northeast of Fort

Worth, supplied the Dallas-Fort Worth area with asphaltic sand, concrete sand, mineral filler, and several gravel blends. Annual plant capacity was 350,000 tons. The sand and gravel deposit being mined averaged about 80% to 85% sand. Laredo Ready Mix Inc. planned a mid-1983 startup for its $890,000 gravel plant and precast-concrete facility north of Laredo.

Industrial.—Texas ranked third among industrial sand and gravel-producing States in 1982, up from fourth place in 1981. Industrial sand and gravel was produced from 16 deposits in 5 counties. McCulloch County was the leading producer, while Colorado, Johnson, Limestone, and Harris Counties each turned out about one-quarter million tons of industrial sand and gravel.

At midyear, NOWSCO, a subsidiary of Big Three Industries Inc., went onstream at its new facility in Longview to produce fracturing sand for oilfield uses. Vulcan also had under construction an $18.5 million, 500,000-ton-per-year facility to produce fracturing sand near Brady in McCulloch County. Fracturing sand was used to enhance recovery by maintaining fissure openings in tight oil- and gas-bearing formations. Kerr Glass Manufacturing Corp. in Waxahachie completed a $1 million plant expansion at yearend that will permit increased production of glass containers. Kerr purchased its sand from Martin Marietta Corp.'s sand and gravel operation in Cleburne, about 30 miles west in Johnson County.

Table 8.—Texas: Sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	18,669	$58,510	$3.13
Gravel	NA	NA	NA	22,674	88,374	3.90
Sand and gravel (unprocessed)	NA	NA	NA	4,184	7,631	1.82
Total or average	e46,000	e$150,000	e$3.26	45,527	154,515	3.39
Industrial sand	2,242	36,992	16.50	2,623	45,007	17.16
Grand total or average	e48,242	e186,992	e3.88	48,150	199,522	4.14

eEstimated. NA Not available.

Table 9.—Texas: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	32,591	$117,952	$3.62
Plaster and gunite sands	310	1,145	3.69
Concrete products	2,125	7,143	3.36
Asphaltic concrete	1,649	6,172	3.74
Road base and coverings[1]	3,105	11,162	3.60
Fill	5,358	9,646	1.80
Snow and ice control	W	W	2.25
Railroad ballast	W	W	2.80
Other	387	1,295	3.35
Total or average	[2]45,527	154,515	3.39

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (cement and lime).
[2]Data do not add to total shown because of independent rounding.

Sodium Sulfate.—Ozark-Mahoning Co., a subsidiary of Pennwalt Corp., activated plans to increase capacity of its S. H. Davis sodium sulfate plant near Seagraves by 50% from 100,000 to 150,000 short tons per year. The company also plans to double bagging capacity at its Brownfield plant. Both these projects were to be completed in late 1983 or early 1984. Although demand for sodium sulfate has stabilized in recent years, Ozark-Mahoning believes that now is an opportune time to prepare for the modest growth in demand it foresees in the 1980's. Moreover, the supply of salt cake, an impure sodium sulfate byproduct of hydrochloric acid and other manufacturing processes, has been declining in recent years.

Stone.—To reduce reporting burdens and costs, U.S. the Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and completed the following year.

Crushed.—Estimated crushed stone production fell by more than 9%, but dimension stone output rose by about one-fifth as demand held firm from ongoing, long-term building projects. Texas maintained its leading position among the 48 States that produced crushed stone in 1982. Average price for all crushed stone decreased only $0.01 per ton to $3.01 in 1982.

Franklin Industries Inc. of Nashville, Tenn., purchased Dresser Industries Inc.'s Nolanville crushed limestone facility. The $5 million Nolanville operation has produced chemical-grade limestone products for the glass, paint, paper, plastics, roofing, and rubber industries. Purchase of the Nolanville plant will allow Franklin to expand its markets substantially in the Southwest when the expanded, renovated, and newly equipped facility returns to full production with 20 added employees in the second quarter of 1983.

Dimension.—The State ranked seventh among the 38 States that cut dimension stone, up from eighth place in 1981. Average price for all dimension stone slipped from $132.34 to $116.76.

In June, Leander Cut Stone Inc. began operating its new facilities in Cedar Park, 7 miles northwest of Austin. Leander quarries and cuts building limestone. Parker Bros. & Co. Inc. in Houston announced the closure of its Seadrift Div., resulting in the layoff of 40 employees. Parker Bros. also plans to terminate all its remaining shell-dredging operations in Texas and Louisiana. Shell mining in bays, lakes, and coastal waters has led to increasing opposition, resulting in legal impediments from environmentalists as well as commercial and sports fishers.

Sulfur.—Production and shipments of Frasch sulfur declined precipitously in 1982 as industrial demand collapsed—output fell to the lowest level in 36 years. Shipments were off more than one-third; however, price held firm, moving down about 5%. In contrast, recovered elemental sulfur extracted from natural gas and crude oil increased 14%, from 1,136,000 to 1,297,000 metric tons, a record high; however, price eased from $101.45 to $99.81 per metric ton. Total sulfur output in all forms was the lowest in 11 years.

As in 1981, four companies at seven operations in five counties—Culberson, Fort Bend, Liberty, Pecos, and Wharton—produced Frasch sulfur. During the year, three mines were closed—Duval Corp.'s new (1980) Phillips Ranch operation, Occidental Chemical Co.'s Long Point, and Texasgulf Inc.'s Moss Bluff. Recovered elemental sulfur was extracted from natural gas and crude oil at 58 operations, down from 60 in 1981, in 33 counties.

In early November, members of the New Mexico Mining Association toured Duval's Rustler Springs sulfur mine in Culberson County, about 70 miles south of Carlsbad, N. Mex. The British Sulphur Corp. Ltd. rates this Texas operation as the world's largest, most efficient Frasch sulfur mine. Sulfur from the Rustler Springs Mine is moved by rail to Galveston, Duval's principal sulfur distribution center.

Freeport Minerals Co., a subsidiary of New York City-based Freeport-McMoRan Inc., sold to the Brazos River Harbor Navigational district almost all of Freeport's interests in land and mineral rights located near Freeport, Tex. The land sold for $14 million and included about 7,700 acres owned in fee and 3,600 additional acres in which Freeport had other property interests. The property, a Freeport holding for about 70 years, was the site of the company's first Frasch sulfur mine, which operated from 1912 to 1935.

Texasgulf, a unit of the French firm Société Nationale Elf Aquitaine, continued to produce Frasch sulfur at its Newgulf

(Boling Dome) operation, but at a sharply curtailed rate. This oldest native sulfur mine in the Nation has been operated continuously since 1929. Texasgulf ships nearly all the output in liquid form by rail to its principal terminal at Beaumont. Facilities at Beaumont include storage tanks for liquid sulfur and storage vats for solidified sulfur. Texasgulf ceased operating its Moss Bluff Frasch sulfur mine at the end of September because of depleted reserves. The mine near Liberty, in Liberty County, began production in 1948 and yielded more than 9 million tons of sulfur. Texasgulf offered its 102 employees at the operation transfers, retirement incentives, or special termination allowances.

Marathon Oil Co., a division of United States Steel Corp., made plans to expand and modify its existing Yates plant to include a natural gas liquids-extraction facility and a sulfur-extraction unit with a capacity of 49 long tons per day. The project is to be completed by the second quarter of 1984.

Table 10.—Texas: Sulfur produced and shipped from Frasch mines

(Thousand metric tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1978	3,720	3,752	W
1979	3,897	4,649	W
1980	4,081	4,810	W
1981	3,908	3,674	W
1982	2,898	2,360	W

W Withheld to avoid disclosing company proprietary data.

Talc.—In Hudspeth County, six producers quarried 205,000 tons of talc worth $3.02 million or about $14.73 per ton. Output was off again in 1982, down more than one-quarter from that of 1981. Value per ton was nearly unchanged. Construction- and housing-related markets for talc products were weak during most of the year. Texas ranked third in output of talc in 1982, as production represented about one-fifth of the total tonnage, down from one-fourth in 1981.

Vermiculite (Exfoliated).—W. R. Grace & Co. continued to operate two exfoliation plants in Bexar and Dallas Counties, and Vermiculite Products Inc. ran its plant in Harris County. All three plants used imported vermiculite; Texas' last producing mine in Llano County was closed in 1979. Total production and sales of exfoliated vermiculite declined only slightly during 1982. Average price moved up by about one-tenth. Construction-industry markets for vermiculite in aggregates and insulation were down sharply; however, fireproofing-related demands increased just about enough to cancel the aggregate and insulation losses. Agricultural demands for exfoliated vermiculite were down only slightly.

METALS

Aluminum.—As in 1981, Texas ranked fourth in primary aluminum production, recovered from bauxite. Seventeen States again recorded aluminum production. Texas output was off 23%, about parallel to the Nation's 27% decline. Market weakness in 1981 continued through 1982. Production was curtailed owing to soft demands in all markets except for containers and packaging; inventories were reduced about 9% by yearend, and the spot price for the metal was in a downtrend from about 51 cents per pound to 43 cents for the first half of the year and then remained in the 44- to 47-cent range through yearend.

At Point Comfort, Aluminum Co. of America (Alcoa) permanently closed its 145,000-metric-ton-per-year smelter in May following 18 months of temporary closure. Alcoa was operating its highest cost and only gas-fueled smelter at reduced capacity when it was closed to control metal inventories in November 1980. Alumina production at the adjacent refinery was not affected by the permanent closure. The company stated that a major capital investment would be required at the 30-year-old plant to meet environmental standards and that natural gas will continue to be too costly to use in producing domestic aluminum. Closure of the seven-potline smelter reduces Alcoa's total U.S. primary aluminum capacity by about 9%, to 1,420,000 metric tons. In addition to the refinery at Point Comfort, Alcoa operates reduction plants in Texas, an experimental plant using an aluminum

chloride process at Palestine in Anderson County, and the huge complex at Rockdale in Milam County.

In Fort Bend County, Dowell, a division of Dow Chemical U.S.A., used 150,000 pounds of sintered bauxite proppants under high hydraulic pressure to increase gas flow at AMAX Petroleum Corp.'s Crider No. 1 well in Katy South Field. Using bauxite-based proppants rather than sand is a new technique to increase permeability of oil- and gas-bearing rock strata. Sand costs about 5 cents per pound; sintered bauxite is 85 cents per pound. Bauxite proppants, however, are much less subject to crushing and impacting than sand in deep wells; the resulting longer life of the gasfield yields a better hydrocarbons payoff and justifies the initial higher cost of using bauxite.

Reynolds Aluminum Recycling Co. constructed a 4,500-square-foot recycling complex in Dallas capable of handling 3 tons of aluminum scrap per hour. In Bryan, Alumax Inc. halted talks with city officials and has no further plans to consider Bryan or other Texas sites for an aluminum reduction plant because of increasing electrical costs. Bryan-College Station soon will have a new electrical-energy supply when the Texas Municipal Power Agency's Gibbons Creek Steam Electric Station comes onstream in 1983. The lignite-fueled, minemouth, electricity generating facility is at Carlos, about 20 miles east of Bryan.

Copper.—Consumption of copper continued the downtrend begun in 1979. As a consequence, ASARCO Incorporated (Asarco) processed domestic and imported ores at its El Paso smelter and continued operations at its Amarillo refinery but at reduced rates compared with those of 1981. At the Amarillo refinery, the company began installing equipment for acid cleaning of continuous-cast copper rod to enhance the surface characteristics of the high-quality rod. The equipment will become operational in mid-1983.

Iron Ore.—Demand for steel products continued to weaken in 1982; consequently, iron ore output in Texas fell almost 40% following 1981's 30% decline. Value per long ton continued firm, rising about 17%, following the 26% increase in 1981. Texas ranked seventh among 12 iron ore-producing States, up from eighth place among 13 States in 1981. Limonite and siderite ores mined from surface operations in Cass and Morris Counties were used primarily to produce pig iron; minor quantities were sold for cement manufacture and for miscellaneous products. Faced with rising inventories and continued weak demand for its products, Lone Star Steel closed its iron ore mines and blast furnace in late August and remained shut down through yearend.

In Houston, Armco Inc. ceased producing direct-reduced iron in May because of sharply increased natural gas costs. As old contracts for gas expired, the company was confronted with a tenfold increase in cost for renewed gas contracts, an increase that would preclude economic operation of the plant. The 360,000-short-ton-per-year facility was built in 1972.

Lead and Zinc.—Because of weak demand and a resultant downtrend in price through 1982, Asarco suspended operations indefinitely at its zinc fuming plant in the El Paso lead smelter. The company also suspended operations at its Corpus Christi zinc refinery in October after producing at 50% of capacity since February. The amount of lead Asarco processed increased substantially as the industry recovered from strike-interrupted production in 1981. Custom lead materials purchased from others, recording the largest gain, more than offset the reduced output from Asarco's domestic mines as the company responded to weakened prices and demand.

Silver.—Owing to the declining market price of silver during the first 6 months of 1982, exploration and development projects for silver in west Texas were idled before midyear. The price of silver bottomed at about $5 per ounce in June and then turned upward to finish the year at about $11; however, exploration and development projects shelved in 1981 and early 1982 were not reactivated.

Tin.—In Texas City, Gulf Chemical & Metallurgical Co., a subsidiary of Associated Metals and Minerals Corp., operated the Nation's only tin smelter. Tin recovery increased substantially in 1982 because of a marked increase in imported tin concentrate. In addition to tin concentrate, the company used secondary tin-bearing materials, tin residues, and slags for feedstocks.

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[1]State Liaison Officer, Bureau of Mines, Denver, Colo.

Table 11.—Texas: Primary smelters, refineries, and reduction plants

Product, company, and plant	Location (county)	Material treated
Aluminum:		
Aluminum Co. of America:		
Point Comfort (alumina)	Calhoun	Bauxite.
Rockdale (reduction)	Milam	Alumina.
Anderson County (reduction)	Anderson	Do.
Reynolds Metals Co.:		
San Patricio (reduction)	San Patricio	Do.
Sherwin plant (alumina)	do	Bauxite.
Antimony:		
ASARCO Incorporated:		
El Paso smelter	El Paso	Ore.
Anzon American Inc.:		
Laredo smelter	Webb	Ore.
Cadmium:		
ASARCO Incorporated:		
Electrolytic	Nueces	Ore.
Copper:		
ASARCO Incorporated:		
Amarillo refinery	Potter	Blister and anode.
El Paso smelter	El Paso	Ore and concentrate.
Phelps Dodge Refining Corp.:		
Nichols refinery	do	Blister and anode.
Iron:		
Armco Inc.:		
Houston plant	Harris	Ore and scrap.
Lone Star Steel Co.:		
Daingerfield plant	Morris	Do.
United States Steel Corp.:		
Baytown plant	Chambers	Do.
Lead:		
ASARCO Incorporated:		
El Paso smelter	El Paso	Ore and concentrate.
Magnesium:		
Dow Chemical U.S.A.:		
Freeport plants, electrolytic	Brazoria	Seawater.
Manganese:		
Tenn-Tex Alloy Corp	Harris	Ore.
Sodium:		
Ethyl Corp	do	Salt.
Tin:		
Gulf Chemical & Metallurgical Co.:		
Texas City smelter	Galveston	Ore, slag, residue.
Zinc:		
ASARCO Incorporated:		
Corpus Christi electrolytic	Nueces	Ore and concentrate.
El Paso fuming plant	El Paso	Dust and residue.

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 and copper bars.
GNB Batteries Inc	Lead scrap	Battery lead oxide and 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 Co	Tin metal scrap	Tin.
Gregg:		
Marathon-LeTourneau Co	Steel scrap	Steel castings and shapes.
Southwest Steel Castings Co	do	Steel castings.

Table 12.—Texas: Secondary metal recovery plants —Continued

County and company	Material	Product
Guadalupe:		
Structural Metals Inc	Steel scrap	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 and zinc scrap	Aluminum and zinc ingots and 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 and soft lead and dresses.	Battery metals and 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 and 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 plant	Cameron and Galveston.
Milwhite Co. Inc	Box 15038 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.
Capitol Aggregates Inc	Route 13, Box 412 San Antonio, TX 78209	do	Do.
Centex Corp	4600 Republic National Bank Tower Dallas, TX 75201	do	Hays and Nueces.
General Portland Inc	12700 Park Central Place Dallas, TX 75251	do	Dallas and Tarrant.
Gifford-Hill & Co. Inc	Box 520 Midlothian, TX 76065	do	Ellis.
Gulf Coast Portland Cement Co	Box 262 Houston, TX 77001	do	Harris.
Lone Star Industries Inc	Box 47327 Dallas, TX 75247	do	Harris and Nolan.
Longhorn Cement Div., Kaiser Cement Corp.	Kaiser Center 300 Lakeside Dr. Oakland, CA 94612	do	Bexar.
River Cement Co	180 Weidman Rd. Manchester, MO 63011	do	Orange.
Southwestern Portland Cement Co.	Box 392 El Paso, TX 79943	do	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	Pit and plant	Denton, Guadalupe, Nacogdoches, Parker, Van Zandt, Wise.
Balcones Minerals Corp	Box B Flatonia, TX 78941	do	Fayette.
Elgin-Butler Brick Co	Box 1947 Austin, TX 78767	do	Bastrop.

Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Clays —Continued			
Featherlite Corp	Box 141 Ranger, TX 76470	Pit and plant	Eastland.
General Portland Inc	3333 Fort Worth Ave. Dallas, TX 75211	do	Dallas and Limestone.
General Refractories Co	600 Grant St. Room 3000 Pittsburgh, PA 15219	do	Cherokee.
Gulf Coast Portland Cement Co., a division of McDonough Co.	Box 262 Houston, TX 77001	Pit	Chambers.
Henderson Clay Products Co	Box 490 Lindale, TX 75771	Pit and plant	Rusk.
Lone Star Industries Inc	Box 12449 Dallas, TX 75225	Pit	Fisher and Harris.
Milwhite Co. Inc	Box 15038 Houston, TX 77020	Pit and plant	Fayette and Walker.
Southern Clay Products Inc	Box 44 Gonzales, TX 78629	do	Angelina, Cherokee, Gonzales.
Texas Clay Industries Inc	Box 469 Malakoff, TX 75148	do	Henderson.
Texas Industries Inc	8100 Carpenter Freeway Dallas, TX 75247	do	Comanche, Dallas, Ellis, Fort Bend, Henderson, Marion, Van Zandt.
Fluorspar:			
D. & F. Minerals Co	Box 75 Terlingua, TX 79852	Mine	Brewster.
Graphite:			
Southwestern Graphite Co	Burnet, TX 78611	Mill	Burnet.
Gypsum:			
Genstar Building 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	Stonewall.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Nolan.
Do	do	Plant	Harris.
Iron ore:			
Lone Star Steel Co	Box 12226 Dallas, TX 75225	Mine	Cass and Morris.
Lime:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Calhoun.
Armco Inc	Box 96120 Houston, TX 77213	do	Harris.
Austin White Lime Co	Box 9556 Austin, TX 78766	do	Travis.
Champion International Corp	Box 872 Pasadena, TX 77501	do	Harris.
Chemical Lime Co. Inc	P. M. Highway 2602 Clifton, TX 76634	do	Bosque.
Holly Sugar Corp	Drawer 1778 Hereford, TX 79045	do	Deaf Smith.
McDonough Bros. Inc	Route 2, Box 222 San Antonio, TX 78229	do	Bexar.
Round Rock Lime Co	Box 38 Blum, TX 76627	do	Hill.
Texas Lime Co	Box 851 Cleburne, TX 70631	do	Johnson.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Comal.
Salt:			
Diamond Shamrock Corp	717 North Harwood Dallas, TX 75201	do	Chambers.
The Dow Chemical Co	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	Brine	Harris, Jefferson, Matagorda.

Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Capitol Aggregates Inc	Drawer 33240 San Antonio, TX 78233	Stationary plant	Guadalupe, Travis, Val Verde.
Dresser Industries Inc	Kosse, TX 76653	do	Limestone.
The Fordyce Co	Box 1981 San Antonio, TX 78297	do	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	do	Borden, Crosby, Lubbock, Taylor.
Lone Star Industries Inc	Box 12449 Dallas, TX 75225	do	Colorado and Denton.
Parker Bros. & Co. Inc	Box 107 Houston, TX 77001	Stationary plant and dredge.	Colorado, Harris, Victoria.
Thorstenberg Materials Corp	363 North Belt, No. 540 Houston, TX 77054	do	Colorado and Fayette.
Sodium (metallic):			
Ethyl Corp	Box 472 Pasadena, TX 77502	Plant	Harris.
Sodium sulfate (natural):			
Ozark-Mahoning Co	1870 South Boulder Tulsa, OK 74119	do	Gaines and Terry.
Stone:			
General Portland Inc	Box 324 Dallas, TX 75201	Quarry	Dallas, Tarrant, Wise.
Gifford-Hill & Co. Inc	Box 47127 Dallas, TX 75247	do	Comal, Ellis, Wise.
Lone Star Industries Inc	Box 47327 Dallas, TX 75247	do	Burnet, Nolan, Wise.
McDonough Bros. Inc	Route 2, Box 222 San Antonio, TX 78229	do	Bexar.
Parker Bros. & Co. Inc	Box 107 Houston, TX 77001	do	Comal.
Texas Crushed Stone Co	Box 9345 Austin, TX 78717	do	Llano and Williamson.
Texas Industries Inc	Box 146 Midlothian, TX 76065	do	Ellis and Wise.
White's Mines Inc	Box 421 San Antonio, TX 78206	do	Brown, 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.
Cities Service Oil Co	Box 300 Tulsa, OK 74102	do	Gaines and Van Zandt.
Getty Oil Co	Box 8 Scroggins, TX 75480	do	Franklin and Freestone.
Gulf Oil Co	Box 701 Port Arthur, TX 77640	do	Jefferson.
Phillips Petroleum Co	Bartlesville, OK 74003	do	Brazoria, Crane, Ector, Hutchinson.
Shell Oil Co	Box 2099 Houston, TX 77001	do	Cass, Harris, Karnes.
Warren Petroleum Corp	Box 1589 Tulsa, OK 74101	do	Crane, Hopkins, Karnes.
Sulfur (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.
Jefferson Lake Sulfur Co	Box 1185 Houston, TX 77001	do	Fort Bend.
Texasgulf Inc	200 Park Ave. New York, NY 10017	do	Fort Bend, Jefferson, Liberty, Pecos, Wharton.
Talc:			
Amoco Minerals Co. (Cyprus)	7000 Yosemite St. Box 3299 Englewood, CO 80155	Mine and plant	Hudspeth.
Pioneer Talc Co. Inc	Chatsworth, GA 30705	do	Do.
Southern Clay Products Inc	Box 44 Gonzales, TX 78629	Mine	Do.
Texas Talc Co	Box 866 Van Horn, TX 79855	do	Do.
Westex Talc Co	Box 15038 Houston, TX 77020	Mine and plant	Culberson and Hudspeth.
Vermiculite (exfoliated):			
W. R. Grace & Co	2651 Manila Rd. Dallas, TX 75200	Exfoliating plant	Bexar and Dallas.
Vermiculite Products Inc	Box 7327 Houston, TX 77008	do	Harris.

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 in Utah, $622 million in 1982, dropped 24% from the record $820 million achieved in 1981. In order of value of output, Utah's principal commodities were copper, gold, potassium salts, portland cement, silver, salt, vanadium, molybdenum, construction sand and gravel, and native asphalt (gilsonite).

Nationally, the State ranked 1st in value of gilsonite and beryllium hydroxide production; 2d in copper, potash, and vanadium; 3d in gold; 4th in silver and molybdenum; and 11th in value of all nonfuel minerals produced.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	290	$2,296	[2]183	[2]$994
Copper (recoverable content of ores, etc.) metric tons	211,276	396,471	189,090	309,778
Gem stones	NA	80	NA	80
Gold (recoverable content of ores, etc.) troy ounces	227,706	104,663	174,940	65,762
Gypsum thousand short tons	300	2,705	231	2,363
Iron ore (usable) thousand long tons, gross weight	691	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
Perlite do.	(3)	4	--	--
Salt do.	1,072	21,775	1,227	23,210
Sand and gravel:				
Construction do.	e8,212	e54,550	7,579	14,920
Industrial do.	22	286	W	W
Silver (recoverable content of ores, etc.) thousand troy ounces	2,883	30,321	4,342	34,522
Stone:				
Crushed thousand short tons	2,840	12,157	p2,500	p9,800
Dimension do.	3	280	p3	p280
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 (fullers earth, 1982), 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
Total	XX	r819,882	XX	622,499

eEstimated. pPreliminary. 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.

[3]Less than 1/2 unit.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Beaver	$82	(3)	
Box Elder	W	$1,132	Stone (crushed), salt, stone (dimension), silver.
Cache	3,166	1,213	Stone (crushed).
Carbon	W	56	Carbon dioxide.
Davis	2,663	(3)	
Duchesne	355	(3)	
Emery	W	--	
Garfield	W	--	
Grand	16,479	W	Potassium salts, salt.
Iron	W	10,032	Iron ore.
Juab	W	494	Stone (crushed), gypsum, silver, gold, copper.
Kane	W	(3)	
Millard	W	4,405	Lime, stone (crushed), gypsum, beryllium, perlite.
Morgan	W	W	Cement, stone (crushed).
Rich	(4)	--	
Salt Lake	562,264	553,778	Copper, gold, molybdenum, silver, cement, salt, lime, stone (crushed), sand and gravel (industrial), clays, lead, zinc.
San Juan	W	(3)	
Sanpete	1,035	W	Gypsum, clays.
Sevier	W	W	Gypsum, clays, salt.
Summit	W	W	Zinc, lead, silver, clays, gold, copper.
Tooele	36,581	54,843	Copper, lime, gold, salt, silver, stone (crushed), magnesium compounds, clays, tungsten.
Uintah	W	W	Asphalt, phosphate rock.
Utah	19,275	9,962	Stone (crushed), silver, gold, copper, clays, lead, zinc.
Wasatch	528	(3)	
Washington	429	(3)	
Weber	27,248	10,370	Salt, asphalt, magnesium compounds, sodium sulfate, clays.
Undistributed[5]	93,519	119,045	
Sand and gravel (construction)	XX	e54,550	
Total	763,624	e819,882	

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.

[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]Less than 1/2 unit.

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

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

Table 3.—Indicators of Utah business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	646.0	668.0	+3.4
Unemployment	do	43.0	52.0	+20.9
Employment (nonagricultural):				
Mining[1]	do	20.3	18.4	-9.4
Manufacturing	do	89.6	85.9	-4.1
Contract construction	do	28.3	27.1	-4.2
Transportation and public utilities	do	34.2	35.4	+3.5
Wholesale and retail trade	do	130.6	131.9	+1.0
Finance, insurance, real estate	do	26.3	26.6	+1.1
Services	do	103.7	108.7	+4.8
Government	do	125.1	126.3	+1.0
Total nonagricultural employment[1]	do	[2]558.0	560.3	+.4
Personal income:				
Total	millions	$12,632	$13,566	+7.4
Per capita		$8,322	$8,733	+4.9

See footnotes at end of table.

Table 3.—Indicators of Utah business activity —Continued

	1981	1982[p]	Change, percent
Construction activity:			
Number of private and public residential units authorized	8,797	6,950	-21.0
Value of nonresidential construction ---- millions	$260.6	$304.8	+17.0
Value of State road contract awards ---- do	$65.0	$85.0	+30.8
Shipments of portland and masonry cement to and within the State ---- thousand short tons	701	599	-14.6
Nonfuel mineral production value:			
Total crude mineral value ---- millions	$819.9	$622.5	-24.1
Value per capita, resident population	$536	$401	-25.2
Value per square mile	$9,224	$7,331	-20.5

[p]Preliminary.
[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.

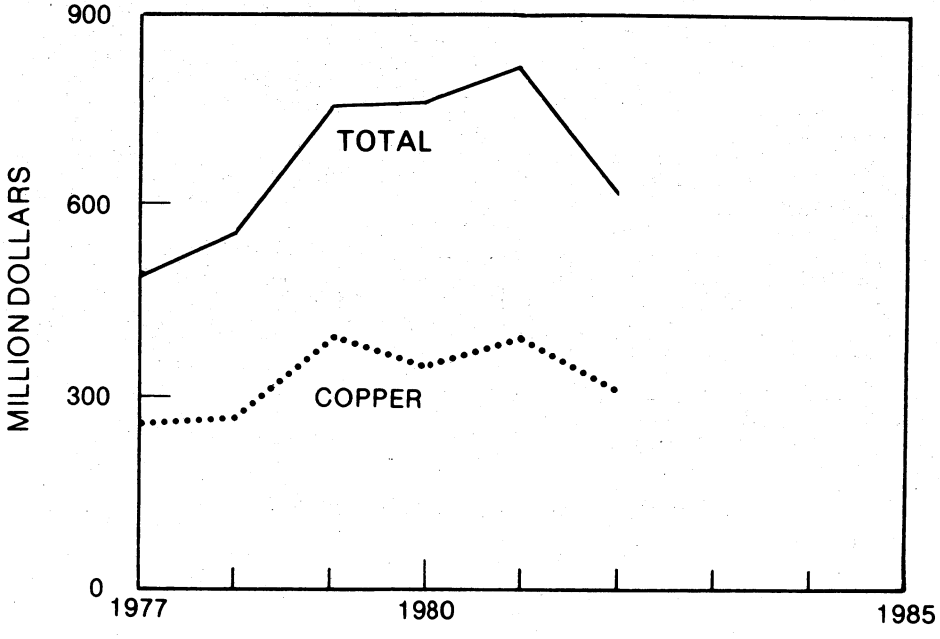

Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Utah.

Metal production comprised nearly three-fourths of the total value of Utah's nonfuel mineral output; copper, the most important commodity, totaled over two-thirds of the value of the metal recovered and one-half of the total value of nonfuel mineral production. The State produced 16.6% of the Nation's copper. Utah Copper Div. of Kennecott Minerals Co., a subsidiary of Kennecott Corp., was the principal producer of copper and the byproduct metals gold, molybdenum, and silver. Despite the deepening recession, the company continued to operate at a level about 10% below normal with a reduced work force.

In 1982, silver was the only metal in the State that increased in output, and did so only because of the production Ranchers Exploration and Development Co. achieved at its new Escalante Mine. The State's iron ore production plummeted as steel plant operations were curtailed and iron ores continued to be shipped in from Wyoming.

Overall, the value of output in the nonmetals group declined as the construction industries continued in the doldrums. The leading commodities in terms of value were potash, portland cement, salt, lime, construction sand and gravel, gilsonite, and phosphate rock. Despite the general decline, increases in value were posted in the production of masonry and portland cement, magnesium compounds, potassium salts, and salt.

Trends and Developments.—Except for silver, production of every metal in the State declined in quantity and value. The downturn was attributed to a number of factors: the depressed demand for metals and correspondingly low prices brought on by the worldwide recession, competition with private and government-owned foreign producers, high energy costs, high operating costs, and an oversupply of most metals.

These conditions severely affected the oldest mining districts in the State. In the West Mountain (Bingham) district, Kennecott Minerals reduced copper production at its Bingham Canyon open pit, and Anaconda Minerals Co., a subsidiary of Atlantic Richfield Co., closed its new Carr Fork copper mine. In the Park City district, mining companies survived by preparing their properties for real estate development on the surface and by seeking financing to develop and explore their silver-lead-zinc ore deposits. In the Tintic area, Kennecott Minerals reduced output of its flux gold-silver-copper ore and then closed the Trixie Mine, the last producing mine in the district. In the Iron Springs district, output from iron mines ceased as Utah's only steel plant curtailed production. The Colorado Plateau area also was affected as uranium demand faded with the cessation of new nuclear powerplant construction and as demand for its vanadium coproduct, used as an alloying element in iron and steel, fell.

Increasing interest in precious metal production, however, was reflected in development of the new Escalante silver mine in Iron County, and the revival of the old Camp Floyd (Mercur) gold mining district by Getty Mining Co., a subsidiary of Getty Oil Co.

Exploration Activities.—Largely unreported, exploration activities in the State continued in the recession-dominated year. Examples of the status of several projects in the State are noted. In the Main Tintic district, ASARCO Incorporated, under a lease arrangement, erected a headframe and rehabilitated the Chief Consolidated Mining Co.'s No. 2 shaft to the 1,450-foot level in preparing for a drilling program. Work, however, was postponed until additional financing became available. Also under a lease arrangement with Chief Consolidated, Sunshine Mining Co. erected a new headframe at the Apex No. 2 shaft of the Burgin Mine in the East Tintic district; however, in early 1982, as precious metal prices declined, the company deferred exploration and development on this property. After the Homansville Fault project was released from a Kennecott Minerals lease in October 1982, Chief Consolidated conducted a geophysical survey of the area in the East Tintic district. On November 11, 1982, Horn Silver Mines Inc. and Tintic Mineral Resources Inc. completed a lease agreement with Freeport Minerals Co., a subsidiary of Freeport-McMoRan Inc., to explore 244 patented mining claims in the old San Francisco mining district for precious and base metals.

Legislation and Government Programs.—The Mining and Mineral Resources and Research Institute at the University of Utah in Salt Lake City, which was created under title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines. In addition, the Bureau, by means of a $1,280,000 grant, aided in the establishment of a generic mineral technology research center in comminution.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Beryllium.—Beryllium ore production declined in quantity and value during 1982. In its 1982 annual report, Brush Wellman Inc., the principal producer of beryllium ore in the United States, reported 359,000 pounds of beryllium was obtained from 91,000 tons of bertrandite ore milled at Delta in 1982, compared with 490,000 pounds recovered from 121,000 tons in 1981.

Ore containing bertrandite, a hydrous beryllium silicate, was open pit mined from the volcanic tuff beds underlying the topaz rhyolites on Spor Mountain in western Juab County.[2] Drilling on the property in 1982 added approximately 368,000 tons of proved bertrandite reserves. As of December 31, 1982, the company estimated proved bertrandite ore reserves to be 4,352,000 tons with an average grade of 0.23%.

The ore was trucked from the Topaz-Spor Mountain area to Brush Wellman's facilities near Delta for processing into a beryllium hydroxide concentrate. The product was then shipped to Elmore, Ohio, for conversion to beryllium alloys, beryllia ceramic, and metallic beryllium. The company's properties on Spor Mountain contained the only U.S. commercialized bertrandite deposit. The extraction facilities have an annual capacity of 112,000 tons of ore, according to the 1980 Brush Wellman Inc. 10K Annual Report. In a separate input at its Delta processing plant, the company also treated high-grade, hand-cobbed beryl ore containing at least 10% beryllium oxide; however, modification of the system was underway in 1982 to utilize ores containing as little as 7% beryllium oxide. Brush Wellman continued to encourage the development of domestic deposits of beryl; beryl ores were imported primarily from China and Brazil in 1982.

Copper.—As the recession deepened and the market for copper decreased, copper production declined about 11%. Contributing to the nearly 22% slump in the value of copper production was the fall in the average unit price from $0.85 per pound in 1981 to $0.74 in 1982.

Utah's principal copper producer was the Utah Copper Div. of Kennecott Minerals Co., a subsidiary of Kennecott Corp., that was acquired in 1981 by Standard Oil Co., an Ohio corporation (Sohio). Sohio was 50% owned by British Petroleum Co. The Utah Copper Div. at Bingham Canyon, 25 miles southwest of Salt Lake City, included the world's largest open pit copper mine and 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 per day of ore; 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.[3] Support facilities included a 175,000-kilowatt coal-fueled powerplant; a 54,000-ton-per-year lime plant; and maintenance shops for repairing 94 haulage trucks, 80 locomotives, 41 electric shovels, 22 rotary drill rigs, 1,000 ore cars, and other equipment. The Sohio 1982 10K Annual Report to the Securities and Exchange Commission showed that the Utah Copper Div. mined and processed 36,878,000 net tons of ore to yield 199,518 net tons of copper in 1982, compared with 39,024,000 net tons of ore yielding 223,123 tons of copper in 1981. The average grade of ore mined increased from 0.582% in 1981 to 0.625% in 1982.

In 1982 developments, engineering evaluations continued for modernizing the company's mine and concentrators with replacement of the mine transportation system, in-pit crushers, and conveyors. Some retrofitting of the flotation cells in the Magna mill was already underway.

In April, the Salt Lake County Commission authorized Kennecott Minerals to issue up to $40 million worth of revenue bonds to finance additional improvements for air-pollution control equipment and to install water-pollution facilities at its Utah Copper Div.

Deteriorating market conditions forced reduction of hourly and salaried workers at Kennecott Minerals operations in Utah. Layoffs announced in the first quarter and at midyear 1982 were approximately 1,440 hourly and 297 salaried workers at the Utah Copper Div.; about 123 salaried personnel were released from the Kennecott Minerals headquarters during the first quarter of 1982. The Utah Copper Div. and Kennecott Minerals offices reportedly had employed more than 7,400 people in 1981.

Anaconda did not resume production at its Carr Fork Mine, Tooele County, in 1982.

Shipments had been suspended on November 18, 1981; underground development work was curtailed in April 1982 when the work force was reduced from 850 to about 200. Citing poor copper markets and the depressed economy, the company gradually released another 120 employees beginning in October 1982. The remaining staff continued pumping operations and will maintain equipment until conditions improve. On December 9, laid off employees were notified that their petition to the U.S. Department of Labor for additional unemployment benefits was denied. Under the Trade Act of 1974, if loss of work could be attributed to competetion from foreign countries, former employee benefits could have been extended.

Other copper producers in the State included the Midvale tailings project of Sharon Steel Corp. and the Trixie Mine of Kennecott Minerals.

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
1980, total	4	29,384,411	179,538	$109,977,798	2,203,289	$45,475,885
1981, total	9	36,858,359	277,706	104,662,786	2,882,671	30,320,999
1982:						
Iron	1	W	W	W	W	W
Juab	1	W	W	W	W	W
Salt Lake	1	W	W	W	W	W
Utah	3	W	W	W	W	W
Total	6	33,764,573	174,940	65,761,695	4,342,333	34,521,547

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1980, total	157,775	$356,251,322	W	W	W	W	$514,022,502
1981, total	211,276	396,471,474	1,662	$1,338,141	1,576	$1,547,808	534,341,208
1982:							
Iron	--	--	--	--	--	--	W
Juab	--	--	--	--	--	--	W
Salt Lake	W	W	--	--	--	--	W
Utah	W	W	W	W	--	--	W
Total	189,090	309,777,887	W	W	--	--	W

W Withheld to avoid disclosing company proprietary data.

Table 5.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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-silver	1	W	W	W	W	--	--
Siver	4	W	W	W	--	W	--
Copper	1	W	W	W	W	--	--
Total	6	W	W	W	W	W	--
Other lode material:							
Gold-silver tailings	--	W	W	W	W	--	--
Copper precipitates	1	W	--	--	W	--	--
Grand total	6	33,764,573	174,940	4,342,333	189,090	W	--

W Withheld to avoid disclosing company proprietary data.

[1]Detail will 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.

Table 6.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1982, 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	169,877	--	--
Direct smelting of:					
Ore	W	W	432	W	--
Tailings	W	W	78	--	--
Precipitates	--	--	18,703	--	--
Total	174,940	4,342,333	189,090	W	--

W Withheld to avoid disclosing company proprietary data.

Gold.—Gold output declined 23% as the copper industry curtailed production; in Utah, gold was the most important byproduct of copper output. The 37% drop in the value of gold production was also attributable to a fall in the average unit price of gold from $459.64 per troy ounce in 1981 to $375.91 in 1982. The State continued to rank third in the Nation's gold output, with Kennecott Minerals' Utah Copper Div. as the principal producer. Other producers, in declining order of output, included the Escalante Mine of Ranchers and the Trixie and Iron Blossom Mines of Kennecott Minerals.

Getty Mining proceeded with developing its gold mine at Mercur, Tooele County, 40 miles southwest of Salt Lake City. Site construction and removal of overburden neared completion during 1982. By November, the tailings dam was 70% finished, the warehouse was 60% completed, and the processing plant was 40% completed. Using open pit mining methods and cyanide leach and carbon absorption processes adapted for extracting micrometer-sized gold, the company scheduled production to begin in mid-1983, with the mill reaching its 3,000-ton-per-day design capacity by yearend. The $90 million project was expected to recover 80,000 ounces of gold per year for 14 years. The number of workers employed during the construction phase varied from 350 to 500; under full production, salaried and hourly workers were expected to number 238.

According to the Getty Oil Co. 10K Report, DeGolyer & MacNaughton consultants estimated that as of December 31, 1982, the deposit contained 5.36 million short tons of proved and 4.8 million short tons of probable reserves, averaging 0.09 ounce of gold per short ton.

During 1982, Johnson Matthey Investments Inc. of Johnson Matthey & Co. Ltd., London, England, constructed a gold and silver refinery on a 22-acre site in Salt Lake Valley. Johnson Matthey Refining Inc. was to operate the state-of-the-art facility and begin production early in 1983. Built at a cost of $5.3 million, the plant was to have an initial annual capacity of 1 million ounces of gold and 4 million ounces of silver; and ultimate annual capacity was projected at 3 million ounces of gold and 14 ounces of silver. Feed was to be obtained from precious metals operations in the west and from gold and silver scrap produced in manufacturing electronics. Approximately 100 people were to be employed at the refinery.

Iron Ore and Steel.—In 1982, iron ore output declined sharply in tonnage and in value as producers in the Iron Springs mining district, Iron County, shut down or curtailed their operations. Until mid-1982, United States Steel Corp. direct shipped a hematitic iron ore from its Mountain Lion open pit mine on Iron Mountain to the United States Steel Geneva Works near Orem, Utah County; the latter half of the year, Geneva was supplied with iron ore pellets from the company's Atlantic City Mine near Lander, Wyo. CF&I Steel Corp., which had shipped iron ore from the Comstock Mine to its steel plant in Pueblo, Colo., and Utah International Inc., a subsidiary of General Electric Co., which had shipped iron ore concentrates from the Iron Springs district, were shut down in 1982; Utah International put its concentrators up for sale. The recession, depressed automotive and construction industries, and competition with foreign imports were cited as the reasons for the decline in Utah's iron and steel industry.

The Geneva Works of United States Steel operated at a greatly reduced rate, often

reduced to operating 1 of 3 blast furnaces and 1 or 2 of 10 open-hearth furnaces. The structural steel mill was down; and the hot-strip mill, which produced plate and hot-rolled sheet and coils, was operated at reduced levels. Of approximately 4,700 workers normally employed at the plant, nearly 1,700 had been laid off since the summer of 1981. Some workers were recalled sporadically as work became available.

United States Steel reorganized its Geneva Works near Orem and its Pittsburg Works at Pittsburg, Calif., into a single operating entity to improve planning and coordination of production. Most of the steel produced at its plant in Utah was shipped to California for finishing into a variety of sheet products such as cold-rolled sheets, galvanized sheets, and tin plate.

In environmental matters, engineers at the Geneva Works developed an advanced technique to suppress emissions from the blast-furnace cast house and open-hearth tapping operations. The new technology was expected to save more than $15 million in pollution-control expenses, reduce emissions by 31%, and cost $2 to $3 million less to operate. Under a 1981 U.S. District Court consent decree, the company had agreed to install pollution-control equipment at a cost of more than $77 million. The Environmental Protection Agency and United States Steel asked the U.S. District Court for Utah to approve an amendment to the consent decree signed by the company in 1981 allowing use of the new technique.

Nucor Steel Co., a division of Nucor Corp., operated a new 400,000-ton-per-year mini-mill steel facility at Plymouth, Box Elder County. Steel scrap was melted in two 65-ton electric arc furnaces, and continuous cast into billets for feed into the rolling mill. Products such as angles, rounds, channels, and flats in carbon and alloy steel were manufactured for shipment within an approximate 700-mile radius to Denver, Los Angeles, and the Pacific Northwest. The slow economy in 1982, however, forced a cutback in April to a 32-hour workweek for one-half of the workers, caused 30 layoffs, affected wage cuts and freezes, and postponed a planned expansion to 600,000 tons annual capacity. About 330 workers were employed at this plant. Box Elder County commissioners authorized a $6.3 million pollution-control bond issue for a dust-collection project and a $1 million industrial revenue bond issue for Nucor's Plymouth project.

Using steel products from the Plymouth operation, Nucor's Vulcraft Div. manufactured steel joists and joist girders at its 40,000-ton-per-year plant started up at Brigham City in the third quarter of 1981. Approximately 150 production workers and 31 administrative workers were employed at this plant. The Nucor Grinding Ball Div. at Brigham City, started up late in 1981, sold its product to the mining industry. About 20 people were employed at this division.

Lead.—Utah's lead production plummeted to a fraction of its 1981 output. Only one operator in the State shipped a small amount of lead from its mine in Utah County. Noranda Mining Inc., a subsidiary of Noranda Mines Ltd., Canada, ended its exploration program at the Ontario Mine in the Park City mining district, Summit County. Noranda was Utah's largest lead producer in 1981. On January 29, Noranda laid off 48 workers and, on April 20, terminated its lease with United Park City Mines Co. United Park was granted a 2-year option to purchase the 750-ton mill and other facilities. Pumping operations at the Ontario, however, were ended in April. Resumption of operations depended on metal prices, solving adverse rock conditions, ground water problems, and the potential adverse impact of the Jordanelle Dam if built in the area. Noranda also terminated its lease with the adjacent Park City Consolidated Mines Co. for exploration on the old silver-lead-zinc property that had been dormant for 40 years. The property was opened from the Ontario Drain Tunnel and a drill station was prepared by early 1982, but no exploratory drilling was begun.

Magnesium.—AMAX Specialty Metals Corp., Magnesium Div., a subsidiary of AMAX Inc., operated the Nation's second largest, the world's third largest, magnesium plant at Rowley, Tooele County. The plant recovered magnesium from the brine of Great Salt Lake that was pumped into one of the largest (40,000 acres) solar ponds in the Western Hemisphere. The brines were concentrated by solar evaporation and processed to magnesium chloride. The magnesium chloride was separated into magnesium and chlorine by electrolysis, and the metal was cast into ingots.

The 1982 plant production capacity was 35,000 tons of magnesium metal per year; however, according to the AMAX Inc. 1982 10K Report, the operation was adversely affected by higher production costs and

reduced demand, providing a production of 20,000 tons per year. About 40% of the company's magnesium metal output was exported in 1982. Reportedly, 3 tons of chlorine was also recovered for every ton of magnesium produced. Of the 700 workers employed at the operation, approximately 80 had been laid off by yearend.

Molybdenum.—The Utah Copper Div. continued to ship molybdenum concentrates recovered as a byproduct of its copper production. Utah ranked third in the Nation in molybdenum output. Although the quantity produced declined about one-fourth, the value of that output plunged as the average producer's price per pound of molybdenum contained in technical-grade molybdic oxide fell precipitously.

At the Pine Grove porphyry molybdenum deposit in the central Wah Wah Mountains in western Beaver County, Getty Oil, manager of the Pine Grove Associates joint venture with Phelps Dodge Corp., shut down the exploration project early in December. During the year, a skeleton crew had continued exploration in the Pine Grove area, mostly by conducting tests on previously drilled core. According to the Phelps Dodge Corp. 1982 10K Report, Getty let its option to purchase the deposit expire in 1982. The joint venture agreement to explore and develop the deposit, however, continued; Getty retained the right to earn 52% interest in the property by spending about $45 million, $18.7 million of which had been expended by yearend.

Silver.—In 1982, with the production of nearly 11% of the Nation's silver, Utah ranked fourth after Idaho, Arizona, and Montana. Output increased 51% in quantity and 14% in value because the Escalante Mine, which came onstream in the third quarter of 1981, neared full production during 1982. The average price of silver, however, declined from $10.52 per troy ounce in 1981 to $7.95 in 1982, resulting in less of an increase in value. The Bingham Canyon Mine of Kennecott Minerals' Utah Copper Div. and the Escalante silver mine of Ranchers were the principal silver producers. Other operations recovering silver included Kennecott's Trixie Mine, Sharon Steel's Midvale tailings project, Kennecott's Iron Blossom Mine in Juab County; and two small mines in Utah County.

Ranchers posted production of 1,100,000 ounces of silver from processing 150,000 tons of ore at its Escalante silver mine in its fiscal year ending June 30, 1982; in the following 6 months, Ranchers recovered 1,099,199 ounces of silver from processing 135,435 tons of ore, with the company receiving an average of $8.42 per ounce of silver.[4] Located in Iron County, 42 miles west of Cedar City, silver mineralization in Rancher's operation occurs in a quartz-calcite vein averaging 19 feet thick, more than 800 feet deep, and almost 3,500 feet along the strike. The Escalante deposit was estimated to contain 2.67 million short tons of ore with an average grade of 12.5 ounces per ton. Using end-slashing, a variation of the vertical crater-retreat mining method, the underground mine produced 680 short tons of ore per day, 5 days per week, and pumped approximately 22,000 gallons of water per minute. Farmers in the area used much of the water for irrigation, and the oversupply flowed back into the underground reservoir. Other facilities at the property included a 750-ton-per-day mill, refinery, maintenance shop, warehouse, assay laboratory, change rooms, and offices. In 1982, the mine employed 46 workers, the mill, 27; the refinery, 3; and the administration and clerical sections, 27.[5]

In late November 1982, Kennecott Minerals suspended operations at its Tintic Div., Trixie Mine; approximately 75 hourly and 10 salaried workers were laid off. Shutdown of the mine left no major producing mine in the district. A silver-gold-copper flux was shipped from the Trixie to Kennecott's Garfield smelter.

Vanadium.—Vanadium was recovered from uranium-vanadium ores mined on the Colorado Plateau and shipped to the Atlas Corp. mill near Moab, Grand County; to the Energy Fuels Nuclear Inc. mill at Blanding, San Juan County; or to the Union Carbide Corp. mill at Uravan, Colo. Utah ranked second of four States producing vanadium in the Nation; production, however, declined 12% in quantity and almost 3% in value. Output has come 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. operated mines in the Big Indian district, Green River district, San Juan Canyon, Uravan Minerals Belt, Red Canyon and White Canyon areas of Utah and Colorado, and a uranium-vanadium processing mill approximately 4 miles from Moab. As uranium markets faltered in January 1982, the company placed on standby its Snow and Probe Mines 12 miles southwest of Green

River and Calliham Mine near Monticello and reduced production at its Pandora Mine near LaSal. The alkaline circuit of the Moab mill was temporarily shut down, but the less costly acid-leach recovery system, which included solvent extraction for the recovery of uranium concentrate and vanadium pentoxide, remained in operation. Of 500 workers employed in its mining and milling operations in Utah, about 175 were laid off at the beginning of the year and another 110 were laid off in November In mid-1982, the Utah Air Conservation Committee cited Atlas Minerals for emitting visible pollutants from its mill; the company was given until April 5, 1983, to meet air-quality standards. The Atlas Corp. 1982 annual report ending June 30, 1982, cited sales of 3,506,000 pounds of vanadium pentoxide.

Hecla Mining Co. and Union Carbide, equal partners in the Lisbon Valley uranium-vanadium project, placed the mine on maintenance standby pending recovery of the uranium market. Union Carbide completed its scheduled development work in December 1982.

Throughout the year, the State investigated the problem of removing tailings from the site of the old Vitro uranium-vanadium processing plant in the Salt Lake City metropolitan area.

Zinc.—No zinc was reported produced in the State during 1982. The principal zinc producer in 1981 was the Ontario project of Noranda Mining Inc. in the Park City mining district. The last base metal and precious metal ore was shipped in May 1981, and the lease on the property, owned by United Park City Mines, was terminated in 1982. Zinc prices dropped from an average $0.4455 per pound in 1981, to an average $0.3847 in 1982.

NONMETALS

Asphalt (Native) and Other Bitumens.—Asphaltite, also called gilsonite or uintahite, is a solidified hydrocarbon mined from nearly vertical veins near Bonanza, Uintah County. American Gilsonite Co., a division of Chevron Resources Co. (a subsidiary of Standard Oil Co. of California) mined gilsonite at its property about 50 miles southeast of Vernal. A unique vacuum system carried the material to the surface where it was bagged and shipped to consumers worldwide. The select-grade gilsonite was used in paint and ink; the general-purpose grade was suitable for oil well cementing and drilling fluid applications; the sealer grade was used for automobile body sealers, insulation board, and asphalt applications.[e]

Ziegler Chemical & Minerals Corp. mined gilsonite from veins at Little Bonanza about 5 miles northwest of Bonanza.

During April and May 1982, Hydrocarbon Mining Co., a subsidiary of Oberon Oil Inc., a Utah corporation, and Strategic Mineral Holdings Inc. operated the Wildhorse gilsonite mine south of Ouray, Uintah County. On August 5, the companies entered a joint agreement with Miocene Resources Co., a Nevada corporation, to form the Hydrocarbon Resources Co. for developing the Wildhorse and/or Cottonwood gilsonite mines south of Vernal. Oberon Oil merged with Strategic Mineral Holdings Inc. of Spokane, Wash., to form a new company, Western Strategic Minerals Inc., on October 5, 1982. Western Strategic, in November 1982, reported that the Cottonwood Mine produced over 60 tons of gilsonite during 1982 and that, at the exploration projects, the Wildhorse shaft was down to the 350-foot level and the Cottonwood shaft was below the 300-foot level. As of November 29, 1982, Western Strategic estimated probable reserves of 103,000 tons of gilsonite on its 120-acre Wildhorse lease, 93,500 tons on its 280-acre Alabama lease, and 71,428 tons on its Cottonwood lease, all in the Uintah Basin.

Cement.—Portland cement producers in Utah, listed in descending order of output in 1982, included Ideal Basic Industries Inc. with its 350,000-ton-per-year capacity wet-process plant at Devils Slide, Morgan County; Lone Star Industries Inc.'s 420,000-ton-per-year wet-process plant at Salt Lake City; and Martin Marietta Corp.'s 650,000-ton-per-year dry-process plant at Leamington, Millard County. In 1982, shipments of gray finished portland cement increased about 12%, although its value rose only 3%. The increase in portland cement consumption was partly attributed to startup of construction on the 1,500-megawatt Intermountain Power Project near Lynndyl, Millard County. Masonry cement output also increased in quantity and value. Principal materials consumed in making the cement were limestone, sandstone, gypsum, shale, iron ore, and slag. Energy sources used at the plants included chiefly natural gas, followed by electrical energy, bituminous coal, and a small amount of fuel oil. Ready-mix companies, contractors, concrete manufacturers, building material dealers, and highway contractors were the principal

users of the product.

Clays.—Common clay shale mined by Utelite Corp., Summit County, was used in concrete block and structural concrete and by Interpace Brick Corp. in Utah County for face brick. Mountain Fuel Co.'s subsidiary, Interstate Brick Co., mined clay and shale for face brick at its Cottonwood pit, Salt Lake County, and Five Mile pit, Tooele County; and for floor and wall ceramics as well as face brick at its Henefer pit, Summit County, and Jim Gay pit, Utah County. Martin Marietta mined clay and shale for portland cement at its Hank Allen pit, Juab County. Swelling bentonite was mined by Western Clay Co. at its Redmond pit, Sevier County, for fertilizers, and by Redmond Clay and Salt Co. at its pit in Sanpete County for waterproof sealant and animal feed. Western Clay also mined fuller's earth at its Aurora pit, Sevier County. R. D. Wadley Clay Co. mined fire clay for foundry use at the Wadley pit, Utah County. Common clay and shale production in 1982 declined in quantity and value; the average unit value dropped from $7.92 to $5.43. Interstate Brick used its clays for manufacturing brick and ceramic tile. The firm recently constructed a 509- by 26-foot, 8-inch-wide kiln, widest in the Western Hemisphere, with a rated annual production capacity of 60 million brick equivalent.[7]

Gypsum.—United States Gypsum Co. and Georgia-Pacific Corp. continued as principal producers of crude and calcined gypsum in the State. United States Gypsum trucked crude gypsum from a quarry 7 miles northeast of its crushing and processing facilities at Sigurd, Sevier County. Employing approximately 74 workers at its Utah properties, the firm manufactured a complete line of wallboard and some ready mix at Sigurd.

Georgia-Pacific trucked gypsum ore from its mine 9 miles to the northeast to its milling and processing plants at Sigurd. The rated annual capacity of the Georgia-Pacific wallboard plant was 160 million square feet; however, the company reported production declined 30% because of the downturn in construction. Some gypsum was bagged for use in cement and agriculture. About 115 workers were employed at the Georgia-Pacific operation in 1982.

The United States Gypsum marketing area covered Utah, western Wyoming, southern Idaho, and western Colorado. Georgia-Pacific marketed its products on the western slope of the Rocky Mountains; in Utah, Idaho, southern Wyoming; and most of California, Nevada, and Oregon.

Gypsum was also mined by Cox Enterprises Inc. near Levan, Sanpete County, and by White Mountain Gypsum Co. near Fillmore, Millard County.

Lime.—Leading quicklime producers in the State included Utah Marblehead Lime Co., a subsidiary of General Dynamics Corp., with operations in the Lakeside Mountains, Tooele County; Utah Copper Div. of Kennecott, Salt Lake County; Genstar Cement & Lime Co., a subsidiary of Genstar Corp., Toronto, Canada, Tooele County; and Continental Lime Inc., a subsidiary of Steel Bros. Canada Ltd., Millard County. Genstar Cement principally produced a hydrate of lime that was marketed for use as finishing lime in the construction industry. Lime production in the State declined 14% in quantity and 9% in value.

Magnesium Compounds.—Great Salt Lake Minerals & Chemicals Corp., a division of Gulf Resources & Chemicals Corp., obtained magnesium chloride and other products from the brines of Great Salt Lake west of Ogden. Magnesium chloride in bitterns, the final product of the solar-evaporation process, was used principally as a dust suppressant for roads and industrial areas and in the sugar-beet processing industry. In 1982, a facility was completed for producing a purified grade of magnesium chloride to be used in the textile and detergent industries and for manufacturing a magnesium chloride flake used as a fire retardant. Sales of the commodity increased 44% in 1982.[8]

Perlite.—The Mountain Maid Inc. perlite mine near Fillmore, Millard County, was inactive during 1982. Perlite was shipped from out-of-State for expansion at the Pax Co. plant in Salt Lake County and at the Georgia-Pacific plant at Sigurd. Expanded perlite was sold for use in horticulture, plaster aggregate, masonry-fill insulation, and other products. Quantity and value of output decreased substantially in 1982.

Phosphate Rock.—Chevron Resources open pit mined phosphate rock at its Brush Creek operation 12 miles north of Vernal, Uintah County. Acquired by Chevron Resources in December 1980, the site has been a source of phosphate rock for 22 years. Ore was crushed at the minesite and transported through a 10-mile slurry pipeline to the mill for further crushing and processing by flotation. Concentrates were trucked to the rail terminal at Phoston, north of Heber,

Wasatch County, for shipment to Canada for manufacturing fertilizer.

Chevron temporarily shelved plans to lay an 11-inch underground pipeline from its Vernal property to Rock Springs, Wyo. Requiring 2 years for completion and proposed for construction beginning in spring 1983, the project would have transported a phosphate slurry to a planned fertilizer manufacturing plant near Rock Springs.

Phosphate production in Utah declined both in quantity and in value as recession-hit farmers postponed applying potash and phosphate containing fertilizers in the 1982 growing season. Employing about 160 workers during the year, the Chevron operation, the largest taxpayer in the county, paid about $5.5 million in wages.

Potash.—During 1982, potassium salts production declined; however, sales increased by 31% in quantity and 12% in value. The three companies recovering potash in the State were Great Salt Lake Minerals; Kaiser Aluminum & Chemcial Corp., 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. In 1982, the company proceeded with plans for a $10 million project to increase the size of its evaporation ponds to 34,000 acres by constructing 43 miles of dikes in Bear Lake Bay. The expansion, to be accomplished in three phases over 4 years, could bring the annual capacity of the plant to between 280,000 and 320,000 tons of potash. Salinity and water level of the lake are critical to the economic success of the operation. Gulf Resources & Chemicals Corp. 1982 annual report showed that severe wet weather in the 1982 evaporation season reduced the expected sulfate of potash production and that, together with a weakened agricultural economy, the sales volume declined 7% from 1981 levels.

The Kaiser solar-evaporation installation near Wendover, covering 87,816 acres, involved collecting natural brines in 140 miles of collection ditches on the Bonneville Salt Flats of the Great Salt Lake Desert. The brines were concentrated in a primary evaporation pond covering 8,000 acres. Potassium salts were harvested and processed through a flotation concentrator to separate the halite (muriate of sodium) and sylvite (muriate of potash).[9]

Texasgulf, a subsidiary of Société Nationale Elf Aquitaine (a 67% French Government-controlled oil company), recovered potassium salts at its Lane 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. During the year, Texasgulf protested an increase in State-assessed property taxes. The company pointed out its attempts to develop a new mining technique for tapping reserves beyond the old underground mine. The original room-and-pillar mine was converted to solution mining in mid-1971.

Salt.—The quantity of salt produced in Utah declined in 1982 because of heavy rainfall that diluted evaporation ponds and because of flooding that washed away some companies' salt stockpiles. Salt sold or used, however, increased in quantity and value over that of 1981. Solarsalt producers in 1982 included American Salt Co., Solar Div., Tooele County; 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 produced rock salt and brine in Sevier County; and Moab Brine Co. (LaSal Oil Co.) recovered salt from brine in Grand County. Of the 16 States producing salt, Utah ranked 8th.

Sand and Gravel.—Sand and gravel production in the State declined in 1982.

Construction.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981 collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

During the year, 46 producers mined construction sand and gravel from 63 sites in 22 counties. Listed in order, the following counties shipped 86% of Utah's construction sand and gravel: Salt Lake, Davis, Utah, Box Elder, Uintah, Duchesne, Washington, Iron, Wasatch, and Summit. Ten leading construction sand and gravel pro-

ducers provided 71% of the output in the State, while 16 county highway departments and the Utah State Highway Department accounted for 16% of the total.

During 1982, 18 operators produced less than 25,000 tons each, or 3% of the total output of construction sand in the State; 38 operators produced between 25,000 and 300,000 tons each, or 61%; and 5 operators produced between 300,000 and 600,000 tons each, or 36%. Eighty-eight percent of construction sand and gravel was shipped by truck.

Industrial.—Salt Lake Valley Sand & Gravel Co. produced industrial sand and gravel in Utah County for use in engine traction and sand blasting.

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

	1981			1982		
	Quantity (thousand short tons	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	2,029	$3,970	$1.96
Gravel	NA	NA	NA	4,445	9,152	2.06
Sand and gravel (unprocessed)	NA	NA	NA	1,105	1,798	1.63
Total or average	e8,212	e$54,550	e$6.65	7,579	14,920	1.97
Industrial sand	22	286	13.00	W	W	13.50
Grand total or average	e8,234	e54,836	e6.66	W	W	W

eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

Table 8.—Utah: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,040	$5,911	$1.94
Plaster and gunite sands	95	185	1.95
Concrete products	W	W	2.68
Asphaltic concrete	1,261	2,387	1.89
Road base and coverings	2,308	4,978	2.16
Fill	651	955	1.47
Snow and ice control	W	W	1.56
Other	224	503	2.25
Total or average	7,579	[1]14,920	1.97

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Data do not add to total shown because of independent rounding.

Sodium Sulfate.—Great Salt Lake Minerals recovered sodium sulfate as Glauber's salt from the brines of Great Salt Lake, west of Ogden. Although output during the year declined, the value of that production increased 14%. The product was sold chiefly to paper, detergent, glass, and ceramic industries.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Crushed.—Following a nationwide trend, construction in the State declined, and with it a decline in crushed stone production and value. It was estimated that production decreased by 12% and value decreased by 19%.

Dimension.—According to preliminary estimates for the year, the production and value of dimension stone remained about the same as that of 1981.

Sulfur.—Chevron Oil Co. recovered sulfur from its operation in Davis County.

Vermiculite (Exfoliated).—No crude vermiculite was mined in Utah; however, Vermiculite Intermountain Inc. exfoliated vermiculite shipped in from out-of-State sources. The product was used chiefly for block and loose-fill insulation; fireproofing; roofing, concrete, and plaster aggregates; and for horticulture applications.

[1]State Liaison Officer, Bureau of Mines, Denver, Colo.

[2]Burt, D. M., M. F. Sheridan, J. V. Bikun, and E. H. Christiansen. Topaz Rhyolites-Distribution, Origin and Significance for Exploration. Econ. Geol., v. 77, No. 8, December 1982, pp. 1818-1836.

[3]Anderson, R. J., R. R. Beck, and A. J. Weddick. The Utah Copper Smelter as Modified for Environmental Compliance. J. Metals, v. 34, No. 3, March 1982, pp. 45-53.

[4]Ranchers Exploration and Development Co. 10K Annual Report for the year ended June 30, 1982.

———. Semiannual Report, six months ended Dec. 31, 1982.

[5]Hogan, D. K., D. C. Fitch, R. E. Scheffel, and M. R. Welch. Escalante: Major Silver Mine Nears First Year of Full Operation. Min. Eng., v. 34, No. 9, September 1982, pp. 1323-1327, 1378.

[6]Christensen, S. Gilsonite, Found Nowhere Else in the World. Vernal Express, Apr. 29, 1983, p. 3.

[7]Jeffers, P. E. (ed.). Brickmaking on a Giant Scale. Brick & Clay Record, April 1982, pp. 34-39.

[8]Gulf Resources & Chemicals Corp. 1982 10K Annual Report, 27 pp., and Annual Report, 58 pp.

[9]Rocky Mountain Construction. Kaiser Mines Utah Potash the Easy Way. Sept. 17, 1982, p. N-2.

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.
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	do	Morgan.
Martin Marietta Cement, Mountain Div., a subsidiary of Martin Marietta Corp.	4885 South 900 East Salt Lake City, UT 84117	Quarries and plant	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 Brick Corp., Structural Div.	736 West Harrisville Rd. Box 447 Ogden, UT 84402	Open pit mines and plant	Sevier, Utah, Weber.
Interstate Brick Co., a subsidiary of Mountain Fuel Co.	9210 South 5200 West West Jordan, UT 84084	do	Salt Lake, Toole, 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:			
Anaconda Minerals Co., a subsidiary of Atlantic Richfield Co., Carr Fork Operations.[2]	R.F.D. 1, Box 79 Tooele, UT 84074	Underground mine and mill	Tooele.
Kennecott Minerals Co., 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.
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 ore:			
United States Steel Corp., Utah Ore Operations.	Box 859 Cedar City, UT 84720	Open pit mines	Iron.
Utah International Inc	Box 649 Cedar City, UT 84720	Open pit mines and plants	Do.
Lime:			
Continental Lime Inc., a subsidiary of Steel Bros. Canada Ltd.	268 West 400 South Suite 201 Salt Lake City, UT 84101	Quarry and plant	Millard.
Genstar Cement & Lime Co., a subsidiary of Genstar Corp.	Box 357 Grantsville, UT 84029	Open pit mine and plant	Tooele.
Utah Marblehead Lime Co., a subsidiary of General Dynamics Corp.	Box 596 Grantsville, UT 84029	do	Do.
Magnesium:			
AMAX Specialty Metals Corp., Magnesium Div., a subsidiary of AMAX Inc.	238 North 2200 West Salt Lake City, UT 84116	Solar evaporation plant	Do.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
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.	Box 1208 Moab, UT 84532	Solution mine, solar evaporation, concentrator, plant.	Grand.
Salt:			
American Salt Co	Box 477 Grantsville, UT 84029	Solar evaporation and concentrator.	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 South Weber Dr. R-4 Ogden, UT 84405	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.	1550 West 800 North, Sandy, UT 84070	Pit	Utah.
Silver:			
Ranchers Exploration and Development Co.	Box 308 Enterprise, UT 84725	Underground mine, mill, plant	Iron.
Stone:			
McFarland and Hullinger	915 North Main Tooele, UT 84704	Quarry	Tooele.
Southern Pacific Transportation Co.	One Market Plaza San Francisco, CA 94105	do	Box Elder.
Star Stone Inc	Box 218 Oakley, ID 83346	do	Do.
United States Steel Corp., Western Stone Operations.	Box 857 Santaquin, UT 84655	do	Utah.
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 gold and silver.
[3]Also gold, lime, molybdenum, rhenium, selenium, silver, and stone.
[4]Also magnesium compounds, salt, and sodium sulfate.
[5]Also magnesium compounds.

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 in 1982 was $50.2 million, a decrease of $3.9 million from that of 1981. The State again ranked first nationally in the value of dimension stone, accounting for about one-fifth of the U.S. total. In addition, Vermont ranked second in domestic sales and output of asbestos and talc. Crushed stone and construction sand and gravel were also produced in the State.

Trends and Developments.—In 1982, Vermont produced only five mineral commodities and ranked 44th overall in the United States in the value of nonfuel mineral output. However, the State continued to be a significant domestic producer of asbestos, dimension stone, and talc (table 4).

Exploration Activity.—Late in the year, Cyprus Mines Corp., a subsidiary of Standard Oil Co. (Indiana), began core drilling a talc deposit in Chester, Windsor County. In 1983, the company planned to obtain a bulk sample for analysis at the firm's laboratory at Alpine, Ala.

Newfane Soapstone Associates received approval from the Newfane Planning Commission to reopen a soapstone quarry last worked in the 1880's. According to the company, about 400,000 tons of soapstone would be mined at the Windham County site over a 20-year period and used in the manufacture of soapstone stoves and accessories. Operations were scheduled to begin in the summer of 1983 if the mine plant is approved under the State's land use requirement act.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel (construction) thousand short tons	e3,196	e$7,254	3,218	$6,854
Stone:				
Crushed do.	1,319	5,144	p1,200	p5,300
Dimension do.	207	30,756	p202	p29,446
Combined value of other nonmetals	XX	10,919	XX	8,550
Total	XX	r54,073	XX	50,150

eEstimated. pPreliminary. rRevised. 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

(Thousands)

County	1980	1981[1]	Minerals produced in 1981 in order of value
Addison	W	W	Stone (crushed).
Bennington	$942	$137	Stone (dimension).
Caledonia	W	(2)	
Chittenden	W	W	Stone (crushed).
Essex	W	(2)	
Franklin	W	W	Stone (crushed).
Grand Isle	6	--	
Lamoille	W	W	Asbestos, talc, stone (crushed).
Orange	W	1,182	Stone (dimension).
Orleans	494	43	Do.
Rutland	W	17,666	Stone (dimension), stone (crushed).
Washington	W	W	Do.
Windham	--	W	Talc.
Windsor	W	W	Talc, stone (dimension), stone (crushed).
Undistributed[3]	41,194	27,790	
Sand and gravel (construction)	XX	e7,254	
Total[4]	42,637	54,073	

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

[1]County distribution for construction sand and gravel is not available; total State value shown separately under "Sand and gravel (construction)."

[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 may not add to totals shown because of independent rounding.

Table 3.—Indicators of Vermont business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	260.0	265.0	+1.9
Unemployment	do	15.0	18.0	+20.0
Employment (nonagricultural):				
Mining	do	.6	.7	+16.7
Manufacturing	do	51.3	49.1	-4.3
Contract construction	do	11.0	9.8	-10.9
Transportation and public utilities	do	8.6	8.7	+1.2
Wholesale and retail trade	do	42.6	42.9	+.7
Finance, insurance, real estate	do	8.3	8.4	+1.2
Services	do	45.7	47.0	+2.8
Government	do	36.2	35.7	-1.4
Total nonagricultural employment	do	204.3	202.3	-1.0
Personal income:				
Total	millions	$4,499	$4,875	+8.4
Per capita		$8,726	$9,446	+8.2
Construction activity:				
Number of private and public residential units authorized		2,574	3,675	+42.8
Value of nonresidential construction	millions	$32.6	$52.6	+61.3
Value of State road contract awards	do	$32.5	$41.0	+26.2
Shipments of portland and masonry cement to and within the State	thousand short tons	130	114	-12.3
Nonfuel mineral production value:				
Total crude mineral value	millions	$54.1	$50.2	-7.2
Value per capita, resident population		$100	$97	-3.0
Value per square mile		$5,310	$5,219	-1.7

pPreliminary.

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

Table 4.—Vermont: Position in U.S. mineral production in 1982

Commodity	Rank in Nation in output	Number of producing States	Total U.S. output (thousand short tons)	Share of U.S. output (percent)
Asbestos	2	2	70	W
Stone (dimension)	2	38	1,330	15
Talc	2	11	1,049	W

W Withheld to avoid disclosing company proprietary data.

In other developments, North American Exploration Co., Charlottesville, Va., completed an exploratory drilling program for gold in Cuttingsville and Shrewsbury, Rutland County. Columbia Gas Transmission Co., Charleston, W. Va., leased 250,000 acres in western Vermont and New York for oil and gas exploration. During the year, the company continued seismic surveying.

Legislation and Government Programs.—The State's first comprehensive oil and gas legislation, Act 240, was passed during the 1982 legislative session. The legislation calls for the State Geologist to provide geological services to the newly created National Gas and Oil Resources Board and to serve in an advisory capacity to the board.

During the year, the Office of the State Geologist continued to maintain cooperative agreements with the U.S. Bureau of Mines for the purpose of providing statistical data on mineral production, and to investigate and evaluate the mineral resources of the State. The Office also continued to maintain a cooperative topographic mapping program with the National Mapping Division of the U.S. Geological Survey (USGS). A new cooperative program involving the assessment of Vermont's potential for damaging landslides in the higher elevations of the Green Mountains was in the negotiation and budgeting stage. This program will be conducted by the Engineering Geology Branch of the USGS Geologic Division. The U.S. Department of Energy funded regional literature studies regarding the State's potential for geologic disposal of high-level nuclear waste in crystalline rocks. The Office of the State Geologist completed two new publications in 1982: (1) Vermont handbook for soil erosion and sediment control on construction sites, Special Publication No. 3, and (2) bedrock geology of the Lincoln area, Vermont, Special Bulletin No. 2.

Other programs in the State in 1982 included an acid rain research study by the University of Vermont sponsored by the U.S. Forest Service, Department of Agriculture. The work, which began late in 1982, will investigate how acid precipitation may affect long-term productivity of northern forests. In addition, the physiological effects on trees of metals made soluble as a result of soil acidification will be examined.

Research on development of a substitute for asbestos from slate and limestone mining wastes by the University of California at Los Angeles (UCLA), cosponsored by the U.S. Bureau of Mines, continued in 1982. The research project was initiated in 1978 to find an economic means of disposing of large quantities of slate and marble wastes in Vermont. In the UCLA work, the slate and limestone mining wastes are used to produce glass fibers with an alkali resistance comparable to that of asbestos. About 40% of the asbestos fibers used in the United States is added to cement as a reinforcing agent. The asbestos fibers are highly resistant to the corrosive alkalinity of wet cement.

In a separate but related project, the U.S. Bureau of Mines has contracted with the Manville Service Corp. to produce quantities of the slate-limestone glass fibers. The objectives of this work are to demonstrate that the fibers could be produced under industrial conditions and to obtain sufficient quantities of the material so that it can be tested in actual cement-reinforcement applications. Results of the research were expected in 1983.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Asbestos.—Vermont was one of two States that produced asbestos in 1982, ranking second to California in output. The Vermont Asbestos Group Inc. (VAG), the State's only producer, was closed the first 5 months of the year. As a result of the shutdown, which reflected the depressed conditions in the housing and automobile industries, sales declined compared with those of 1981.

Because of the continuing decline in asbestos sales, VAG sought financial assistance from local, State, and Federal agencies as well as private investors. Late in the year, the Northeastern Vermont Development Association, which coordinated financing plans, announced that a $1.4 million assistance package was tentatively arranged. A decision on approval of the package was expected in 1983.

Sand and Gravel.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981,

collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Output of construction sand and gravel in 1982 was about the same as that of 1981, 3.2 million tons; the State accounted for 10% of production in the six-State New England region. Construction sand and gravel was produced in 12 of the State's 14 counties. Bennington and Chittenden Counties led Vermont in production and accounted for approximately one-half of the State's total output. The number of active pits reported in 1982 increased to 63 from 36 in 1980 when the last full construction sand and gravel survey was conducted. In 1982, major uses of construction sand and gravel in Vermont paralleled those of 1980 with road base and coverings, concrete aggregate, and fill as the leading uses.

Table 5.—Vermont: Construction sand and gravel sold or used by producers

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	NA	NA	NA	743	$1,615	$2.17
Gravel	NA	NA	NA	1,637	4,165	2.54
Sand and gravel (unprocessed)	NA	NA	NA	838	1,074	1.28
Total or average	e3,196	e$7,254	e$2.27	3,218	6,854	2.13

eEstimated. NA Not available.

Table 6.—Vermont: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	794	$2,157	$2.72
Plaster and gunite sands	W	W	5.12
Concrete products	51	144	2.82
Asphaltic concrete	295	900	3.05
Road base and coverings[1]	1,133	2,068	1.83
Fill	634	780	1.23
Snow and ice control	162	416	2.57
Railroad ballast	W	W	2.98
Other	150	390	2.60
Total[2] or average	3,218	6,854	2.13

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (cement).
[2]Data may not add to totals shown because of independent rounding.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its survey of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and finalized the following year.

Crushed.—Estimated output in 1982 was 1.2 million tons, a decline of about 119,000 tons compared with 1981 production. The six-State New England region accounted for only about 2% of the U.S. crushed stone output with Vermont's share at 0.15%.

Dimension.—Nationally, Vermont again ranked first in dimension stone sales and second in output. Production dropped slightly from 207,000 tons in 1981 to 202,000 tons in 1982, based on estimated data. Dimension granite, marble, and slate were mined at about 25 operations; sales were estimated to have exceeded $500,000 at nearly one-half of these operations. The Wetmore and Morse quarries of the Rock of Ages Corp. and the Danby Imperial quarry of the Vermont Marble Co. were among the 10 leading U.S. dimension stone operations based on total sales value.

In December, Vermont Marble, a subsid-

iary of OMYA Inc., received a multimillion dollar order to supply about 1,800 tons of marble for a Saudi Arabian building. The marble was expected to be mined at the Danby Imperial quarry and shipped to the city of Riyadh between February and September of 1983.

Granite Industries of Vermont Inc., a granite fabricator, polished and hand-cut a portion of granite used in building the Vietnam War Veterans Memorial in Washington, D.C. The black granite, imported from Bangalore, India, was polished and cut using a computerized system that is one of only a few of its type in the United States. The automated machinery is commonly utilized in the European granite industry.

Talc.—Output declined about 10% in 1982 compared with the 1981 level, but Vermont ranked second nationally in production among the 11 States mining talc.

Windsor Minerals Inc., the State's leading producer, streamlined operations at some of the company's five mines and two mills because of weakened demand and rising production costs. At the West Windsor mill, Windsor changed the work schedule to around-the-clock shifts 3 days per week, thus lowering electricity costs by operating during off-peak power periods. The altered work schedule also reduced the complicated and time consuming startup-shutdown procedures to once per week instead of daily.

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[1]State Liaison Officer, Bureau of Mines, Pittsburgh, Pa.
[2]State geologist, Agency of Environmental Conservation, Montpelier, Vt.

Table 7.—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	R.R. 1, Box 51 Shaftsbury, VT 05262	Pits	Bennington.
Hinesburg Sand & Gravel Co	Box 200 Hinesburg, VT 05461	do	Chittenden.
Stone:			
L. F. Carter Inc	Box 224 Pittsford, VT 05763	Quarry	Rutland.
Cooley Asphalt Paving Corp	Box 542 Barre, VT 05641	do	Washington.
OMYA Inc	Box 10 Florence, VT 05744	Quarries	Addison, Rutland, Windsor.
Pike Industries Inc	U.S. Route #3 Tilton, NH 03276	do	Addison.
Rock of Ages Corp	Box 482 Barre, VT 05641	do	Orange, Washington, Windsor.
Shelburne Limestone Corp	Bishop Rd. Shelburne, VT 05482	do	Chittenden and Franklin.
Frank W. Whitcomb Construction Corp	Box 429 Bellows Falls, VT 05101	Quarry	Chittenden.
White Pigment Corp	Proctor, VT 05765	Quarries	Addison and Rutland.
Talc:			
Eastern Magnesia Talc Co	Menlo Park, NJ 00817	Mine and mill	Lamoille.
OMYA Inc	Chester, VT 05143	do	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]

In 1982, Virginia's mineral industry produced $263.2 million worth of nonfuel mineral commodities. This was $16.1 million less than that reported in 1981, making 1982 the third consecutive year that nonfuel mineral output and value declined. The slump in the Nation's economy, apparent since the fall of 1979, was responsible for the reduced demand for Virginia's mineral products.

Despite the recession and slump in sales, the State's mineral industry continued to produce a variety of commodities. Virginia led the Nation in the output of kyanite and was one of three States reporting vermiculite production. During the year, an 8.9-pound gem topaz crystal, believed to be the largest found in North America, was discovered at a former mica mine in Powhatan County.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	502	$2,016	422	$2,237
Gem stones	NA	20	NA	20
Iron oxide pigments, crude short tons	W	W	1,269	372
Lead (recoverable content of ores, etc.) metric tons	1,607	1,294	--	--
Lime thousand short tons	804	35,984	641	29,118
Sand and gravel (construction) do	e7,109	e24,470	6,978	28,522
Stone:				
Crushed do	37,071	152,630	p35,200	p142,300
Dimension do	4	1,130	p4	p1,130
Zinc (recoverable content of ores, etc.) metric tons	9,731	9,558	--	--
Combined value of aplite, cement, gypsum, kyanite, sand and gravel (industrial), talc (soapstone), vermiculite, and value indicated by symbol W	XX	r52,178	XX	59,484
Total	XX	r279,280	XX	263,183

eEstimated. pPreliminary. 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 Virginia, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Accomack	$209	(3)	
Albemarle	W	W	Stone (crushed).
Amelia	W	$90	Clays.
Amherst	W	W	Do.
Appomattox	W	W	Do.
Augusta	W	3,167	Do.
Bath	611	W	Do.
Bedford	W	W	Do.
Bland	W	W	Do.
Botetourt	W	42,743	Cement, stone (crushed), clays.
Brunswick	W	W	Stone (crushed).
Buchanan	--	W	Do.
Buckingham	W	W	Kyanite, stone (dimension), stone (crushed).
Campbell	W	W	Stone (crushed).
Caroline	780	562	Do.
Carroll	72	312	Do.
Charles City	W	(3)	
Chesapeake (city)	571	(3)	
Chesterfield	W	W	Stone (crushed), clays.
Clarke	W	W	Stone (crushed).
Craig	W	(3)	
Culpeper	1,920	W	Stone (crushed).
Dinwiddie	W	W	Do.
Fairfax	W	W	Do.
Fauquier	W	W	Stone (crushed), stone (dimension).
Floyd	15	--	
Franklin	13	W	Stone (crushed), talc.
Frederick	W	W	Stone (crushed), lime.
Giles	W	W	Lime, stone (crushed).
Gloucester	W	(3)	
Goochland	10,427	5,490	Stone (crushed).
Grayson	W	W	Do.
Greensville	W	W	Stone (crushed), clays.
Halifax	W	W	Stone (crushed).
Hanover	W	W	Stone (crushed), aplite, stone (dimension).
Henrico	13,475	1,081	Stone (crushed).
Henry	W	W	Do.
Isle of Wight	W	(3)	
James City	W	(3)	
King and Queen	W	(3)	
King George	W	(3)	
King William	28	(3)	
Lancaster	W	(3)	
Lee	2,340	2,260	Stone (crushed).
Loudoun	15,464	11,914	Do.
Louisa	W	W	Vermiculite.
Middlesex	8	(3)	
Montgomery	W	W	Stone (crushed), stone (dimension), clays.
Nelson	W	--	
New Kent	W	(3)	
Northampton	7	(3)	
Northumberland	W	(3)	
Nottoway	W	W	Stone (crushed).
Orange	W	W	Clays.
Pittsylvania	W	W	Stone (crushed).
Prince George	W	(3)	
Prince William	W	W	Stone (crushed), clays.
Pulaski	2,075	W	Stone (crushed), iron oxide pigments (crude).
Rappahannock	W	--	
Richmond (city)	W	W	Stone (crushed), clays.
Roanoke	4,409	3,936	Do.
Rockbridge	W	W	Do.
Rockingham	W	1,690	Stone (crushed).
Russell	5,633	4,600	Do.
Scott	1,435	1,473	Do.
Shenandoah	W	W	Lime, stone (crushed).
Smyth	W	5,964	Gypsum, lime, stone (crushed), clays.
Southampton	W	(3)	
Spotsylvania	W	W	Stone (crushed).
Stafford	W	W	Do.
Surry	W	(3)	
Tazewell	W	W	Stone (crushed), clays.
Virginia Beach (city)	1,017	W	Sand and gravel (industrial).
Warren	W	W	Cement, lime, stone (crushed).
Washington	W	2,141	Stone (crushed).
Westmoreland	W	(3)	

See footnotes at end of table.

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

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Wise	$2,503	$3,035	Stone (crushed).
Wythe	15,837	W	Zinc, stone (crushed), lead, iron oxide pigments (crude).
York	W	[e]	
Undistributed[4]	226,459	164,352	
Sand and gravel (construction)	XX	[e]24,470	
Total	[5]305,306	279,280	

[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: 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), 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, Newport News (city), Norfolk (city), Norton (city), Page, Patrick, Petersburg (city), Portsmouth (city), Powhatan, Prince Edward, Radford (city), Richmond, Roanoke (city), Salem (city), South Boston (city), Staunton (city), Suffolk (city), Sussex, Waynesboro (city), Williamsburg (city), and Winchester (city).

[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 values indicated by symbol W.

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

Table 3.—Indicators of Virginia business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,601.0	2,650.0	+1.9
Unemployment	do	158.0	204.0	+29.1
Employment (nonagricultural):				
Mining[1]	do	21.7	22.8	+5.1
Manufacturing	do	414.0	397.7	-3.9
Contract construction	do	116.3	100.3	-13.8
Transportation and public utilities	do	117.6	117.2	-.3
Wholesale and retail trade	do	460.4	456.7	-.8
Finance, insurance, real estate	do	106.1	105.6	-.5
Services	do	418.3	428.0	+2.3
Government	do	506.6	501.3	-1.0
Total nonagricultural employment[1]	do	[2]2,160.8	2,129.6	-1.4
Personal income:				
Total	millions	$56,267	$60,422	+7.4
Per capita		$10,363	$11,003	+6.2
Construction activity:				
Number of private and public residential units authorized		30,494	29,711	-2.6
Value of nonresidential construction	millions	$1,032.2	$1,030.4	-.2
Value of State road contract awards	do	$198.0	$214.2	+8.2
Shipments of portland and masonry cement to and within the State	thousand short tons	1,661	1,465	-11.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$279.3	$263.2	-5.8
Value per capita, resident population		$53	$48	-9.4
Value per square mile		$6,922	$6,448	-6.8

[p]Preliminary.

[1]Includes bituminous coal, 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.

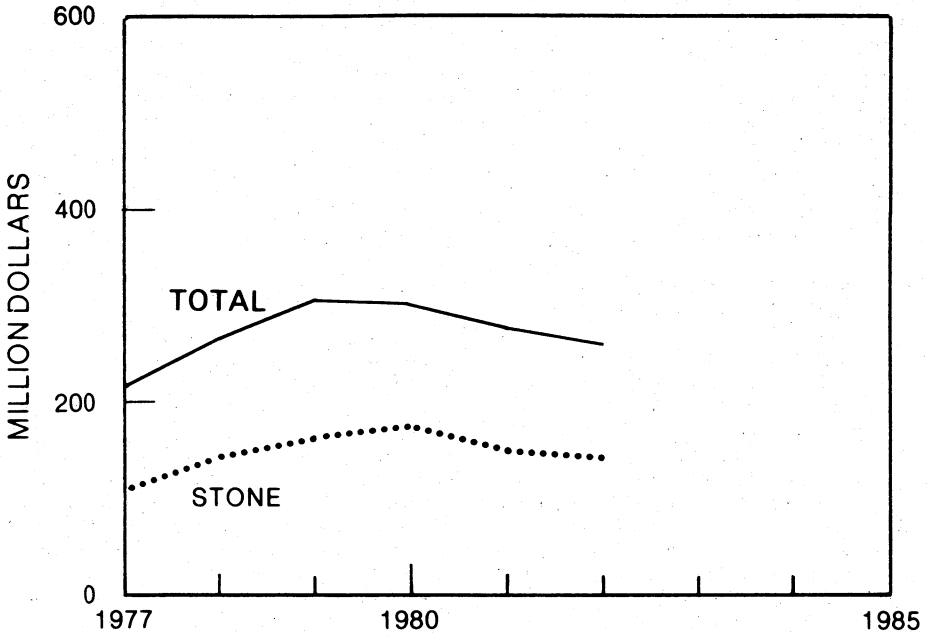

Figure 1.—Value of stone and total value of all nonfuel mineral production in Virginia.

Trends and Developments.—The development of Virginia's mineral resources has a long and varied history. Iron ore was reported in Virginia during a precolonizing expedition in 1585-86. By 1724, there were four iron furnaces in the State, and by 1750, Virginia and Maryland were exporting more than 2,500 tons of iron annually to England.[3] An estimated 26 million tons of iron ore have been mined in Virginia, and production continued until the 1930's when economics forced the last furnace to close.

Lead was mined along with zinc, in southern Virginia, from 1756 to 1981. When The New Jersey Zinc Co. closed its Austinville Mine in Wythe County in 1981, it was the oldest active mine in the Nation.

Over the centuries, the State's mineral producers have turned from metallic to nonmetallic minerals, and currently Virginia ranks high in industrial mineral output. However, in 1982, preliminary exploration activity by the uranium industry held promise that the State might again become an important producer of metallic ores.

In July, Marline Uranium Corp., a wholly owned subsidiary of Marline Oil Corp., announced the discovery of a significant concentration of uranium mineralization in Pittsylvania County in southern Virginia. A report on reserves, prepared by an independent engineering firm, estimated 30 million pounds of uranium oxide (U_3O_8) with an average grade in excess of 4 pounds per ton of ore. Additional quantities of lower grade ore were discovered in association with the main deposit, which occurs in granitic rocks of Precambrian age. At yearend, Union Carbide Corp. announced an agreement with Marline Uranium to evaluate selected Marline Uranium-leased properties. If the 18-month evaluation proves favorable, Union Carbide has the option to develop the deposit with Marline Uranium.

The production of mineral commodities used in construction—cement, clays, stone, and sand and gravel—declined for the third year as interest rates discouraged residential construction and a slump in consumer spending prevented normal commercial expansion.

Despite the recession and downturn in mineral commodity sales, interest in Virginia's mineral potential remained strong with several mineral producers planning or beginning new operations during the year.

Bennett Minerals Co., King and Queen County, began marketing an absorbent clay used as an industrial and animal waste absorbent, and Saltville Silica Inc., Smyth

County, began producing an industrial sand.

In the fall, the Augusta County Board of Zoning Appeals issued a special use permit to James River Limestone Co., Buchanan, to mine the abandoned Cold Springs kaolin mine dumps. The kaolin will be marketed for filler and extender applications. The mining operation will reclaim the area according to a State-approved plan eliminating spoil visible from Interstate 81.

The longstanding controversy between mineral extraction and residential values continued to plague Virginia's stone industry. Bull Run Stone Co., Loudoun County, and Rockydale Quarries, Roanoke County, faced strong opposition from local citizens' groups on expansion plans. Bull Run sought to expand an existing quarry, while Rockydale sought to install a new crusher.

On a more positive note, Luck Stone Corp., Richmond, was issued an air pollution permit for a quarry north of Ruckersville in Greene County. A special use permit was approved in March 1982, and access road construction was scheduled for early 1983. Quarry production will be limited to 800,000 tons of crushed granitic material per year.

Vulcan Materials Co. continued development of a quarry in Fairfax County. The company donated a nearby mined-out quarry to the county for a settling basin.

The economic doldrums affected all segments of the mineral industry—fuels as well as nonfuels. Orders for metallurgical-grade coal for steel production fell drastically, and the demand for steam coal by utilities lagged as consumers reduced usage of electrical power. By mid-fourth quarter, 29 coal companies had filed for reorganization or bankruptcy.[4] Despite the recession, coal output in 1982 was reported at 40.5 million tons valued at $1.42 billion, a slight decrease from that of 1981.

Petroleum output was 49,425 barrels valued at $1.5 million, and 6.9 billion cubic feet of natural gas was produced, valued at $24.1 million.[5] Petroleum output increased although natural gas production declined.

Exploration Activities.—Interest in base metal sulfide mineralization in Virginia's gold-pyrite belt remained high through much of the year. Exploration in the central Virginia Piedmont province continued as far southwest as Appomattox County and as far northeast as Culpeper County. In Orange County, the Walnut Creek Mining Inc. gold mining venture opened a quartz vein near Rhodesville along Walnut Run and began a commercial panning operation at Wilderness, about 10 miles to the northeast. Callahan Mining Corp. drilled several core holes below the working of the old Melville gold mine, Orange County, which was active in the 1930's.

At yearend, Chevron Resources Co. had essentially completed its exploration activity for base metal sulfides in Carroll, Floyd, and Patrick Counties in southwest Virginia. More than 40 core holes were drilled, mainly in Carroll County. Core samples reportedly were not as promising as surface sampling indicated.

Legislation and Government Programs.—The Virginia Division of Mineral Resources continued a program of basic research into the State's geology and mineral resources.

Several economic geology projects were completed and the results published. Among these were (1) Industrial Rock and Mineral Resources in Virginia; (2) 1982 Directory of Mineral Industries in Virginia; (3) A Vein-Type Uranium Environment in the Precambrian Livingston Formation; (4) Virginia Clay Material Resources; and (5) Gold Occurrences in Virginia, An Update.

A number of economic geology investigations were in progress at yearend. Among these were (1) high-silica resources of Alleghany, Botetourt, Craig, and Roanoke Counties; (2) clay material resources; (3) carbonate resources of Virginia; (4) marl resources; (5) waste material resources; (6) terrace deposits in Buckingham County, Va., mineral resource map; (7) oil and gas maps of five southwest Virginia counties; (8) mineral resources of the Charlottesville 1° by 2° sheet; (9) Herbb pegmatite; (10) alumina resources; (11) additional gold resources in Virginia; and (12) analyses of coal samples collected, 1978-80.

Several geochemical projects in progress hold potential interest to the mineral-producing community. Included are (1) base metal sulfides in Virginia; (2) tin resources of Rockingham County; and (3) gold occurrences in the Everona Limestone.

The Mining and Mineral Resources and Research Institute at the Virginia Polytechnic Institute and State University in Blacksburg, which was created under title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines. In addition, a generic mineral technology research center in mine systems design and ground control was established with the aid of a $1,086,000 Bureau grant.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Despite the nationwide recession, which slackened demand for mineral raw materials, Virginia continued as a leader in industrial mineral production in the Eastern United States. Major mineral commodities produced in Virginia in 1982 included stone, lime, sand and gravel, and clays.

Aplite.—The Feldspar Corp. produced "Virginia Aplite" at a surface mine and processing plant near Montpelier in Hanover County in eastern Virginia. "Virginia Aplite," a feldspar-like rock, was used in the manufacture of glass to improve the workability of the molten material and impart chemical stability to the finished glassware.

The ore was mined by open pit methods and trucked approximately one-fourth mile to the processing plant where it was crushed, screened, and ground. Further processing included the use of scrubbers and Humphrey spirals. The concentrate was dried in rotary kilns, and a magnetic separator removed iron minerals.

During 1982, work was completed on the installation of a wet magnetic separation system to replace the scrubber and spiral circuits. Addition of the 15-foot-diameter magnet was expected to remove iron-bearing impurities, while reducing fuel consumption approximately 50%.

A lower grade "Virginia Aplite" was mined and marketed for aggregate by two companies operating in Nelson and Amherst Counties in central Virginia.

Cement.—Virginia's three cement producers, the Riverton Corp., Lone Star Cement Inc., and Lone Star Lafarge Inc., are located in Warren and Botetourt Counties and in the City of Chesapeake, respectively. Cement production and sales declined for the third year as the recession depressed construction activity.

Riverton, in Warren County in northern Virginia, operated a grinding facility to produce masonry cement. This is one of three plants in the country producing masonry cement exclusively. Limestone was mined, crushed, calcined, hydrated, and mixed with portland cement purchased from out-of-State sources to produce cement for masonry applications. Noncement-grade limestone from an adjacent quarry was sold for aggregate.

Lone Star Cement, Botetourt County, in the western part of the State, produced both portland and masonry cement. Locally mined limestone, shale, and sand were used, as was gypsum from Nova Scotia, Canada, and iron scale purchased from Roanoke Electric Steel Co. The raw material was dry ground as feed for five coal-fired kilns used to produce clinker. The clinker was then ground into cement. Primary shipments were by rail, with approximately 75% of the sales to ready-mix cement companies.

Lone Star Lafarge, in the City of Chesapeake in southeastern Virginia, produced calcium aluminate cement. The Chesapeake facility is one of three in the United States that produces the hydraulic cement, also termed high-alumina cement or Ciment Fondu. Three basic cement types are produced at this plant—Fondu, Al_2O_3, and SECAR 71 and 80. Calcium aluminate cement sets at approximately the same rate as portland cement, but attains high strength in 24 hours. Raw material for this type of cement is primarily high-purity bauxite and limestone with low silica and magnesia content. The Chesapeake plant uses the dry grind process to produce a material for clinker manufacture. The company also imported an unspecified amount of clinker for cement production. Principal sales were for castable refractories and other high-temperature applications.

Clays.—The clay industry in Virginia is mainly concentrated in three distinct geographical areas—the southwest, the east, and the City of Richmond.

Clay producers in southwestern Virginia mined Paleozoic shales for raw material to manufacture common and face brick. Weblite Corp., Botetourt County, mined shale from the Rome Formation to produce a lightweight aggregate. Tazewell Clay Products Co., Tazewell, mined a local shale to extrude clay dummies (stemming material) used by the coal industry as a tamping medium in blastholes.

Producers in eastern Virginia mined a variety of material including phyllite, schist, saprolite, and clay to produce primarily common and face brick. Bennett Minerals Co. completed its first year of production in the Walkerton area of King and Queen County. The $2 million plant processes a montmorillonite clay into absorbents, primarily for the pet litter market. The location of the operation provided ready access to markets throughout the Eastern and Northeastern United States.

Redford Brick Co. in the City of Richmond extracted Pleistocene clay and sapro-

lite from Precambrian rock for brick manufacture.

Table 4.—Virginia: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1978	1,043	3,266
1979	1,059	3,512
1980	762	3,172
1981	502	2,016
1982	422	2,237

Gem Stones.—In September 1982, an 8.9-pound topaz crystal, believed to be the largest discovered in North America, was found on the dump of the Herbb No. 2 mica mine in Powhatan County approximately 24 miles west of Richmond. The deposit, briefly worked in 1944, has a maximum thickness of 40 feet and is 240 feet long. Quartz, beryl, topaz, cleavelandite albite, tantalite-columbite, muscovite, spessartite garnet, plagioclase feldspar weathered to kaolin, amazonite, perthite, and biotite have been reported from the pegmatite. During the 1944 mining, a broken beryl crystal about 5 feet long and 27 inches thick was discovered. The mine is owned by the Powhatan Land Co.

Gypsum.—United States Gypsum Co. operated a wallboard plant in the southwestern part of the State and at Norfolk. In southwestern Virginia, the company operated the Locust Cove Mine in Smyth County and a wallboard plant at Plasterco in adjacent Washington County. The mine is a slope-entry, multilevel operation. Gypsum, occurring as isolated bodies in the Maccrady Shale, was mined by modified underhand stoping methods, crushed underground, and conveyed by belt to the surface, and trucked to the plant. During the year, drilling of several deep holes in the vicinity of the mine was completed to better define the geology and ore reserves. Despite the recession, wallboard demand was strong.

At the Norfolk operation, gypsum obtained from company mines in Nova Scotia was ground and calcined to produce wallboard and other gypsum-based products. Occasional anhydrite shipments were received from the Nova Scotia operations for sale to eastern cement companies.

Kyanite.—Virginia was the leading State in the Nation in the production of kyanite, an aluminum silicate widely used in refractories and ceramics. Kyanite Mining Corp., Buckingham County, was the only Virginia producer and the largest in the United States.

Kyanite Mining operates two surface mines and processing facilities at Willis Mountain and East Ridge in central Virginia. At both locations, kyanite-bearing rock is exposed and stripping is unnecessary. After mining, ore was trucked to the preparation plant where it was crushed, ground, screened, classified, and washed. Flotation was used to remove pyrite and silica. Flotation concentrate was discharged to a fluid bed dryer where remaining iron is magnetized and removed by magnetic separation. The process yields a 35-mesh product, which was packaged or reground into 48-, 100-, 200-, and 325-mesh products. Raw kyanite was also processed into mullite.

Approximately 35% of the production was shipped to overseas customers through the Port of Hampton Roads. Most kyanite for the domestic market was trucked 7 miles to Dillwyn for shipments on the Chesapeake and Ohio or Norfolk and Western Railroads. A portion was trucked to market by common carrier and company-owned trucks. Company officials have reported output at approximately 90,000 tons per year.[6]

Lime.—The State's lime industry consists of seven companies and is located in the northern and southwestern parts of Virginia. Principal sales were to the paper, basic oxygen furnace steel, and water treatment industries. Lime sales as a slag control agent to the steel industry were down owing to the depressed demand for domestic steel. Three companies operated surface mines in Frederick and Shenandoah Counties in northern Virginia producing lime from the New Market Limestone. The Riverton Corp. operated several mines and plants in Warren County.

In southwestern Virginia, two companies operated underground room-and-pillar mines and lime manufacturing facilities in Giles County on the West Virginia border. A third company operated a surface mine and lime plant near Saltville in Smyth County; the company terminated operations in midyear. Production was from high-calcium, Ordovician age limestones.

Chesapeake Corp. of Virginia contracted with Allis-Chalmers Corp. to construct a 10-1/2-foot-diameter, 265-foot-long rotary kiln, tube coolers, and ancillary equipment at Chesapeake's pulp mill at West Point. The $1 million project for the recovery and regeneration of quicklime will provide for the recycling of 180 tons of lime per day.

Table 5.—Virginia: Lime sold or used by producers, by use

Use	1981		1982	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Paper and pulp	211,203	$9,883	170,095	$7,581
Steel, basic oxygen furnace	228,194	10,191	161,476	7,036
Water purification	85,598	3,985	98,842	4,629
Acid water neutralization	66,064	2,887	50,539	2,215
Steel, electric	51,261	2,449	40,116	1,825
Mason's lime	31,941	955	34,827	1,778
Sewage treatment	32,899	1,530	29,060	1,502
Metallurgical, other	9,844	442	7,332	324
Agriculture	9,678	256	5,695	240
Other[1]	77,284	3,406	43,468	1,990
Total	803,966	35,984	641,450	[2]29,118

[1]Includes calcium carbide (1981), chrome, fertilizer, animal and human food, glass, open-hearth steel, other chemical and industrial uses, other construction uses (1981), road stabilization, soil stabilization, sugar refining, and tanning.
[2]Data do not add to total shown because of independent rounding.

Mica.—Crude mica, purchased from Brazil and India, was processed at Newport News on the Atlantic coast. Asheville Mica Co. and an affiliate, Mica Co. of Canada Inc., used muscovite block and film to manufacture a variety of products used by the electrical industry.

Perlite (Expanded).—Manville Building Materials Corp., Shenandoah County in northern Virginia, processed perlite, a volcanic rock that expands to approximately 20 times its original volume when heated. The perlite was mined in Grants, N. Mex., and shipped to the Manville plant in Woodstock by rail. After expanding, the material was used in the manufacture of roof insulation board.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Producers of construction sand and gravel continued to feel the effects of the recession, which reduced new construction. Producers in Virginia reported that demand and output fell 131,000 tons below the 1981 level.

The U.S. Bureau of Mines received production-value reports from 45 companies mining 58 deposits in 34 counties-cities. The 10 top-producing counties-cities accounted for approximately 6.2 million tons or 88% of the total construction sand and gravel produced. This production was localized in three areas in the eastern part of Virginia.

The leading area, in terms of output and value, was the four contiguous counties of Charles City, Chesterfield, Henrico, and Prince George in the southeastern part of the State. This four-county area accounted for 54% of the tonnage reported. The contiguous counties of Caroline, King George, Spotsylvania, and Stafford in northeastern Virginia comprised the second largest producing area, and the Cities of Chesapeake and Virginia Beach on the Atlantic coast comprised the third largest area of production.

Industrial.—At yearend, three companies produced industrial sand for glass, casting, traction, and insulation applications. Unimin Corp. produced sand for glass manufacture at a mine and flotation plant near Gore in Frederick County; J. C. Jones Sand Co. Inc. produced an industrial-grade sand for casting applications and as a traction medium at Virginia Beach; and Saltville Silica, a new operation in Smyth County, produced sand for glass manufacture in Tennessee.

Table 6.—Virginia: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,114	$13,622	$4.37
Plaster and gunite sands	W	W	3.45
Concrete products	1,351	7,270	5.38
Asphaltic concrete	410	1,279	3.12
Road base and coverings	724	3,088	4.26
Fill	1,030	1,979	1.92
Snow and ice control	W	W	2.51
Other	350	1,285	3.68
Total[1] or average	6,978	28,522	4.09

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Data may not add to totals shown because of independent rounding.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	2,829	$11,313	$4.00
Gravel	NA	NA	NA	3,509	16,283	4.64
Sand and gravel (unprocessed)	NA	NA	NA	639	926	1.45
Total or average	e7,109	e$24,470	e$3.45	[1]6,978	28,522	4.09
Industrial sand	W	W	7.50	W	W	11.74
Grand total or average	W	W	e3.46	W	W	W

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

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

Sales of crushed stone in 1982 were described as slow by the Virginia Aggregate Association. Aggregate sales during the first 6 months of 1982 were off as much as 40% from those of 1981. Some operations remained marginally profitable by reducing their work forces; however, the decrease in sales restricted the companies' borrowing ability, and they were unable to replace equipment and facilities as needed. In December, some operations noted an increase in sales as $30 million in new highway construction increased stone demand in some areas of the State.

During the year, Bull Run Stone Co., Loudoun County, and Rockydale Quarries, Roanoke County, faced strong opposition from local citizens' groups on expansion plans. Both companies sought to upgrade or expand existing operations.

In other developments, Vulcan Materials Co. continued work on a new quarry in Fairfax County. A nearby, mined-out quarry owned by Vulcan will be used by the County Water Authority as a billion-gallon settling basin, saving taxpayers the expense of constructing a new basin. The new quarry has created 70 jobs and an annual payroll in excess of $1.5 million.

Sulfur (Recovered).—Amoco Oil Co., in York County, recovered elemental sulfur from hydrogen sulfide by the Claus process during crude oil refining. Hydrogen sulfide gas was burned, producing sulfur dioxide, which reacted with additional amounts of hydrogen sulfide yielding elemental sulfur in liquid form.

Talc.—Blue Ridge Talc Co. Inc. is the only talc producer in Virginia. The material, a talc, chlorite, dolomite schist, was ground at a company plant on the border between Franklin and Henry Counties and sold to foundries primarily as a releasing agent for metal molds. The economic conditions prev-

alent throughout 1982 depressed the steel and foundry industries, and talc sales fell drastically.

Vermiculite.—Virginia, South Carolina, and Montana were the three States with vermiculite production in 1982. Virginia Vermiculite Ltd. operated a surface mine and processing facility near Boswells Tavern, in Louisa County northwest of Richmond. A combination front-end/backhoe loader was used to mine the ore, which was trucked to the nearby mill for processing. Processing steps included screening, washing, and grinding. Riffle tables and flotation cells were used to separate unwanted material and concentrate the vermiculite. The concentrate was dewatered and dried in a rotary kiln. All vermiculite was sold unexfoliated; principal sales were to a fertilizer manufacturer in Ohio and for use in oil well drilling mud in Arizona and Texas. Other sales were to eastern greenhouses with exfoliation furnaces. Despite the recession, demand for the crude vermiculite remained strong.

METALS

The recession affected all segments of Virginia's mineral industry, including metals, and sales of most metal commodities were down from those reported in 1981. The State's two steel producers reported a slump in sales, and the single ferroalloy producer ceased production and shipped from stockpile for much of the year. Sales of out-of-State magnetite, used principally in coal cleaning, declined as coal demand slumped. Output of lead produced from scrap was also off as the effects of the recession and a mild winter resulted in fewer sales of replacement automobile batteries.

Ferrovanadium.—The Chemstone Corp., a subsidiary of Engelhard Corp., produced ferrovanadium at Strasburg, Shenandoah County, in northwestern Virginia. The company used an aluminothermic reduction process to produce 55% and 80% ferrovanadium product. The primary raw material, vanadium pentoxide, was obtained from three Western States.

Production was temporarily halted in June because of slackened sales to the depressed steel industry. Shipments during the remainder of the year were from stockpile.

Gold.—Walnut Creek Mining Inc. began development work on an auriferous quartz vein in Orange County near Rhodesville. The company also operated a commercial gold panning operation west of Fredericksburg in the vicinity of Wilderness.

During 1982, Callahan Mining Corp. drilled seven exploratory holes for gold, near Wilderness in Orange County.

Iron Oxide Pigments.—Two companies processed crude iron oxide pigments during 1982. Hoover Color Corp. mined crude pigment material for the production of ocher, umber, and sienna pigments. The company also purchased a significant tonnage of pigment materials from foreign sources. Blue Ridge Talc Co. calcined and bagged iron ore shipped from Michigan for use as a paint coloring agent.

Lead.—The Hymann Viener & Sons Co. operated the State's only secondary lead smelter in Richmond. The smelter, which has an annual capacity of 25,000 metric tons, is equipped with blast and reverberatory furnaces and five smelting kettles.

Virginia's only lead-zinc producing mine, The New Jersey Zinc Co. operation at Austinville, closed in 1981. The mine, first worked in the mid-1700's, was allowed to flood. The company was attempting to sell the processing equipment.

Lithium.—Lithium hydroxide, used in the manufacture of multipurpose, lithium-based grease, was produced by Foote Mineral Co. at Sunbright in southwestern Virginia. Lithium carbonate, the raw material for lithium hydroxide manufacture, was obtained from the company's mining and processing complex at Kings Mountain, N.C.

Magnetite.—Reiss Viking Corp., Tazewell County, shipped magnetite from New York for processing into a coal preparation medium marketed primarily in eastern coalfields. Byproduct magnetite recovered during kyanite processing by Kyanite Mining Corp. was sold to Lone Star Cement Inc., Botetourt County, for use in the cement manufacturing process.

Manganese.—Manganese ore, imported from Gabon, was ground at a Union Carbide Corp. plant at Newport News. The ground ore was shipped to other company facilities for the manufacture of batteries.

Steel.—Two companies, Roanoke Electric Steel Co., Roanoke, and Intercoastal Steel Corp., Chesapeake, comprise Virginia's steel industry. Both companies operated electric furnaces using scrap for feed. Intercoastal operated two furnaces, while Roanoke Electric operated four intermittently during the year. Roanoke Electric completed installation of its fourth furnace. The unit, 18 feet in diameter, was shut down because of the slump in steel sales.

[1]State Liaison Officer, Bureau of Mines, Tuscaloosa, Ala.
[2]Head geologist, Economic Geology Section, Virginia Division of Mineral Resources.
[3]St. Clair, H. W. Mineral Industry in Early America. Bureau of Mines, 1977, 62 pp.
[4]The Washington Post. Nov. 29, 1982.
[5]Sweet, P. Virginia's Mineral Industry. Va. Miner., v. 29, August 1983.
[6]Dixon, G. B., Jr. Kyanite Mining in Virginia. Va. Miner., v. 26, No. 1, February 1980.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Aplite (crude):			
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.
Ferroalloys:			
Chemstone Corp.[3]	Box 189 Strasburg, VA 22657	Plant	Shenandoah.
Gypsum:			
United States Gypsum Co	Box 4686 Norfolk, VA 23523	do	Norfolk (city).
Do	Route 1 Saltville, VA 24370	Mine and plant	Washington.
Iron oxide pigments (crude):			
Hoover Color Corp	Box 218 Hiwassee, VA 24347	do	Pulaski.
Kyanite:			
Kyanite Mining Corp	Dillwyn, VA 23936	do	Buckingham and Prince Edward.
Lime:			
Chemstone Corp.[4]	Box 71 Strasburg, VA 22657	Plant	Shenandoah.
National Gypsum Co	Star Route 635 Ripplemead, VA 24150	do	Giles.
Virginia Lime Co	Star Route 635 Ripplemead, VA 24150	do	Do.
Perlite (expanded):			
Manville Building Materials Corp	Box 442 Woodstock, VA 22644	do	Shenandoah.
Sand and gravel:			
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.[5]	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 lime.
[4]Also ferroalloys.
[5]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 $172 million in 1982, a decline of 17% from that of 1981. Nonmetals—barite, cement, clays, diatomite, gem stones, gypsum, lime, olivine, peat, sand and gravel, stone, and talc—accounted for 96% of the total output value. Metals—copper, gold, lead, and silver—accounted for the remainder.

During the past 3 years, the number of major U.S. mining and exploration companies working in Washington declined in favor of individual prospectors, small local companies, and Canadian firms. During the year, there were 78 companies reported as actively mining and exploring in the State. Exploration and development for precious metals predominated during the year, primarily owing to depressed prices for the other metallic commodities.

Washington was the leading producing State for primary aluminum, with an estimated 27% of the Nation's production. A depressed market and high energy costs caused a number of potlines to be closed. The seven reduction plants operated at about 70% of capacity at yearend.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	15	$1,284	W	W
Portland	do	1,560	100,845	1,154	$75,988
Clays	do	[2]263	[2]1,524	251	1,829
Gem stones		NA	200	NA	200
Sand and gravel:					
Construction	thousand short tons	e16,870	e42,130	15,190	40,295
Industrial	do	304	3,358	242	2,809
Silver	thousand troy ounces	67	709	W	W
Stone:					
Crushed	thousand short tons	9,516	25,619	p8,600	p23,800
Dimension	do	15	2,378	p14	p2,375
Talc	do	--	--	8	20
Combined value of barite (1982), clays (fire clay 1981), copper, diatomite, gold, gypsum, lead (1982), lime, olivine, peat, tungsten ore and concentrate (1981), and values indicated by symbol W		XX	30,461	XX	24,712
Total		XX	r208,508	XX	172,028

eEstimated. pPreliminary. 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 Washington, by county[1]

(Thousands)

County	1980	1981[2]	Minerals produced in 1981 in order of value
Adams	W	$74	Stone (crushed).
Asotin	$267	(3)	
Benton	W	W	Stone (crushed).
Chelan	W	W	Sand and gravel (industrial).
Clallam	W	W	Clays, stone (crushed).
Clark	2,382	753	Stone (crushed).
Columbia	193	--	
Cowlitz	W	500	Do.
Douglas	W	(3)	
Ferry	W	W	Gold, silver.
Franklin	177	W	Stone (crushed).
Grant	W	W	Diatomite.
Grays Harbor	1,872	952	Stone (crushed).
Island	166	36	Do.
Jefferson	W	W	Do.
King	W	W	Cement, stone (crushed), clays, peat, gold, silver.
Kitsap	W	1,035	Stone (crushed).
Kittitas	W	W	Stone (crushed), clays.
Klickitat	W	303	Stone (crushed).
Lewis	W	30	Do.
Lincoln	W	1,231	Do.
Mason	W	W	Do.
Okanogan	W	W	Stone (crushed), peat, gypsum.
Pacific	637	795	Stone (crushed).
Pend Oreille	W	W	Cement, stone (crushed).
Pierce	17,540	W	Lime, stone (dimension), stone (crushed), clays.
San Juan	1,615	(3)	
Skagit	W	W	Olivine, stone (crushed), stone (dimension).
Skamania	368	W	Stone (crushed), gold, silver, copper.
Snohomish	W	W	Stone (crushed), stone (dimension).
Spokane	W	W	Stone (crushed), clays.
Stevens	W	11,492	Lime, sand and gravel (industrial), stone (crushed), clays, tungsten.
Thurston	W	271	Stone (crushed).
Wahkiakum	25	85	Do.
Walla Walla	W	131	Do.
Whatcom	W	W	Cement, stone (crushed), stone (dimension).
Whitman	970	434	Stone (crushed).
Yakima	W	W	Stone (crushed), stone (dimension).
Undistributed[4]	181,144	148,263	
Sand and gravel (construction)	XX	e42,130	
Total[5]	207,362	208,508	

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

[1]Garfield County is not listed because no nonfuel mineral production was reported.

[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 some gem stones, sand and gravel, stone that cannot be assigned to specific counties, and values indicated by symbol W.

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

Trends and Developments.—AMAX Inc. abandoned plans for its Mount Tolman molybdenum mine, citing prolonged soft market conditions. Heavy equipment was disassembled and removed, and layoffs and transfer of key personnel were effected. This action led the Colville Indian Confederated Tribes to seek a new partner to develop the copper-molybdenum deposit near Keller. A Colville Tribal spokesman reported that the environmental statement for the project was completed, the drilling was finished, and mining was ready to commence.

International Titanium Inc., after 1 year of construction on a plant at Moses Lake, started production of titanium sponge in April.

Union Carbide Corp. announced plans to construct what may be the world's largest polycrystalline silicon plant at Moses Lake. The plant was scheduled to be operational in 1984.

U.S. Borax and Chemical Corp. submitted a proposal to the Grays Harbor Port Authority at Hoquiam for an option to purchase a 45-acre site in Grays Harbor County and construct a roasting and leaching plant

to process molybdenum concentrate from the Quartz Hill Mine in Alaska.

ASARCO Incorporated's Tacoma copper smelter operated under a variance that required the company to analyze various smelter technologies that might be used to achieve a 90% capture standard. The company was required to install hoods to reduce fugitive emissions of SO_2 and arsenic. The Tacoma smelter is the only arsenic producer in the Nation.

Legislation and Government Programs.—The Mining and Mineral Resources and Research Institute at the University of Washington in Seattle, created under title III of Public Law 95-87, received $150,000 for operations and research efforts from the U.S. Bureau of Mines.

U.S. Bureau of Land Management receipts obtained and distributed to the State through the Mineral Leasing Act were $583,000 in 1982.

The U.S. Bureau of Mines had several projects in progress in Washington: cooperative programs with the U.S. Bureau of Indian Affairs, RARE II further planning areas, wilderness area studies, reclamation research, and mineral deposit evaluations for minerals availability.

Activities of the State Division of Geology and Earth Resources consisted of geologic mapping, and geologic hazard and energy investigations. An important responsibility of the division is the regulation of surface mines. Strategic mineral investigations continued in northeastern Washington, with particular emphasis on tin, tungsten, and molybdenum.

Table 3.—Indicators of Washington business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,990.0	2,012.0	+1.1
Unemployment	do	189.0	244.0	+29.1
Employment (nonagricultural):				
Mining[1]	do	3.1	3.1	--
Manufacturing	do	303.3	289.9	-4.4
Contract construction	do	90.3	75.6	-16.3
Transportation and public utilities	do	90.2	89.5	-.8
Wholesale and retail trade	do	388.2	384.1	-1.1
Finance, insurance, real estate	do	92.3	90.8	-1.6
Services	do	318.3	316.9	-.4
Government	do	326.4	319.2	-2.2
Total nonagricultural employment[1 2]	do	1,612.0	1,569.0	-2.7
Personal income:				
Total	millions	$47,546	$49,390	+3.9
Per capita		$11,274	$11,635	+3.2
Construction activity:				
Number of private and public residential units authorized		24,558	17,285	-29.6
Value of nonresidential construction	millions	$850.0	$995.6	+17.1
Value of State road contract awards	do	$186.0	$275.0	+47.8
Shipments of portland and masonry cement to and within the State	thousand short tons	1,300	1,022	-21.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$208.5	$172.0	-17.5
Value per capita, resident population		$51	$41	-19.6
Value per square mile		$3,116	$2,523	-19.0

[p]Preliminary.
[1]Includes bituminous coal 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.

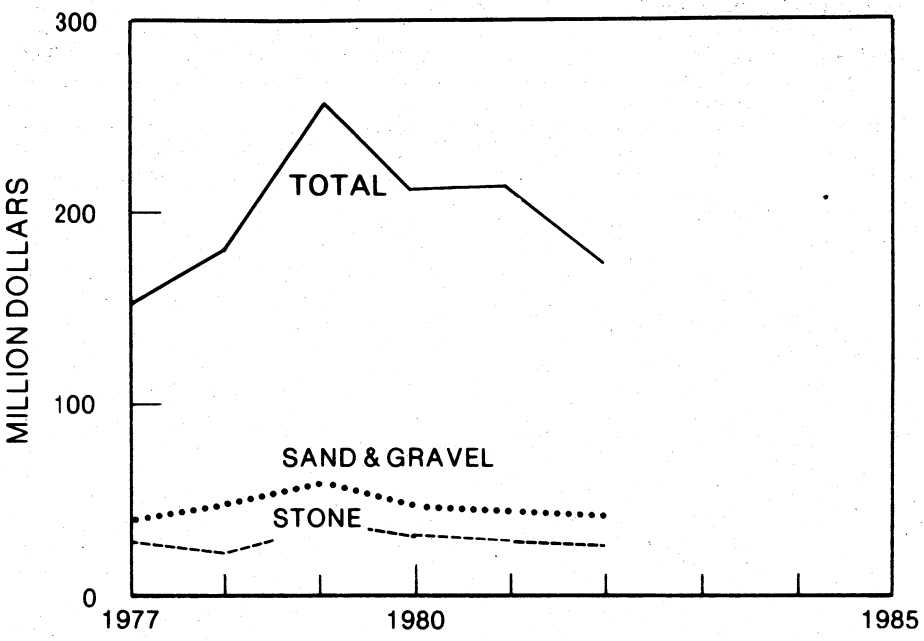

Figure 1.—Value of sand and gravel and stone, and total value of nonfuel mineral production in Washington.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetallic minerals accounted for 96% of the total nonfuel value reported in 1982. Cement led in production value of all nonmetallic commodities produced in the State. Other commodities produced in significant quantity were stone, sand and gravel, diatomite, and lime.

Barite.—Interest was expressed by several companies in the barite deposits in Stevens County, northwestern Washington. A small amount of production was reported from the Chopot Mine. The major interest was the C-E Minerals plant near Northport. C-E Minerals, a wholly owned subsidiary of Combustion Engineering Inc., purchased a mill at nearby Leadpoint to process the barite from the Flagstaff Mountain Mine. Upon depletion of that deposit, the company plans mining at Bruce Creek. No production was reported by C-E Minerals in 1982. Two other projects were under development during the year by Tri-H Mining Co. and Mil-Chem Inc.

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 pentachlorophenol. In addition, Reichhold also produced a variety of organic compounds.

Cement.—Portland cement was produced by four companies: Columbia Cement Corp. and Ashland Technology Co., Bellingham; Ideal Basic Industries Inc., Seattle; Lehigh Portland Cement Co., Metaline Falls; and Lone Star Industries Inc., Seattle. Columbia Cement, Lehigh, and Lone Star also produced masonry cement. Portland cement was used by ready-mix concrete dealers (77%), concrete product manufacturers (11%), building materials dealers (3%), and others, including highway contractors and government agencies (9%). All four plants used coal and electricity for fuel and energy. In addition, three plants also consumed natural gas. In the manufacture of cement, raw materials used were limestone, clay, sand, quartz, iron ore, fly ash, slag, and gypsum. Approximately 96% of the shipments of portland cement was by truck.

Clays.—Production of clays decreased 5%

in quantity but increased 20% in value over that of 1981. Clay was produced in five counties, although most was produced in Clallam and King Counties. Fire clay was produced in King and Stevens Counties.

Diatomite.—Washington was one of four States that produced diatomite in 1982. Inorganic Specialties, a division of Witco Chemical Corp., was the only reported producer from a surface mine near George, in Grant County. The product was processed at the company's plant near Quincy, which has been in operation since 1977. All the diatomite produced was used as a filtration medium and in fillers.

Feldspar.—Feldslite Corp. of America continued exploration and development drilling in Chelan County on the Wenatchee Ridge feldspar deposit. The company's 52 claims cover an occurrence of albite feldspar, which has been under investigation since 1962. There was no production of feldspar reported in 1982.

Gypsum.—Agro Minerals Inc. continued mining at the Poison Lake Mine in Okanogan County. Calcined gypsum was produced in Seattle by Norwest Gypsum Inc., and in Tacoma by Domtar Gypsum America Inc.

Lime.—Tacoma Lime, a division of Continental Lime Inc., in Tacoma, Pierce County, and Northwest Alloys Inc., near Addy, Stevens County, produced lime in 1982. Production quantity and value were down from those of 1981.

Olivine.—A small amount of olivine was mined and processed in Skagit County. Both quantity and value were down from those of 1981.

Peat.—Two companies produced peat during 1982. Maple Valley Humus produced in King County and Bonaparte Peat in Okanogan County.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel production was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Sand and gravel production for construction use has been on a decline since 1979, both in quantity and value. Thirty out of thirty-nine counties showed production, with King and Pierce accounting for 50% of the total production value. Major uses were for concrete aggregate (31%), road base and coverings (24%), fill (23%), asphaltic concrete aggregate (13%), and other (9%). Approximately 72% of the construction sand and gravel was transported by truck.

Industrial.—Industrial sand and gravel was produced only in Chelan and Stevens County.

Table 4.—Washington: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,736	$12,408	$2.62
Plaster and gunite sands	153	302	1.97
Concrete products	618	1,979	3.20
Asphaltic concrete	1,931	5,530	2.86
Road base and coverings[1]	3,706	10,184	2.75
Fill	3,447	8,138	2.36
Snow and ice control	164	429	2.61
Railroad ballast	86	349	4.04
Other	348	976	2.80
Total or average	[2]15,190	40,295	2.65

[1]Includes road and other stabilization (cement and lime).
[2]Data do not add to total shown because of independent rounding.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	3,347	$9,437	$2.82
Gravel	NA	NA	NA	8,543	24,331	2.85
Sand and gravel (unprocessed)	NA	NA	NA	3,301	6,527	1.98
Total or average	e16,870	e$42,130	e$2.50	[1]15,190	40,295	2.65
Industrial sand and gravel	304	3,358	11.05	242	2,809	11.61
Grand total or average	e17,174	e45,488	e2.65	15,432	43,104	2.79

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

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised the following year.

The construction industry continued in a recession. Stone production was down an estimated 10% in quantity and 7% in value from those of 1981.

Sulfur (Recovered).—Four companies recovered sulfur, sulfur dioxide (SO_2), or hydrogen sulfide (H_2S) in 1982. Atlantic Richfield Co. and Mobil Oil Corp. produced sulfur in Whatcom County. Shell Oil Co. produced hydrogen sulfide in Skagit County, and Asarco produced liquid SO_2 in Pierce County.

Talc.—Cascade Talc Inc. produced a small quantity of talc from the Cascade talc pit in Skagit County. Most of the talc sold was used in insecticides.

METALS

Metallic mineral exploration and development in 1982 was concentrated in the northeastern part of the State, in Ferry, Stevens, Okanogan, and Pend Oreille Counties, as well as along the Cascade Range in Pierce, King, Chelan, Whatcom, Clark, Skamania, and Yakima Counties. Exploration and development for precious metals predominated.

Aluminum.—Washington ranked first in the Nation in quantity and value of primary aluminum produced in 1982, with nearly 1 million tons valued at $1.5 billion. The seven reduction plants accounted for an estimated 27% of all aluminum production in the United States. With the closure of some potlines during the year for the reasons indicated below, production was 20% less than in 1981. The feed for the Washington reduction plants was imported, primarily from Australia.

At yearend, the reduction plants were operating at a rate of 920,000 tons per year, or about 70% of capacity. The cutbacks started in 1981 and continued through 1982 owing to a weak aluminum market and increased power rates set by Bonneville Power Administration (BPA). In August, BPA announced that the electric power rate for direct service industries would increase from 17.3 to 25.9 mils per kilowatt-hour effective October 1. The rate was later adjusted to 24.5 mils per kilowatt-hour. BPA's power rates have increased sevenfold since 1979. The rapid increase in energy costs has also caused Kaiser Aluminum & Chemical Corp. to put its proposed $600 million plant modernization programs at Mead and Tacoma on hold.

The following were the capacities and yearend operating rates of the Washington plants, in short tons:

	Rated capacity	Operating rate
Aluminum Co. of America:		
Vancouver	121,000	49,000
Wenatchee	220,000	137,400
Intalco Aluminum Corp.:		
Ferndale	280,000	280,000
Kaiser Aluminum & Chemical Corp.:		
Mead	220,000	55,000
Tacoma	80,000	80,000
Martin Marietta Aluminum Inc.:		
Goldendale	185,000	177,600
Reynolds Metals Co.:		
Longview	210,000	141,000

Table 6.—Washington: Primary aluminum plant production data

Year	Quantity[e] (thousand short tons)	Percent of national total[e]	Value[e] (thousands)
1978	1,208	25	$1,301,367
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

[e]Estimated.

Gold.—Gold was recovered from four mines in Ferry, King, and Okanogan Counties. Most of the production came from Hecla Mining Co.'s Knob Hill Mine in Ferry County, at Republic. According to the company's annual report, ore production was 57,000 tons in 1982, compared with 56,000 tons in 1981. The Knob Hill Mine has been a consistent producer of gold-silver ore and has been in almost continuous operation since the early 1900's. During 1982, an underground program of exploration was started to develop the potential of the surrounding properties owned by Hecla. Preliminary results were encouraging, and efforts will continue in an attempt to prolong the life of the Republic unit. At one of the properties, ore-grade mineralization was discovered in several drill holes.

The Lovitt gold mine in the Wenatchee area was the forefront of gold development in the State. In a joint venture, Asamera Inc. of Calgary, Alberta, Canada, and Breakwater Resources Ltd. of Vancouver, British Columbia, Canada, discovered additional reserves. Reportedly, the deposit contains 5 million tons grading 0.25 ounce of gold per ton. The two companies announced plans to construct a 1,000- to 2,000-ton-per-day mill.

Exploration for gold and silver was at a high level. Of the 55 active exploration companies, 50 reported they were exploring for gold and silver. The counties receiving the most attention were Chelan, Ferry, Okanogan, Pend Oreille, and Stevens.

Magnesium.—The Aluminum Co. of America (Alcoa) Northwest Alloys plant at Addy continued to produce primary magnesium metal, but on November 1, two furnaces were shut down. The closure reduced the operating rate to 67% of annual capacity, which is 25,000 short tons of magnesium per year. High power rates and low demand were the major factors cited for closure.

Silicon.—Union Carbide completed construction of a polycrystalline silicon pilot plant at Washougal and began expansion of the crystals plant to accommodate transfer of research and development and manufacturing operations from San Diego. The company also started construction in July, at Moses Lake, of what will likely be the world's largest polycrystalline silicon plant. The plant was scheduled to be operational by June 1984.

Hanna Mining Co. closed down its Rock Island silicon and ferrosilicon smelter October 1 for an indefinite period. The plant had operated at reduced levels since July 15, when one of its three furnaces was shut down. In 1981, the firm produced 20,000 tons of silicon products.

On November 28, Alcoa's Northwest Alloys halted its ferrosilicon production at Addy for an indefinite period.

Silver.—Silver was recovered from four mines in Ferry, King, Okanogan and Stevens Counties. Hecla was the major producer at the Knob Hill Mine near Republic. Production of silver in the State was more than that of 1981, but value was less.

Madre Mining Ltd. of Sacramento, Calif., and Calgary, Alberta, Canada, made its first shipment of silver concentrate from the Deer Trail Mine in March 1982. The mine is approximately 75 miles northwest of Spokane, in Stevens County. All 1982 shipments originated from the processing of stockpiled ore from the old mine dumps. While processing of the ore continued, the company was engaged in underground development in three locations and announced exposure of an ore shoot that contained a weighted average of 43.6 ounces of silver per ton of ore. Four ore shoots have been encountered and were identified by previous owners. Madre acquired the property in early 1981.

Two other known silver producers in the State were CSS Management Corp. and Cleopatra Mining Co. at the Apex-Damon Mine in King County and Silver Bluff Syndicate at the Silver Bluff Mine in Okanogan County. No production data has been reported.

Titanium.—International Titanium started producing titanium sponge in April at its new plant at Moses Lake. The plant was constructed in 1 year and has the capacity to produce 5 million pounds of titanium sponge per year. Operation was suspended on July 3 to repair leaks of titanium tetrachloride that caused some local concern. Production was resumed after 1 month, following a State Clean Air Board ruling that the company had complied with mandated corrective measures.

Tungsten.—There was no reported production of tungsten in Washington during the year. Early in the year, the U.S. Geological Survey announced discovery of molybdenum and tungsten ores in the Colville

National Forest. The mineralization appeared to be associated with muscovite-biotite granodiorite of Cretaceous Age.

[1]State Liaison Officer, Bureau of Mines, Spokane, Wash.
[2]Geologist and field office supervisor, Washington Division of Geology and Earth Resources, Spokane, Wash.

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 98400	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. and Ashland Technology Co.	Box 37 Marietta Rd. Bellingham, WA 98225	do	Whatcom.
Ideal Basic Industries Inc.[1]	Box 8789 Denver, CO 80201	do	King.
Lehigh Portland Cement Co	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.	Box 120 Renton, WA 98057	do	King, Spokane, Stevens.
Diatomite:			
Inorganic Specialties, a division of Witco Chemical Corp.	277 Park Ave. New York, NY 10017	Mine and plant	Grant.
Gold:			
Hecla Mining Co.[2]	Box 1010 Wallace, ID 83873	Mine and mill	Ferry.
Lime:			
Tacoma Lime, a division of Continental Lime Inc.	1220 Alexander Tacoma, WA 98421	Plant and mine	Pierce.
Northwest Alloys Inc.[3 4]	Box 138A, RRT 1 Addy, WA 99101	do	Stevens.
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:			
Associated Sand & Gravel Co. Inc	Box 2037 Everett, WA 98201	Pits	Skagit and Snohomish.
Cadman Gravel Co	Box 538 Redmond, WA 98052	Pit	King.
Central Pre-Mix Concrete	5111 East Broadway Spokane, WA 99206	Pits	Various.
Friday Harbor Sand & Gravel Co	Box 1203 Bellingham, WA 98225	Pit	San Juan.
Glacier Sand & Gravel Co	5975 East Marginal Way Seattle, WA 98134	Pit	Pierce.
Lone Star Industries Inc	Box 1020 Steilacoom, WA 98388	Pit	Do.
Miles Sand & Gravel Co	Box 236 Auburn, WA 98002	Pit	King and Kitsap.
Reid Sand & Gravel Inc	Box 922 Bellevue, WA 98004	Pit	King.
Stone (1981):			
De Atley Corp	Box 648 Lewiston, ID 83501	Quarry and plant	Yakima.
Industrial Rock Products Inc	3707 California Bank Ctr. Seattle, WA 98164	do	Snohomish.
U.S. Forest Service, Region 6	319 SW. Pine St., Box 3623 Portland, OR 97208	Quarries	Various.
Woodworth & Co. Inc	1200 East D St. Tacoma, WA 98421	Quarries and plant	Pierce.

[1]Also clays.
[2]Also silver.
[3]Also industrial sand and gravel.
[4]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 1982 was $75.6 million, a $11.9 million decrease from that of 1981 and $30.7 million below the record set in 1979 (fig. 1). Crushed stone was the leading nonfuel mineral commodity produced, accounting for nearly one-third of the State's total value. Other commodities produced included cement, common and fire clays, sand and gravel, and lime. Mineral commodities processed or manufactured included aluminum, ferroalloys, synthetic graphite, synthetic iron oxide, nickel, silicon, zinc, and zirconium.

Table 1.—Nonfuel mineral production in West Virginia[1]

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] thousand short tons	220	$502	210	$583
Sand and gravel (construction) do	e651	e2,601	751	3,392
Stone (crushed) do	7,885	28,399	p5,900	p22,700
Combined value of cement, fire clay, lime, salt, and sand and gravel (industrial)	XX	56,046	XX	48,938
Total	XX	r87,548	XX	75,613

eEstimated. pPreliminary. rRevised. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Berkeley	$30,740	$30,411	Cement, stone (crushed), clays, lime.
Boone	W	--	
Brooke	W	(3)	
Fayette	W	--	
Grant	414	355	Stone (crushed).
Greenbrier	7,316	6,483	Do.
Hampshire	W	W	Do.
Hancock	W	W	Clays.
Harrison	123	W	Stone (crushed).
Jackson	--	10	Do.
Jefferson	W	W	Do.
Kanawha	W	W	Do.
Lincoln	W	W	Clays.
Logan	1,511	W	Stone (crushed).
Marshall	W	W	Salt.
Mason	W	--	
Mercer	1,391	W	Stone (crushed).
Mineral	732	478	Do.
Monongalia	W	W	Do.
Morgan	W	W	Sand and gravel (industrial).
Pendleton	W	W	Lime.
Pocahontas	649	457	Stone (crushed).
Preston	W	W	Do.
Raleigh	2,329	2,152	Do.
Randolph	4,376	4,931	Do.
Tucker	411	370	Do.
Tyler	W	W	Salt.
Wetzel	W	(3)	
Wirt	W	--	
Wood	W	(3)	
Wyoming	W	W	Stone (crushed).
Undistributed	56,294	39,299	
Sand and gravel (construction)	XX	e2,601	
Total	106,286	4 87,548	

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

[1]Barbour, Braxton, Cabell, Calhoun, Clay, Doddridge, Gilmer, Hardy, Lewis, McDowell, Marion, Mingo, Monroe, Nicholas, Ohio, Pleasants, Putnam, Ritchie, Roane, Summers, Taylor, Upshur, Wayne, and Webster Counties are not listed because no nonfuel mineral production was reported.

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

Trends and Developments.—According to the U.S. Bureau of Labor Statistics, West Virginia had the Nation's highest unemployment rate (17.8%) in December 1982. This figure is in contrast with the national unemployment rate for the same month, which was estimated to be 10.8%. The State's high unemployment was attributed to the continuing national recession, which affected many industries related to mining or mineral processing. Since West Virginia's economy is highly dependent on those basic industries, companies involved in coal mining, primary metals, construction, glass manufacturing, and pottery were most severely affected.

Construction mineral commodities, which accounted for the majority of the State's nonfuel mineral production, declined in 1982 primarily because of high interest rates and a slowdown in construction activity in the State. West Virginia's primary metals industries (steel, aluminum, and nickel) were also affected by the recent economic downturns. These industries employed as many as 26,000 people in the past, but by April 1982, employment dropped to below 18,000. The economic recession, coupled with steel imports and lower industry demand, contributed to the decline in output and high unemployment in the State.

Despite the recession, construction continued at Union Carbide Corp.'s new silicon plant in South Charleston. The facility will be the company's second in the Nation and second largest in the world. The South Charleston facility, to be completed in 1983, is expected to create 130 permanent jobs.

Legislation and Government Programs.—In December, the Reclamation Commission of the Department of Natural Resources filed proposed coal surface mining regulations, which had been in the drafting stage for more than 2 years. Promulgations will lead to State primacy under the 1977 Federal Surface Mining Act. The State had been operating under a conditional plant approval from the Federal Office of

Table 3.—Indicators of West Virginia business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	785.0	769.0	-2.0
Unemployment	do	84.0	107.0	+27.4
Employment (nonagricultural):				
Mining[1]	do	59.0	62.9	+6.6
Manufacturing	do	111.5	98.9	-11.3
Contract construction	do	30.3	25.8	-14.8
Transportation and public utilities	do	41.9	41.5	-1.0
Wholesale and retail trade	do	131.9	128.1	-2.9
Finance, insurance, real estate	do	22.1	22.0	-.4
Services	do	101.7	103.2	+1.5
Government	do	130.2	126.2	-3.1
Total nonagricultural employment[1]	do	[2]628.5	608.6	-3.2
Personal income:				
Total	millions	$16,336	$17,249	+5.6
Per capita		$8,369	$8,856	+5.8
Construction activity:				
Number of private and public residential units authorized		2,377	1,979	-16.7
Value of nonresidential construction	millions	$76.8	$100.2	+30.5
Value of State road contract awards	do	$220.0	$244.0	+10.9
Shipments of portland and masonry cement to and within the State	thousand short tons	512	487	-4.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$87.5	$75.6	-13.6
Value per capita, resident population		$49	$39	-20.4
Value per square mile		$3,998	$3,127	-21.6

[p]Preliminary.
[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.

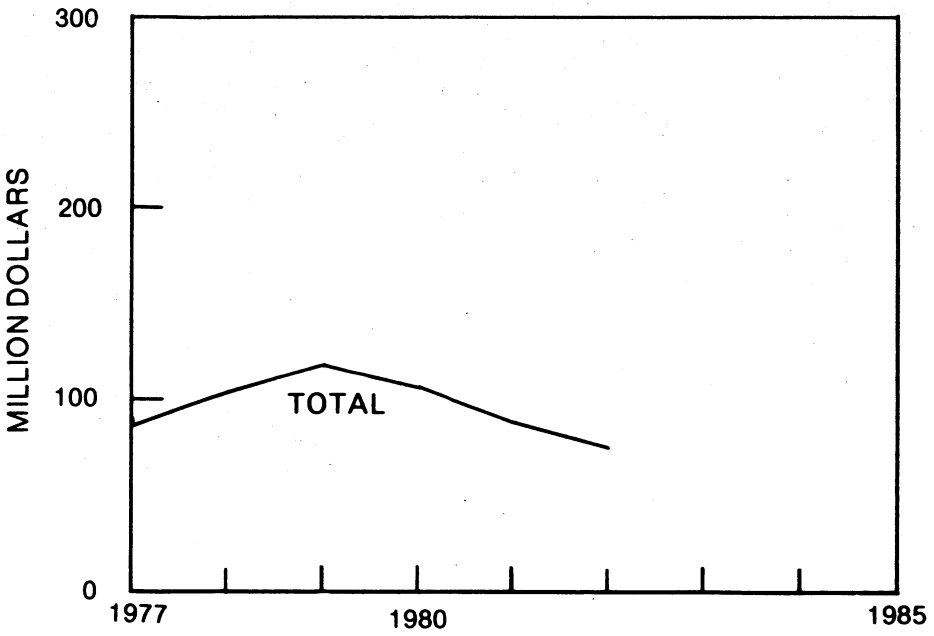

Figure 1.—Total value of nonfuel mineral production in West Virginia.

Surface Mining.

In early January 1983, the President signed into law a bill (H.R. 5161) designating the Cranberry Wilderness Area and two smaller tracts in the Monongahela National Forest as a part of the National Wilderness System. Included in the legislation is the provision for the CSX Co. (Chessie System), the owner of most of the 35,600 acres of the mineral rights, to exchange the coal for Government-owned minerals of equal value elsewhere. Also included in the bill is a payment of more than $2 million to Pocahontas and Webster Counties to compensate them for the loss of tax revenues. An estimated 39 million tons of low-sulfur, low-ash coal lies beneath the thickly forested backcountry.

The Economic Section of the West Virginia Geological and Economic Survey continued evaluating the State's mineral resources. During 1982, additional samples of limestone were collected and chemically analyzed as part of a continuing effort to determine the suitability of the State's limestone for various uses. A computerized chemical and physical data file of West Virginia's limestone resources was near completion. A report including maps showing the depth and thickness of the Greenbrier limestone along and near the State's navigable waterways is in progress. The Economic Section also continued assessing the State's clay and shale deposits; in 1982, the effort concentrated on Putnam, Kanawha, and Raleigh Counties. Reconnaissance work on the geology and hydrologic resources of Mason County was completed. The results of the study will be made available as an open file report by the Survey.

During 1982, the West Virginia Department of Natural Resources issued two surface mining permits for nonfuel minerals; both permits were issued for stone quarries. One permit, covering 10 acres, was issued to Harry Boggs in Spencer, and the other was issued to Beckley Stone Co. in Prosperity for 84 acres. No bonding was involved in either of the permits.

In fiscal year 1982, the Federal Government paid approximately $177,800 to the State as its share of royalties pertaining to activities (mineral leasing, timbering, recreation, user's fees, etc.) in Monongahela National Forest. The majority of the monies distributed were attributable to mineral leasing and mining royalties.

Also during fiscal year 1982, the U.S. Bureau of Mines had 25 active contracts and grants in West Virginia valued at $352,558. A total of 17 of these were with West Virginia University (WVU), 7 were with private firms, and 1 contract was awarded to the U.S. Department of Energy. Most of the monies awarded were for research grants and allotments for mineral-related studies. One grant, awarded to WVU in the amount of $99,862, was for continued research and development of a comprehensive mine rescue team training program. Previously, WVU received Federal contracts totaling $591,439 for the program.

The Mining and Mineral Resources and Research Institute at WVU in Morgantown, which was created under Title III of Public Law 95-87, received $150,000 in fiscal year 1982 for operations and research from the U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Martin Marietta Corp. operated the State's only cement plant at Martinsburg in Berkeley County in the State's eastern panhandle. The wet-process plant, with an annual grinding capacity of 935,000 tons, produced both portland and masonry cement. Combined production and value of both portland and masonry cement declined nearly 9% in 1982, the result of decreased demand by the construction industry. Most of the cement was used in ready-mix concrete and concrete products. In addition to in-State consumption, shipments were made to the District of Columbia, Maryland, North Carolina, Pennsylvania, and Virginia.

In April, Martin Marietta temporarily closed the plant and laid off virtually all of its employees except for those in the packing and shipping divisions. However, in late May, nearly 170 workers were recalled because of depleting inventories. In normal times, salaried and hourly employees at the cement plant number about 230.

Clays.—In 1982, both common and fire clays were produced in the State. Common

clay and shale were mined by Continental Clay Products Co. and Martin Marietta Cement in Berkeley County and by Sanders Dummy Co. in Lincoln County. Berkeley County continued to be the leading producer, accounting for most of the State's total output. Fire clay was mined by one company, Globe Refractories Inc., in Hancock County.

Production of common clay decreased 5% in 1982, although value rose by 16% because of the higher unit values. Principal uses of the common clay from Berkeley County were for face brick and in the manufacture of cement. Common clay mined in Lincoln County was sold as "dummy clay," used in mine explosive stemming.

Output and value of fire clay dropped nearly 50% in 1982, reflecting weaker demand by those industries using refractory products. Fire clay was also sold for use in building bricks.

During the year, Continental Clay Products filed for protection from creditors under Chapter 11 of the Federal Bankruptcy Code. Creditors include Old National Bank and the West Virginia Economic Development Authority, which are owed $2.73 million and $131,870, respectively. Near yearend, the employee union interceded with the minority creditor to avert foreclosure of the brick plant. At yearend, the plant was operating at about 50% capacity, with nearly one-fourth of the plant's 100 workers laid off.[3]

Gem Stones.—Although most gem stones are usually associated with igneous and metamorphic rocks, a limited variety are found in West Virginia's predominantly sedimentary rocks. Among the mineral specimens found in the State are a type of coral, some opal, quartz varieties, and two coal or coallike minerals.[4]

Graphite (Synthetic).—Near yearend, Union Carbide began operating its new graphite specialties plant in Clarksburg, increasing the company's capacity by 50%. Graphite specialties had previously been produced at the company's Niagara Falls, N.Y., facility, but the move to Clarksburg allowed the company to consolidate its specialty operations at one site. Products produced include graphite molds and dies for producing metals crucibles. Nonspecialty products that had been produced at Clarksburg will be produced elsewhere.[5]

Iron Oxide Pigments (Synthetic).—West Virginia ranked third nationally in the production of finished iron oxide pigments. Mobay Chemical Corp., the sole producer in the State, operated a plant in New Martinsville, Wetzel County. The iron oxides were principally used by the paint and construction industries.

Regenerator iron oxides were also recovered from steel plant wastes by National Steel Corp. at its plant in Weirton. Production dropped nearly 74% in 1982, reflecting the continuing downturn in steel production.

Lime.—Lime was produced by two companies in 1982. Both quicklime and hydrated lime were produced by Germany Valley Limestone Co. in Pendleton County. Quicklime was also produced by the Riverton Corp. in Berkeley County. The lime was used principally in acid mine water neutralization, paper pulp, water purification, and sewage treatment. Both quantity and value decreased because of a lower demand by the steel industry. Riverton closed its plant in July 1982.

Salt.—Three companies produced salt brine from deep well solution mining operations in the State. Two firms operated in Marshall County and one firm in Tyler County. Although salt sold or used in 1982 declined about 2% from 1981 levels, value was nearly 19% higher because of higher unit values. Most of the salt was used for the manufacture of chlorine, caustic soda, and other chemicals.

WVU researchers received a $77,000 Federal Highway Administration grant to test salt brine, an unwanted byproduct of oil and gas drilling, for its suitability as a road deicing agent. If successful, the State could save money by using brine instead of the more costly rock salt currently being used. Initial test results using a pressurized brine spraying system were inconclusive. However, a less costly gravity system developed by the engineers seemed promising. Initial testing of the new gravity system was to begin in 1983.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Output of construction sand and gravel declined nearly 73% in 1982 compared with 1980 levels reflecting decreased contract

construction in residential, nonresidential, highway, and public projects.

In 1982, five companies mined construction sand and gravel from five operations in four counties. Leading counties, in order of output, were Hancock, Wetzel, Mason, and Grant. Trucks transported the bulk of the aggregate; the remainder was shipped by rail or barge. Main uses for the material were for asphalt and concrete aggregate, road base, and concrete products.

Industrial.—Industrial sand was produced by two companies in the State. Pennsylvania Glass Sand Corp., the State's leading producer, operated a mine and plant in Morgan County. The other producer in the State was Tolers Sand Co. in Wyoming County. Morgan County accounted for most of the State's total. In 1982, production decreased nearly 32% compared with 1981 output. The leading end uses were for containers, flat glass, and specialty glass.

Although West Virginia has an abundance of quality industrial sand resources and is one of the Nation's leading manufacturers of glassware, the downturn in the economy has had a direct impact on this industry. Of the estimated 30 makers of pressed and blown glassware in the State, many firms were faced with reduced sales, layoffs, and in several cases, closure. Problems facing the industry include high natural gas costs, competition from imports, and a need to modernize facilities to increase efficiency and cut costs.[6]

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	440	$1,916	$4.36
Gravel	NA	NA	NA	307	1,464	4.77
Sand and gravel (unprocessed)	NA	NA	NA	5	12	2.49
Total or average	e651	e$2,601	e$4.00	[1]751	3,392	4.51
Industrial sand	W	W	15.67	W	W	17.67
Grand total or average	W	W	e11.30	W	W	W

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

Table 5.—West Virginia: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	525	$2,336	$4.45
Concrete products	W	W	6.23
Asphaltic concrete	W	W	4.00
Road base and coverings	W	W	5.47
Fill	5	11	2.29
Other	221	1,045	4.73
Total or average	751	3,392	4.51

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

Silicon.—During the year, Semix Corp. of Solarex Corp. of Rockville, Md., began renovating the former Lockheed building and plantsite in the Berkeley County Industrial Park. Plans call for the installation of a silicon-producing furnace and the initial hiring of a limited number of workers. Raw silicon is to be produced from out-of-State, high-purity quartz deposits and is to be used in the manufacture of photovoltaic cells.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary

estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and finalized the following year.

Both crushed limestone and sandstone were produced in West Virginia. Based on preliminary estimates, production and value declined 25% and 20%, respectively. Major uses for the crushed stone were for construction aggregate, road base, concrete, and riprap.

METALS

Aluminum.—Depressed markets for aluminum resulted in plant shutdowns and contemplated closings. In January, Kaiser Aluminum & Chemical Corp. closed the last of its four potlines and restructured its nearby fabricating plant in Ravenswood, Jackson County, because of reduced demand, high operating costs, and unresolved labor issues. In the fall, it was anticipated that Kaiser might restart one potline, but the company announced in November that it would not reopen because of the inability of management and labor to agree on contract concessions. Nearly 2,000 workers have been laid off at the Ravenswood plant since April 1981.

In December, Kaiser and members of the United Steelworkers of America agreed on a plan that would both limit layoffs and provide changes in work and personnel rules at the company's Ravenswood aluminum smelter and fabrication plant. The agreement provides that there will be no additional layoffs at Ravenswood if the fabrication plant maintains a monthly production rate of 30 million pounds of aluminum products. The fabrication plant, which was operating at approximately 60% at yearend, had an average production of 34 million pounds per month during the last 3 months of the year.

Ferroalloys.—During the year, three companies produced ferroalloys in the State. Elkem Metals Co. operated an electric furnace producing a full line of silicon products at Alloy in Fayette County; Foote Mineral Co. operated one of its three electric ferrosilicon furnaces at Graham in Mason County; and Chemetals Corp., a subsidiary of SEDEMA S.A., operated a fused-salt electrolytic furnace at Kingwood in Preston County. Chemetals continued to be the only domestic producer of low-carbon ferromanganese.

In 1982, ferroalloy shipments were 16% lower than that of 1981. The decline in sales reflected the continued depressed conditions of the automotive and steel industries and competition from foreign imports of ferroalloy products. Owing to the low sales levels, most plant operations were curtailed during the year.

Iron and Steel.—National Steel, the Nation's fourth largest steel producer, announced in March that it was negotiating divestiture of its Weirton Steel Div. The company decided to limit future capital spending at the plant and direct corporate funds elsewhere. Near yearend, talks continued between the company and representatives of the 10,000 employees on the Employee Stock Ownership Plan (ESOP) that could lead to the sale of Weirton Steel to the employees.

In August, National also announced that it would permanently shut down Brown's Island coke plant at Weirton, idling nearly 275 workers. The plant, which began operations in 1973, requires modernization to meet Environmental Protection Agency regulations for air quality control. However, preliminary engineering plans for rebuilding the coke plant were underway. The plans are contingent on Weirton's success with the proposed ESOP.

In late December, United Steelworkers union members voted to approve major contract concessions at the Wheeling-Pittsburgh Steel Corp. Wheeling plant. The agreement would cut wages and benefits by $3.65 per hour, which will be returned to the employees by 1986. Wheeling agreed not to close any of its plants for 4 years and to share 50% of its profits with workers. Wheeling-Pittsburgh, the Nation's eighth largest steelmaker, operated plants at Benwood, Follansbee, Beech Bottom, and Wheeling.

In August, Steel of West Virginia Inc. purchased and reopened the recently closed Connors Steel plant in Huntington. The plant has an annual capacity to produce 250,000 tons of continuous cast billets and 150,000 tons of rolled products. About 250 employees returned to work.

Nickel.—Huntington Alloys, a division of Inco Alloy Products Co., produced wrought high-nickel alloys at its Huntington plant in Cabell County. The alloys were used by the energy, chemical, aerospace, and other major industries. Deliveries continued to decline in 1982, reflecting the continuing worldwide recession and weak demand for metals.

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, W. Va.
[3]Martinsburg Journal (W. Va.). Continental Clay. Dec. 28, 1982.
[4]Kirstein, D. S. Gem Stones of West Virginia. Mountain State Geology. W. Va. Geol. and Econ. Survey, December 1982, pp. 34-36.
[5]American Metal Market. UC Starts Up Graphite Plant in West Virginia. Dec. 21, 1982.
[6]Charleston Mail (W. Va.). Natural Gas Prices, Flood of Imports, Squeeze State's Glass Manufacturers. Dec. 8, 1982.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Kaiser Aluminum & Chemical Corp.	Box 98 Ravenswood, WV	Refinery	Jackson.
Cement:			
Martin Marietta 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.
Riverton Corp	Route 3 Martinsburg, WV 25401	do	Berkeley.
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:			
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 (1981):			
Acme Limestone Co	Box 27 Fort Spring, WV 24936	Mine and quarry	Greenbrier.
Beckley Stone Co	Box 1284 Beckley, WV 25801	Quarry	Raleigh.
The H. Frazier Co. Inc	Box 1877 Richmond, VA 23211	do	Greenbrier.
Greer Limestone Co., a division of Greer Steel Co.	Greer Bldg. Morgantown, WV 26505	Mine and quarries	Monongalia and Pendleton.
Marquette Co	Route 3, Box 489 Morgantown, WV 26505	Mine	Monongalia.
Shenandoah Quarry Inc	Box C Millvale, WV 25432	Quarry	Jefferson.

[1]Also clays and 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] and Thomas J. Evans[2]

The value of nonfuel mineral production in Wisconsin was $112.3 million in 1982, $67.4 million below the record value set in 1979 and $39.5 million below the value reported for 1981. Output of all mineral commodities within the State declined during 1982 owing to the depressed State economy and nationwide recession. Iron ore production was especially hard hit owing to reduced demand for steel.

Nationally, Wisconsin ranked 37th in value of nonfuel mineral production; nonmetallic mineral commodities, led by stone and sand and gravel, continued to contribute the greatest amount of value to the State's mineral production. Other mineral commodities produced were, in decreasing order of value, lime, iron ore, cement, peat, and abrasives. Perlite and vermiculite from out-of-State sources were processed in Wisconsin, and sulfur was recovered as a refinery byproduct.

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

Mineral		1981		1982	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Iron ore (usable)	thousand long tons, gross weight	853	W	263	W
Lime	thousand short tons	326	$17,548	312	$17,685
Peat	do	10	535	9	W
Sand and gravel:					
Construction	do	e18,210	e34,522	14,515	29,218
Industrial	do	1,100	13,180	788	9,662
Stone:					
Crushed	do	15,189	39,962	p11,400	p36,100
Dimension	do	40	4,259	p37	p2,644
Combined value of abrasive stone, cement, and values indicated by symbol W		XX	41,749	XX	16,985
Total		XX	r151,755	XX	112,294

eEstimated. pPreliminary. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Ashland	W	W	Stone (crushed).
Barron	$243	(3)	
Bayfield	W	W	Stone (crushed).
Brown	W	W	Lime, stone (crushed).
Buffalo	463	$231	Stone (crushed).
Burnett	753	(3)	
Calumet	W	201	Stone (crushed), stone (dimension).
Chippewa	557	(3)	
Clark	W	58	Stone (crushed).
Columbia	W	W	Sand (industrial), stone (crushed).
Crawford	W	192	Stone (crushed).
Dane	4,550	2,126	Do.
Dodge	W	W	Lime, stone (crushed).
Door	688	W	Stone (crushed).
Douglas	13,888	12,259	Lime, cement, stone (crushed).
Dunn	W	W	Stone (crushed).
Eau Claire	W	(3)	
Florence	18	(3)	
Fond du Lac	W	W	Stone (crushed), lime, stone (dimension).
Forest	229	(3)	
Grant	1,643	1,255	Stone (crushed).
Green	W	W	Do.
Green Lake	W	W	Sand (industrial), stone (crushed).
Iowa	1,010	598	Stone (crushed).
Jackson	W	W	Iron ore, sand (industrial).
Jefferson	566	504	Stone (crushed).
Juneau	W	W	Do.
Kenosha	1,737	(3)	
Kewaunee	617	(3)	
La Crosse	W	754	Stone (crushed).
Lafayette	876	715	Do.
Langlade	W	(3)	
Lincoln	393	(3)	
Manitowoc	7,878	W	Lime, stone (crushed), stone (dimension).
Marathon	6,801	W	Stone (dimension), stone (crushed).
Marinette	W	W	Stone (crushed), sand (industrial).
Marquette	W	(3)	
Milwaukee	W	W	Stone (crushed), cement.
Monroe	1,935	1,459	Stone (crushed).
Oconto	658	107	Do.
Oneida	493	(3)	
Outagamie	2,023	1,429	Stone (crushed).
Ozaukee	623	183	Do.
Pepin	56	101	Do.
Pierce	1,449	W	Stone (crushed), sand (industrial).
Polk	2,858	W	Stone (crushed).
Portage	1,457	(3)	
Price	101	(3)	
Racine	W	W	Stone (crushed).
Richland	220	131	Do.
Rock	2,604	707	Do.
Rusk	663	(3)	
St. Croix	W	323	Stone (crushed).
Sauk	W	W	Stone (crushed), abrasives.
Sawyer	106	(3)	
Shawano	W	W	Stone (crushed).
Sheboygan	W	55	Do.
Taylor	1,369	(3)	
Trempealeau	880	658	Stone (crushed).
Vernon	W	205	Do.
Vilas	449	(3)	
Walworth	2,009	(3)	
Washburn	W	(3)	
Washington	993	W	Stone (crushed).
Waukesha	12,337	4,384	Stone (crushed), stone (dimension), peat.
Waupaca	W	W	Stone (crushed).
Waushara	W	(3)	
Winnebago	W	1,320	Stone (crushed).
Wood	188	132	Stone (crushed), stone (dimension).
Undistributed[4]	75,908	87,145	
Sand and gravel (construction)	XX	e34,522	
Total[5]	152,290	151,755	

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

[1]Adams, Iron, and Menominee Counties are not listed because no nonfuel mineral production was reported.

[2]County distribution for construction sand and gravel is not available; total State value is shown separately under "Sand and gravel (construction)."

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

[4]Includes sand and gravel that cannot be assigned to specific counties (1980) and values indicated by symbol W.

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

Table 3.—Indicators of Wisconsin business activity

		1981	1982[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,373.0	2,450.0	+3.2
Unemployment	do	185.0	261.0	+41.1
Employment (nonagricultural):				
Mining	do	2.2	1.8	-18.2
Manufacturing	do	543.1	496.3	-8.6
Contract construction	do	60.7	52.1	-14.2
Transportation and public utilities	do	90.8	87.0	-4.2
Wholesale and retail trade	do	432.4	429.6	-.6
Finance, insurance, real estate	do	95.9	97.2	+1.4
Services	do	375.9	384.0	+2.2
Government	do	319.0	319.1	--
Total nonagricultural employment[1]	do	1,919.9	1,867.2	-2.7
Personal income:				
Total	millions	$47,617	$50,022	+5.0
Per capita		$10,042	$10,497	+4.5
Construction activity:				
Number of private and public residential units authorized		14,196	10,820	-23.8
Value of nonresidential construction	millions	$503.3	$382.7	-24.0
Value of State road contract awards	do	$159.2	$173.3	+8.9
Shipments of portland and masonry cement to and within the State	thousand short tons	1,372	1,080	-21.3
Nonfuel mineral production value:				
Total crude mineral value	millions	$151.8	$112.3	-26.0
Value per capita, resident population		$33	$24	-27.3
Value per square mile		$2,784	$2,000	-28.2

[p]Preliminary.
[1]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.

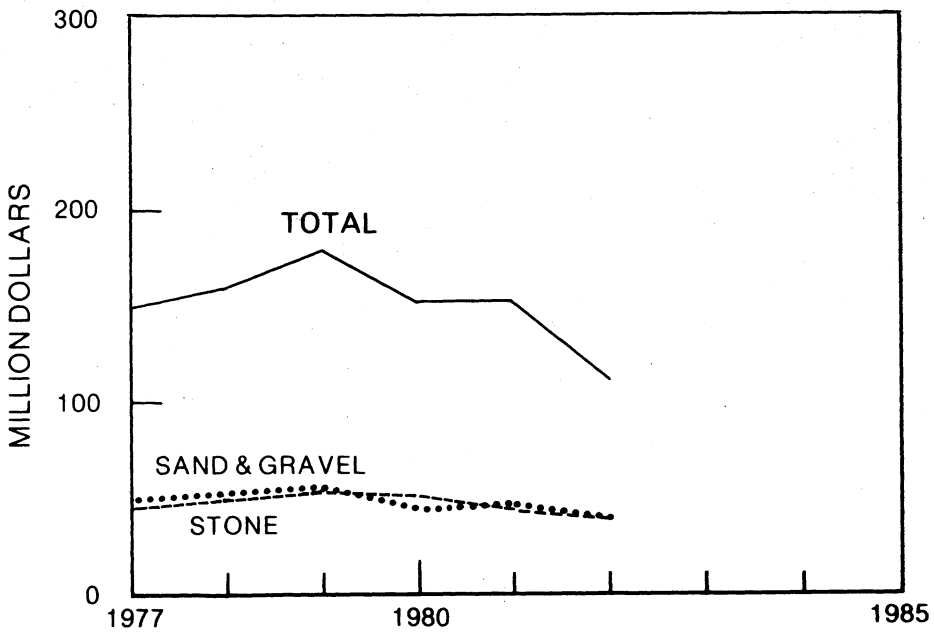

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Wisconsin.

Trends and Developments.—Wisconsin's economy suffered because of the recession. Unemployment was at a double-digit rate for the last 9 months of the year, peaking at 11.8% in October and 11.7% in December, the highest rates since the great depression. The State's average annual rate of unemployment was 10.7%, compared with 7.8% in 1981. Employment in manufacturing fell to its lowest level in 20 years, and many companies reduced their inventories of raw materials because of high interest rates, which raised costs.

State-based sales volume declined again in 1982 through mergers and acquisitions. Anderson/Roethle & Associates Inc. reported that 22 out-of-State companies acquired Wisconsin firms and 3 companies were absorbed by foreign firms, resulting in the loss of control over more than $1.6 billion in annual sales. This compares with the loss of control over more than $4.2 billion in 1981.

The State Department of Development reported that there were only 193 new capital investment projects undertaken in Wisconsin during the year. This represents a 30% decrease from 1981 figures and the fourth consecutive year of decline. Compared with 1981 levels, new jobs added were down 51%, and new plant and equipment spending was down 64%. Additionally, 37 plants closed in 1982, terminating more than 2,200 jobs and virtually offsetting the jobs created by new capital investments.

For the third consecutive year, housing and general construction declined, directly affecting a large segment of Wisconsin's mineral industry. The State's Department of Industry, Labor, and Human Relations reported a 21% drop below 1981 figures for the number of building plans examined for compliance with the State's commercial building code in areas outside of Milwaukee. In the four-county Milwaukee area (Milwaukee, Ozaukee, Washington, and Waukesha Counties), building permits for housing units dropped 25.4% from those of 1981. The U.S. Department of Commerce reported a 23.8% drop in the number of construction permits issued for residential units (public and private). Also, the value of private nonresidential construction dropped 24% below 1981 figures.

Several developments occurred during the year within Wisconsin's mineral industry. On April 9, Jackson County Iron Co. closed taconite operations near Black River Falls in response to a continuing decline in the demand for steel. The mine and plant remained closed at yearend, affecting more than 250 employees.

In May, St. Marys Cement Ltd., Toronto, Canada, acquired cement distribution facilities in Milwaukee and Green Bay from Lehigh Portland Cement Co., Allentown, Pa. The facilities are operated as St. Marys Wisconsin Cement Inc.

On July 1, Flambeau Mining Corp. closed its office in the Town of Grant, Rusk County, as part of a nationwide economy move by its parent company, Kennecott Minerals Co., a subsidiary of Standard Oil Co. (Ohio). The office had been in existence since 1968, shortly after the Flambeau copper deposit was discovered.

In August, Allied Corp., an international manufacturer of chemicals, electrical products, and industrial equipment, announced it had acquired Nitragin Sales Corp., a Milwaukee-based producer of seed inoculants. Demilco Inc., a division of Nitragin Sales, produces peat near Delafield in Waukesha County.

In late December, Exxon Minerals Co. submitted an environmental impact report (EIR) and mining permit application to the Wisconsin Department of Natural Resources (DNR) for development of the Crandon zinc-copper deposit in Forest County. The EIR is the principal environmental assessment document used by DNR to prepare an environmental impact statement (EIS) in accordance with the Wisconsin Environmental Policy Act. The mine-permitting process was expected to last 2 or more years. If the State grants a mining permit, Exxon will decide whether economic conditions will allow it to proceed with mine construction.

Exploration.—Metallic mineral exploration dropped sharply in 1982. The number of drill holes completed, exclusive of drill holes related directly to the Exxon Crandon project, totaled only 57, compared with 97 in 1981, a decline of more than 41%. Although there were 14 companies licensed for exploration in 1982, only 8 actually conducted exploratory drilling. Twelve drill holes were completed in southeastern Oneida County, with other areas of exploration concentrated in northeastern Marathon County, central Iron County, and southeastern Price County-northwestern Lincoln County. Twenty drill holes were completed for purposes of continuing mine feasibility studies on the Exxon Crandon project in Forest County.

All metallic mineral exploration in 1982

was directed toward base metal targets. Uranium exploration in northern Wisconsin, the subject of public hearings and legislative activity in 1980 and 1981, did not occur in 1982. Drilling activity in 1982 is summarized in table 4.

Mineral leasing activity in 1982 included 17,489 new acres leased in 12 counties. Most of the leasing activity (more than 7,700 acres) occurred in Price County, with more than 1,000 acres leased in each of Forest, Lincoln, Oneida, and Taylor Counties. Total new acreage leased in 1982 was down 40% from 1981 levels and more than 65% from 1980 levels. Mineral leasing records are based on mineral registers in each county, which are maintained in accordance with section 107.25 of the Wisconsin statutes.

Table 4.—Wisconsin: Metallic mineral exploration in 1982

Licensed exploration companies	Number of drill holes	Total footage drilled
AMAX Exploration Inc	4	1,349
American Copper & Nickel Co. Inc	7	1,639
Amoco Minerals Co	2	2,606
Amselco Exploration Inc	--	--
Central Wisconsin Joint Venture	--	--
Ernest K. Lehmann & Associates of Wisconsin Inc	13	8,113
Exxon Minerals Co.[1]	20	28,994
Inspiration Mines Inc	--	--
Kerr-McGee Corp	12	7,088
Minatome Corp	--	--
Mineral Sciences Div., UOP Inc	--	--
Noranda Exploration Inc	18	15,937
St. Joe American Corp	1	854
Texasgulf Western Inc	--	--
Total	77	66,580

[1]Drilled on the Crandon deposit.

Source: Metallic Mineral Exploration Drillhole Abandonment Reports, Wisconsin Department of Natural Resources.

Shipping.—According to the Seaway Port Authority of Duluth, waterborne commerce passing through the Port of Duluth-Superior in 1982 totaled 26.9 million metric tons, down 26% from the 36.4 million tons reported in 1981. The major reason for this drop in tonnage was the decline in shipments of iron ore and concentrates caused by the recession and the depressed steel industry. Shipments of iron ore and concentrates to domestic ports totaled 13.1 million tons, down from the 21.7 million tons shipped in 1981. Export of these commodities to Canada totaled 2.9 million tons, a slight increase over the 2.6 million tons shipped in 1981. Shipments of iron ore and concentrates through the Burlington Northern Inc. transshipment facility on Allouez Bay in Superior amounted to 8 million gross tons, compared with 10.7 million gross tons shipped in 1981.

Limestone and limestone products delivered to the port during the year from Canadian and domestic sources totaled 82,172 and 852,442 metric tons, respectively. The CLM Corp. lime plant and the Huron Cement Div. of National Gypsum Co. clinker grinding facility, both in Superior, used a portion of these commodities. A total of 20,281 metric tons of salt was also imported from Canadian sources.

The Port of Milwaukee, which serves the densely populated southeastern part of the State, also had a decline in total waterborne commerce during the year owing to the depressed economy. Total tonnage dropped 22.4% compared with that of 1981. Nonfuel mineral commodities imported into the region are shown in table 5. Cement was shipped to area distribution centers for ultimate use in construction. Salt was used mainly for snow and ice removal, and sand was used by the area's foundries. Clinker was imported for a cement-grinding facility, and potash was imported for fertilizer manufacture.

Wisconsin shipbuilders completed work on several vessels in 1982. Fraser Shipyards Inc., in Superior, converted three lake carriers to self-unloaders for USS Great Lakes Fleet Inc., a subsidiary of United States Steel Corp.

Bay Shipbuilding Corp. in Sturgeon Bay, a subsidiary of Manitowoc Co. Inc. delivered a tug and barge unit to Amoco Oil Co. for transporting fuel oil on the Great Lakes.

The firm also delivered a 42,000-ton-deadweight-capacity, self-unloading tug notch barge to Beker Shipping Co., Greenwich, Conn., a subsidiary of Beker Industries Corp. Beker is a major producer of phosphate rock, phosphoric acid, and fertilizer. The barge, considered to be one of the largest self-unloaders in the world for transporting phosphate rock, is capable of discharging 4,000 tons per hour.

Table 5.—Port of Milwaukee: Nonmetallic mineral commodity imports

(Short tons)

Commodity	1981	1982
Salt	222,683	[1]408,871
Cement	416,587	339,258
Sand	65,534	37,415
Clinker	--	32,086
Potash	--	[1]21,549
Limestone	11,687	--
Slag	11,460	--
Total	727,951	839,179

[1]Includes Canadian imports.

Source: Port of Milwaukee, U.S.A.

Legislation and Government Programs.—During the year, Wisconsin enacted several laws relating to the mineral industry. Chapter 131, Laws of 1981, which became effective March 11, 1982, authorizes DNR to sell sand and gravel from State-owned lands to towns and counties for road construction if material is unavailable from private sources within a reasonable distance of the worksite. The law allows local governments to save on transportation costs in areas where the State owns much of the land.

NR 182, administrative rules for metal mine waste disposal facilities, were promulgated in September. The final adoption of NR 182 ended a 4-year effort by DNR to prepare and approve rules for controlling the disposal of metallic mining wastes as mandated in May 1978 by the Wisconsin Legislature. These rules became controversial owing to the standards applied to ground water quality protection and the design of waste disposal facilities. Also promulgated in September were revisions to NR 132 (mining) and NR 131 (prospecting). These codes were modified to incorporate aspects of the NR 182 rules.

The Third District county appeals court overruled the judgment of the Oneida County circuit court that the State's Geologic Information Act was unconstitutional. In holding section 107.15 of the Wisconsin statutes constitutional, the court noted that the law is a valid exercise of the State's police powers and was not an infringement of a contract. The legal action was initiated by Noranda Exploration Inc. in 1979 to protect its drilling information. Noranda appealed the decision to the State Supreme Court, and oral arguments were scheduled for February 1983.

In September, Wisconsin's Mining Investment and Local Impact Fund Board selected the recipients for its discretionary grant program, which deals with mine-related impacts. At that time, more than $108,000 in grants was approved. Subsequently, the submittal of Exxon's mine-permit applications for the Crandon project made four recipients eligible for block grants from the board of $100,000 each, and the discretionary grant program was modified. Grants to be awarded in 1983 now total about $91,000, including a $25,000 grant to the community of Black River Falls for planning assistance to deal with impacts associated with the closing of the Jackson County Iron Co. open pit taconite operation. Also, funds were awarded to 11 other communities or groups of communities. Discretionary funds in 1983 are to be expended for mining-related activities in the following areas: (1) local and regional impact committees, (2) legal services, (3) environmental and technical studies, and (4) capital improvements.

The Radiation Protection Section of the State Department of Health and Social Services released a report during the year on radiological monitoring of uranium exploration drilling in northern Wisconsin. Mandated and funded by the Wisconsin Legislature through the Uranium Exploration Safety Subcommittee of the Legislative Council Mining Committee, the report gave the results of monitoring holes drilled by Kerr-McGee Corp. in southern Florence County in late 1980 and early 1981. Measurements of radon in air and water and gamma exposure rates indicated uranium exploration produced no noticeable radiological impact on the environment. Another report on monitoring holes drilled by Minatome Corp. in northern Florence County was expected in late 1983.

The Wisconsin Geological and Natural History Survey continued its program of bedrock mapping in northern Wisconsin in 1982. A preliminary version was released of the Northeast Sheet at a scale of 1:250,000. Fieldwork continued in the Northwest, West-Central, and East-Central Sheet areas. A new 1:1,000,000-scale bedrock geologic

map of the entire State was completed and approved for printing and release in early 1983.

Another major project by the State Survey was the evaluation of peat resources throughout the State. Several nonfuel peat operations are active in Wisconsin, and the study, funded by the U.S. Department of Energy to assess fuel-grade peat, was expected to provide useful information on the location, size, and character of the State's peat resources. In 1982, trips to review the Michigan and Minnesota peat programs, field sampling, and preliminary sample analysis were completed. Project completion was scheduled for October 1983. By yearend, the Survey also had completed compiling a directory of active mineral producers within Wisconsin.

In September, the U.S. Bureau of Mines through its Twin Cities Research Center awarded a $43,000 contract to the Geological and Natural History Survey for an ongoing study of reclamation techniques on zinc roaster waste piles near Mineral Point. The zinc waste sites had been identified by DNR as one of the greatest environmental problems related to past mining practices in Wisconsin. The study, expected to be completed in early 1985, will analyze problems associated with the revegetation of the zinc wastes and develop a reclamation technique for revegetating and stabilizing the wastes.

During 1982, the U.S. Department of Energy National Uranium Resource Evaluation (NURE) program released a report, GJBV-222(82), covering investigation of uranium anomalies in several States. Among the areas evaluated were two in northeast Wisconsin—the McCaslin Mountain and Goodman-Dunbar areas—which previously had been reported in the literature to have some uranium potential. The NURE investigations of these areas found them to have little potential, which in turn allayed some of the concerns that some State residents had about uranium mining.

In 1982, the U.S. Bureau of Land Management's Lake States Office in Duluth, Minn., released five new maps showing the location of public lands and Federal mineral ownership in northwestern Wisconsin. The maps are part of a series showing significant acreage of federally owned mineral rights that coincide with areas of mineral exploration interest. Areas covered by the maps are Bloomer, Spooner, Park Falls, and Medford, as well as Ironwood, Mich.

In fiscal year 1982, the State received approximately $512,580 from the Federal Government for its share of funds generated by activities on national forest lands (timbering, mineral leasing, recreation, user fees, etc.). This compares with $498,700 that the State received in fiscal year 1981. No action was taken by the U.S. Congress on the seven areas previously nominated for wilderness designation in the Chequamegon and Nicolet National Forests.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasive Materials.—Quartzite was mined at a small quarry located east of Baraboo, Sauk County, by Baraboo Quartzite Co. Inc. for use as a deburring and burnishing media. Drilling and blasting were done by a contractor. The rock was then crushed, tumbled to remove rough edges, and screened to about 20 different sizes ranging from 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 declined during the year because of the depressed economy.

Cement.—Two firms operated cement-grinding facilities during 1982. The Huron Cement Div. operated a plant in Superior, and St. Marys Wisconsin Cement operated a plant in Milwaukee. Both firms brought in clinker from out-of-State sources. St. Marys was a newcomer to Wisconsin markets as its parent company, St. Marys Cement, purchased the Milwaukee plant and a distribution terminal in Green Bay from Lehigh Portland Cement Co., Allentown, Pa. The Milwaukee plant had been acquired by Lehigh Portland from the United States Steel Universal Atlas Cement Div. in 1980.

Shipments of cement were down for the year because of the depressed housing and other construction markets. Most of the cement was transported in bulk form by truck; the remainder was shipped by rail. The cement was distributed to ready-mix concrete facilities, concrete products manufacturers, building material dealers, and contractors.

Lime.—During 1982, lime was the third most valuable mineral commodity produced in Wisconsin. Production decreased about 4% from that of 1981 because of the depressed economy, which affected most end uses. 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 produced lime at a plant in Douglas County. Lime was used in paper and pulp manufacture, water purification, mason's lime, and sewage treatment; other uses included steel production, finishing lime, and road stabilization. Lime produced in the State was shipped throughout the Midwest and South, to Canada, and overseas.

Rockwell Lime in Manitowoc installed a second kiln and hydrator and modified its dust collection and stone-handling systems to increase capacity and efficiency.[3]

Peat.—Waukesha County, with three producers, accounted for all of Wisconsin's peat output in 1982. Demilco mined and kiln-dried peat near Delafield for shipment to a plant in Milwaukee, where it was used as an ingredient in seed inoculant. Certified Peat & Sod Inc., located near New Berlin, produced and distributed packaged and bulk peat for general soil improvement purposes. Bogda's Top Soil & Excavating Co., also with operations near New Berlin, produced bulk peat for soil improvement. Peat production decreased slightly from 1981 to 1982 because of the depressed economy.

In July, Nitragin Sales was acquired by Allied Corp., an international manufacturer of chemicals, electrical products, and industrial equipment. Allied plans to operate the firm as a part of expanded activities in agricultural research and product development.

Perlite (Expanded).—Only one company in Wisconsin expanded perlite during the year. Midwest Perlite Co. operated a plant at Appleton in Outagamie County. Output was used mainly for horticultural purposes, with lesser quantities used in plaster and concrete aggregate and cavity fill insulation.

Sand and Gravel.—*Construction.*—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, no annual survey of construction sand and gravel producers was conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1. Sand and gravel used in construction was the second leading mineral commodity produced in Wisconsin in 1982, accounting for 26% of the State's total nonfuel mineral value. Production occurred in 60 of the State's 72 counties. There were 157 producers extracting sand and gravel at 197 locations. From 1980 to 1982, value per ton increased about 12%. Most construction sand and gravel was transported by truck.

Table 6.—Wisconsin: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,669	$10,343	$2.22
Plaster and gunite sands	W	W	3.62
Concrete products	461	985	2.14
Asphaltic concrete	2,090	4,884	2.34
Road base and coverings[1]	4,940	9,246	1.88
Fill	1,961	2,886	1.47
Snow and ice control	193	334	1.73
Railroad ballast	W	W	4.50
Other	200	539	2.70
Total[2] or average	14,515	29,218	2.01

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (cement and lime).
[2]Data may not add to totals shown because of independent rounding.

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

	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	NA	NA	NA	3,667	$7,571	$2.06
Gravel	NA	NA	NA	8,828	18,421	2.09
Sand and gravel (unprocessed)	NA	NA	NA	2,021	3,225	1.60
Total[1] or average	e18,210	e$34,522	e$1.90	14,515	29,218	2.01
Industrial sand	1,100	13,180	11.98	788	9,662	12.26
Grand total or average	e19,310	e47,702	e2.47	15,303	38,880	2.54

eEstimated. NA Not available.
[1]Data may not add to totals shown because of independent rounding.

Industrial.—Sand used for industrial purposes was produced by three companies in four counties. Output dropped 28% compared with that of 1981; average unit value increased about 2%. Major sales of sand were for foundry applications, hydraulic fracturing, glass containers, and sandblasting. Most of the sand was transported by truck, and the rest, by rail. Industrial sand produced in Wisconsin is marketed throughout the United States.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The survey of stone producers will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be finalized the following year.

Crushed.—Early in the year, 16 independent construction companies located throughout east-central Wisconsin banded together to form a new organization called the 4X Corp., with corporate headquarters in Neenah. The organization has more than 400 employees and is involved in supplying crushed stone and asphalt-paving and excavating services. The companies now collectively composing the 4X Corp. are Courtney & Plummer Inc., Twin City Concrete Corp., Two Rivers Concrete Corp., Wausau Materials Corp., Valders Lime & Stone Co. Inc., Valders White Rock Cut Stone Co., Lee Truck Sales, Oshkosh Ready Mix Co., Randolph Ready Mix Co., Green Lake Ready Mix Co., Lake Mills Concrete Corp., Neosho Ready Mix Co., Mayville Construction Co., W.E.D. Corp., Inland Trucking Co., and Waupun Ready Mix Co.

The Vulcan Materials Co. limestone quarry at Racine received the Showplace Award in the National Crushed Stone Association (NCSA) About Face Program. The program gives recognition to crushed stone operators that have made constructive efforts to attain a pleasing site appearance. This is the second award for the Racine operation. The first was in 1977 when the operation entered the program and won the Outstanding Achievement Award, the second highest recognition in the NCSA beautification awards program.

Sulfur (Recovered Elemental).—Byproduct sulfur was recovered by Murphy Oil Corp. at its refinery in Superior. About 1,000 metric tons was recovered in 1982.

Vermiculite (Exfoliated).—Koos Inc. exfoliated crude vermiculite obtained from out-of-State sources at a plant in Kenosha. Major sales were for agricultural purposes and for loose fill and block insulation. W. R. Grace & Co., Construction Products Div., sold some vermiculite, which was stored at its Milwaukee plant. The firm discontinued exfoliating vermiculite last year.

METALS

Iron Ore.—Jackson County Iron, a subsidiary of Inland Steel Co., closed its Black River Falls Mine and pelletizing operation on April 9, 1982, in response to the continuing decline in demand for steel. About 250 employees were affected by the closure, which remained in effect through yearend. The company reevaluated the operation and announced in December that it had downgraded the mine's life from 10 years to 5 years because of costs associated with going deeper into the ore body. The pit continued to be pumped to allow renewal of mining when economic conditions permit.

Reclamation of taconite mill tailings continued in 1982 with an experimental program utilizing paper processing sludge. Rec-

lamation efforts are being pursued by company employees, consultants, and University of Wisconsin personnel.

In the northern part of the State, the Ashland County Board of Supervisors terminated a mining lease on an iron deposit that had been in effect since 1956. The 99-year lease was with Ashland Mining Corp., a subsidiary of Detroit-based McLouth Steel Corp., and covered more than 700 acres of undeveloped land in the Town of Agenda. The action was taken because McLouth did not pay advanced royalties per terms of the lease while the firm was undergoing bankruptcy proceedings.

Zinc-Copper.—Although zinc and copper were not mined during the year, Exxon Minerals continued evaluating the Crandon deposit in Forest County. The firm completed a $1 million drilling program consisting of 20 holes in the heart of the ore body to test the upper level, where mining would begin. The program was initiated to increase knowledge of the ore blocks. The firm also received permission from DNR to sample six test holes in Little Sand Lake to determine the nature of the bottom material and whether mining would lower the lake level.

In December, Exxon submitted an EIR and applications for a mining permit and an air quality permit for the Crandon deposit to DNR for review. The permit applications are two of a dozen or more permits that would be necessary before site development at the large zinc-copper ore body, discovered in 1975, could begin. The EIR is the principal environmental assessment document used by DNR to prepare an EIS in accordance with the Wisconsin Environmental Policy Act. Review of the Exxon EIR, the permit applications, and other materials to be submitted in 1983 will probably take 24 to 30 months.

Kennecott Minerals closed its Ladysmith office in the Town of Grant. The office was established more than 10 years ago to support activities related to the copper massive-sulfide deposit discovered in 1968 by Bear Creek Mining, a Kennecott subsidiary. Plans for mining the deposit, known as the Flambeau, have been shelved; future development plans are unknown.

Zinc-Lead.—No exploration activity was reported in the southwestern Wisconsin zinc-lead district in 1982. Inspiration Mines Inc., which had purchased Eagle-Picher Industries Inc. properties in the area in 1981, continued reclamation efforts on the mines, which had closed in 1979.

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[1]State Liaison Officer, Bureau of Mines, Minneapolis, Minn.

[2]Assistant professor, Minerals Information, Wisconsin Geological and Natural History Survey, Madison, Wis.

[3]Pit and Quarry. Wisconsin Lime Producer Triples Capacity. May 1982, pp. 52-55.

Table 8.—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:			
National Gypsum Co., Huron Cement Div.	4100 First International Bldg. Dallas, TX 75270	Grinding plant	Douglas.
St. Marys Wisconsin Cement Inc., a subsidiary of St. Marys Cement Ltd.	2200 Yonge St. Toronto, Ontario M4S 2C6 Canada	do	Milwaukee.
Iron ore:			
Jackson County Iron Co., a subsidiary of Inland Steel Co.:			
Black River Falls	30 West Monroe St. Chicago, IL 60603	Mine, concentrator, agglomerator.	Jackson.
Lime:			
CLM Corp	12th Ave. West & Waterfront Duluth, MN 55802	Plant	Douglas.
Rockwell Lime Co	Route 2, Box 124 Manitowoc, WI 54220	do	Manitowoc.
Western Lime & Cement Co	141 North Main St., 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 processing 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	542 West Linberg Appleton, WI 54911	Processing plant	Outagamie.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel (construction):			
American Materials Corp	1 American Ave., 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.
Sand (industrial):			
Badger Mining Corp	Box 97 Fairwater, WI 53931	Pits and plants	Green Lake and Jackson.
Martin Marietta Aggregates, Industrial Sand Div.	Crossroads of Commerce Two Rolling Meadows, IL 60008	Pit and plant	Columbia.
Stone (1981):			
Granite:			
Anderson Bros. & Johnson Co	Box 26 Wausau, WI 54401	Quarries and plant	Marathon.
Ben Gottschalk Inc	Route 1 Mosinee, WI 54455	do	Do.
Lake Wausau Granite Co	Box 397 Wausau, WI 54401	Quarry and plant	Do.
Limestone and dolomite:			
Halquist Stone Co. Inc	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	Quarries and plant	Marathon.
Traprock (basalt):			
GAF Corp	Box 630 Pembine, WI 54156	Quarry and plant	Marinette.
TCI Traprock Inc	Box 176 Dresser, WI 54009	do	Polk.
Sulfur (recovered elemental):			
Murphy Oil Corp	Box 2066 Superior, WI 54880	Byproduct sulfur recovery plant.	Douglas.
Vermiculite (exfoliated):			
Koos Inc	4500 13th Ct. Kenosha, WI 51340	Processing plant	Kenosha.

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 1982 was $668.2 million, 13% less than in 1981, compared with a 1% increase in 1981 and a 29% increase in 1980. This lower total 1982 value reflected a decrease in output of all Wyoming's nonfuel mineral products. Sodium carbonate, constituting more than three-fourths of the State's nonfuel mineral value, fell about 7% in quantity and 10% in value. Bentonite clay, the second ranking nonfuel mineral, declined 34% in quantity and 27% in value, and the third ranking mineral, iron ore, decreased 32% in both quantity and value. These three commodities accounted for approximately 95% of the State's total nonfuel minerals output.

Wyoming ranked ninth among the 50 States in value of nonfuel mineral production, with about 3% of the national total. It ranked first in sodium carbonate output, producing 86% of the Nation's natural soda ash; first in bentonite, producing 71% of the national total; and fourth in iron ore. Altogether, 12 nonfuel minerals, 8 nonmetals, and 4 metals were produced.

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

Mineral	1981		1982	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ---- thousand short tons	3,855	$100,926	2,561	$73,696
Gem stones	NA	250	NA	250
Gypsum ---- thousand short tons	299	2,625	283	2,805
Sand and gravel (construction) ---- do	e3,680	e10,120	3,382	10,279
Stone (crushed) ---- do	3,224	9,858	p2,300	p7,300
Combined value of beryllium concentrate (1982), cement, iron ore, lead (1981), lime, silver (1981), sodium carbonate, and zinc (1981)	XX	644,279	XX	573,865
Total	XX	r768,058	XX	668,195

eEstimated. pPreliminary. rRevised. 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	1980	1981[2]	Minerals produced in 1981 in order of value
Albany	$14,391	$17,130	Cement, stone (crushed), clays, gypsum, lead, silver, zinc.
Big Horn	30,440	W	Clays, gypsum, lime.
Campbell	W	(3)	
Carbon	1,892	(3)	
Converse	W	(3)	
Crook	19,218	W	Clays, stone (crushed).
Fremont	W	W	Iron ore.
Goshen	W	W	Lime.
Johnson	W	W	Clays.
Laramie	W	W	Stone (crushed).
Lincoln	154	(3)	
Natrona	W	206	Clays.
Park	1,736	W	Gypsum.
Platte	W	W	Stone (crushed).
Sheridan	W	(3)	
Sublette	30	(3)	
Sweetwater	W	W	Sodium carbonate.
Teton	W	(3)	
Uinta	W	W	Clays.
Washakie	W	W	Clays, lime.
Weston	W	W	Clays.
Undistributed[4]	692,685	740,603	
Sand and gravel (construction)	XX	e10,120	
Total	760,546	[5]768,058	

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.

[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 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 Wyoming business activity

		1981	1982p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	250.0	253.0	+1.2
Unemployment	do	10.0	15.0	+50.0
Employment (nonagricultural):				
Mining[1]	do	38.5	37.7	-2.1
Manufacturing	do	9.9	9.2	-7.1
Contract construction	do	21.0	18.0	-14.3
Transportation and public utilities	do	18.3	17.8	-2.7
Wholesale and retail trade	do	50.3	49.2	-2.2
Finance, insurance, real estate	do	7.7	7.7	--
Services	do	33.3	33.4	+.3
Government	do	44.5	44.2	-.7
Total nonagricultural employment[1]	do	223.5	217.2	-2.8
Personal income:				
Total	millions	$5,771	$6,005	+4.0
Per capita		$11,733	$11,970	+2.0
Construction activity:				
Number of private and public residential units authorized		4,136	3,386	-18.1
Value of nonresidential construction	millions	$82.8	$66.3	-20.0
Value of State road contract awards	do	$58.6	$110.7	+88.9
Shipments of portland and masonry cement to and within the State	thousand short tons	506	405	-20.0
Nonfuel mineral production value:				
Total crude mineral value	millions	$768.1	$668.2	-13.0
Value per capita, resident population		$1,636	$1,331	-18.6
Value per square mile		$7,867	$6,824	-13.2

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.

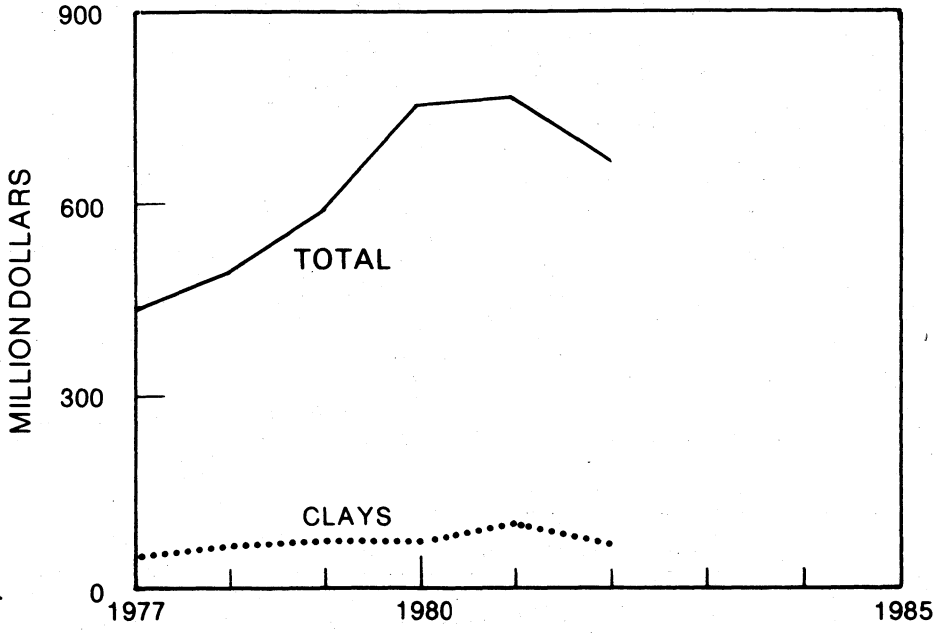

Figure 1.—Value of clays and total value of nonfuel mineral production in Wyoming.

The relative importance of nonfuel minerals to Wyoming's economy was evident in a per capita production value of $1,331, compared with the U.S. average of $85.

Nonfuel minerals were reported produced in 21 of Wyoming's 23 counties. All of these 21 counties had output of construction sand and gravel; 7 counties produced only construction sand and gravel. Bentonite, the second most widely distributed mineral among the counties, was produced in eight counties. Sweetwater County's unique endowment of trona (sodium carbonate) resources was the site of all five of the State's large trona mines and by far the leading county in nonfuel mineral production.

The total taxable valuation of the State in 1982 increased to about $8.1 billion. Of that amount, about 76% was mineral related; 72% was derived directly from mineral production, but less than 3% was related to nonfuel mineral production. Out of the total $388.2 million in severance taxes, nonfuel minerals were assessed approximately $9.1 million, and in ad valorem taxes, $13.6 million of the $368.3 million was assessed against all mineral products in the State. Mineral-production assessments, about $5.8 billion, were down about $100 million from the 1981 level.

The Wyoming Employment Security Commission reported the State's average labor force in 1982 was 253,000, and average number employed was 238,000. Total nonfarm employment in December 1982 was 210,700, down 6.2% from December 1981. Comparable employment in mining was 37,700, about 18% of the total, down 5.3% from that of 1981. Metal mining employed 2,900, down 17.1%, and the aggregate for bituminous coal, quarrying, and nonmetallic mining was 10,900, down 6.8%. Average number of hours employees worked in mining declined from 42.2 in 1981 to 38.6 in 1982, compared with 40.6 and 36.9, respectively, in manufacturing. Average weekly hours worked in metal mining increased during the year, from 40.5 to 41.9.

The average weekly wage for manufacturing in Wyoming ($299) was lower than the national average ($345); however, the average wage for mining in Wyoming ($471) was higher than the U.S. average ($464). Although the average weekly manufacturing wage increased about 4.5% nationally between December 1981 and December 1982, it declined 10% in Wyoming in the same period. In mining, the figures reverse, declining 0.5% nationally, but increasing 1% in Wyoming. The highest wages paid in Wyoming were in coal, quarrying, and nonmetallic mining, $669 per week, up 10%

from that of 1981. Metal mining paid an average $547 per week, up 8%.

Exploration Activities.—During 1982, exploration for precious metal deposits in Wyoming was at one of its highest peaks and centered on the State's greenstone belts. Timberline Minerals Inc. and Kerr-McGee Corp. Minerals Exploration Div. explored their properties in the Seminoe Mountains. Several companies sought precious and strategic metals in the Elmers Rock greenstone belt of the central Laramie Range. Individuals and small companies continued their limited underground and surface exploration in the South Pass area. Platinum and gold exploration in the Mullen Creek-Nash Fork shear zone extended into the Medicine Bow Mountains. The Lake Alice district near Cokeville was investigated for copper and silver and red-bed sandstones; other mineralized formations in the Overthrust Belt from Evanston on the south to Teton Pass on the north were given some attention. The Geological Survey of Wyoming actively explored for metallic occurrences throughout the State.

During 1982, exploration for industrial minerals also was reported in Wyoming. Several companies were testing for silica sand and limestone in southern and central Wyoming. Some exploration for tantalum and rare-earth elements took place in north-central and northeastern Wyoming. A few companies were active in zeolite exploration in southern and central Wyoming.

Legislation and Government Programs.—During its budget session February 9 to March 3, 1982, the Wyoming Legislature took no actions affecting nonfuel mining. Later in the year, however, the Joint Mines, Mineral, and Industry Committee of the legislature met to recodify Title 30, the State mining statutes; the committee prepared bills for consideration in the 1983 legislative session to update the language and remove repetitive sections and outdated laws. The revision would propose no new laws or substantive changes to existing laws.

Wyoming led all 50 States in receiving Federal royalties for minerals produced on public lands in the State; $167.8 million for fiscal year 1982.

The U.S. Senate approved legislation to increase the amount of designated wilderness in Wyoming by about 678,000 acres to a total of 2.87 million acres, about 31% of national forest lands in the State.

During the year, Geological Survey of Wyoming activities included an inventory of geologic hazards, landslides mapping, and investigations of diamondiferous kimberlites, Archean greenstone belts, tight gas sands, and tar sands. Work continued on an index to geologic mapping and a stratigraphic atlas. Publications included "Ore Deposits of Wyoming"; a report on "Selected Gold-Bearing Samples, Seminoe Mountains Greenstone Belt, Carbon County"; a geological reconnaissance report of "Metallic Deposits for In Situ and Heap Leaching Extraction Research Possibilities"; and a report titled "General Geologic Setting and Mineralization of the Porphyry Copper Deposits, Absaroka Volcanic Plateau, Wyoming."

The U.S. Supreme Court agreed to hear an appeal of a 1979 district court ruling that gravel is a mineral. The district court ruling, reversed by the U.S. 10th Circuit Court of Appeals, had been taken to the U.S. Supreme Court by the U.S. Department of the Interior. Central to the issue is the Stock-Raising Homestead Act of 1916 that reserved all mineral rights on lands transferred under the act to the Federal Government. In effect, the appellate court ruling revoked the Government's title to all gravel on the more than 70 million acres of land transferred under the act. The case initially involved land near Jeffrey City designated as grazing land in 1926; as much as 13% of Wyoming may be affected. The Governor of Wyoming, along with the Wyoming Stock Grower's Association, opposed the Federal Government's claim to ownership of gravel on those lands.

The Mining and Mineral Resources and Research Institute at the University of Wyoming in Laramie, which was created under title III of Public Law 95-87, received $150,000 in fiscal year 1982.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Production at Wyoming's only cement plant, Monolith Portland Cement Co., was down moderately in 1982 compared with that of 1981. About one-third of material sold and shipped from the plant, located just south of Laramie in Albany County, was from the preceding year's stocks. The major product of the wet-process plant was types I and II, general-purpose gray cement, used for such things as sidewalks and struc-

tures. Also produced was a small amount of oil well cement used in casing and capping oil wells. No masonry cement output was reported. More than 90% of output was sold to ready-mix companies; about 5% to concrete product manufacturers; and the remainder to other contractors, building material dealers, and miscellaneous customers. About 41% of output was shipped by rail to a terminal in the Denver, Colo., area, one of Monolith's major markets; 59% was shipped by truck directly to consumers. Most of the product was shipped in bulk; a relatively small amount was bagged. One characteristic of the Monolith plant is its self-sufficiency, producing its own gypsum, limestone, sandstone, shale, and water, as well as the finished product.

Rated at an annual capacity of 400,000 tons of cement, but more realistically capable of 325,000 tons, the plant was operated at a recession-induced level of 55% to 60%, with a full-time work force of 122. A $25 million expansion completed in 1982 included a $15 million kiln (the plant's only kiln), a $4.7 million finishing mill, a $3 million slurry grinding mill, a $2.3 million packhouse, and a $500,000 quality-control laboratory. Completing this plant expansion helped Monolith remain open and competitive in a very difficult market. In addition to the Denver market, Monolith served customers elsewhere in Colorado, Nebraska, and Wyoming.

Pozzolanic International, a Mercer Island, Wash., company, bought fly ash from such coal-burning powerplants as the Wyodak powerplant east of Gillette, which it resold for about $15.60 per ton. Fly ash is used in cement production to give a longer working time and more consistency. Although most was sold locally, some was shipped to Canada and northern California. Fly ash also was used in mud for oil drilling.

Clays.—Wyoming produced over 7% of the U.S. total clay value of output in 1982, second only to Georgia, which produced more than one-half of the total; the third ranking State produced less than one-half of Wyoming's value of output. In the production of high-swelling sodium bentonite clay, however, Wyoming again led the Nation with nearly 75% of total output. Clay was reported produced by 10 companies at 115 sites in 8 Wyoming counties. Common clay used in producing cement and brick was extracted at four sites by three companies in Albany, Big Horn, Crook, and Uinta Counties; this output was only a small portion of the total. Eight companies working at 113 sites produced bentonite in 6 counties—Big Horn, Crook, Johnson, Natrona, Washakie, and Weston. Big Horn and Crook Counties accounted for 70% of the total; Weston was the third ranking county in volume of output.

American Colloid Co., the largest clay producer, was followed, in declining order of output, by Wyo-Ben Inc.; Dresser Minerals, a division of Dresser Industries Inc.; Federal Bentonite, a division of Aurora Industries Inc.; NL Industries Inc., Baroid Div.; Kaycee Bentonite Corp.; International Minerals & Chemical Corp.; and Benton Clay Co. The three largest producers accounted for more than 50% of total output. Benton Clay and Kaycee Bentonite operated in the Powder River Basin. American Colloid, NL Industries' Baroid Div., Federal Bentonite, and International Minerals & Chemical operated in the Black Hills area, and American Colloid, Baroid, Dresser Minerals, Kaycee Bentonite, and Wyo-Ben in the Bighorn Basin.

Bentonite production, second only to sodium carbonate in value of nonfuel minerals produced in Wyoming, declined severely in 1982, 33% in quantity and 27% in value, because of the fall in oil and gas drilling and the depression in steel mills and foundries. Drilling footage declined by 31% in 1982 but improved in the last 3 months of the year. Iron ore pelletizing plants restricted output or temporarily shut down, and traditional foundry use fell as automobile production was being restructured in a depressed market. Oil industry demand held up better than taconite pelletizing demand, providing about 40% of bentonite demand, whereas use as a pelletizer was about 10% of the total demand. Use in foundry sand, once the "bread and butter" of the bentonite industry, was about 10% of the total; animal feed, about 2%; and others of bentonite's 150 uses, the remainder. Foreign sales accounted for about 20% of the market for Wyoming bentonite products.

Changes in bentonite markets were characterized by a buyer's market, price discounting, and a demand for high quality, which restricted producers' ability to blend higher and lower grade bentonites. Average price was about $29 per ton, but ranged up to about $150 per ton for specialty grades.

Greater competition between trucks and railroads to transport bentonite benefited the industry. The Burlington Northern Railroad (BN) reduced its freight rates for bentonite, in one instance from $61 to $50 per ton, or 18%. Nevertheless, BN's share of the bentonite-hauling market dropped (from 36% in 1977 to 29% in 1980), and the railroad cut back employment serving the industry by about 17 people in June.

Employment in the bentonite industry fell from about 1,200 to under 900. In July, Baroid closed its new $20 million bentonite processing facility at Lovell, which it had opened in July 1981, laid off about 50 people, and consolidated its production operations at its Colony plant in Crook County. American Colloid laid off 12 workers at its Lovell plant in June. Wyo-Ben trimmed its bentonite operations in Greybul, Lovell, and Thermopolis and went to a 32-hour week in April. Dresser Minerals operated its large Greybull plant at 40% to 50% of the 1981 level, reducing employment from about 180 to about 90 people. The plant was closed for the winter in October, contrasted with the previous 3 years when the company had mined through the winter to meet demand. In July, employment at American Colloid's Lovell operation dropped from a peak of 120 plant and 28 field workers to about 40 plant and 10 field workers. Wyo-Ben laid off 33, mostly from its Lucerne plant near Thermopolis. The nearly 300 jobs lost did not include those cut back by mining and trucking contractors and by BN, which served the bentonite industry.

During 1981, the U.S. Bureau of Land Management (BLM) opened to public claim the bentonite deposits on 2,300 acres north of Cowley. In 1982, several companies and individuals who participated in this "land rush" turned to the courts to resolve valid claims to the land.

A 2-year controversy over appropriate environmental controls on bentonite mining continued throughout 1982. The eight-company-member bentonite association argued that because of the intermittent mining of small pits for obtaining different grades of bentonite, companies should not be required to reclaim pits each time they ceased mining them. Conservationists, the Wyoming Department of Environmental Quality, and some landowners wanted to limit the time bentonite pits could be left open before reclamation had to be undertaken.

Bentonite deposits, which in Wyoming are the result of volcanic ash alteration, are extracted only by surface mining methods because of the higher costs of underground mining. No underground mining of the clay has been reported. The material is loaded into trucks at the mining site, transported to a mill, segregated according to physical characteristics, blended to obtain the desired product characteristics, screened, and dryed. Drying removes about 25% of the moisture in the bentonite; the product is then pulverized into a variety of size ranges, mixed with additives, and packaged or bulk shipped to the consumer.

Gem Stones.—Wyoming gem stones consisted almost entirely of jade, actually Wyoming nephrite, the official State stone. Jade is found in several Wyoming counties, but most notably in the Granite Mountain area of southern Fremont and southwestern Natrona Counties.

Analysis continued on Wyoming's approximately 50 known kimberlite outcroppings; several are known to contain both industrial and gem diamonds. Two companies, Cominco American Inc. and Superior Minerals Co., continued examining the commercial possibilities of the diamonds found at several sites in the State. The Geological Survey of Wyoming and University of Wyoming Geology Department shared a National Aeronautics and Space Administration grant to develop and test techniques for rapidly detecting and analyzing kimberlite-containing diamonds. Techniques to be tested include infrared aerial photography and ultraviolet film to detect differences in soil types and vegetation, followed by field testing.

Gypsum.—Production of gypsum fell about 5% from the 1981 level. Crude gypsum was produced by the Wyoming Construction Co. in Albany County; Georgia-Pacific Corp., Gypsum Div., Big Horn County; The Celotex Corp., a division of Jim Walters Corp., Park County; and the Pat O'Hara Co., Park County. About 44 people were employed in these operations. Celotex, the largest producer, was followed by Georgia-Pacific. Calcined gypsum was produced by Celotex near Cody and by Georgia-Pacific near Lovell. Output reflected the nationwide slump in building materials demand, particularly wallboard.

Lime.—Output of lime declined about 27% from the 1981 level. Two companies reported production in 1982—The Great-

Western Sugar Co. in Big Horn County and the Holly Sugar Corp. in Goshen and Washakie Counties. Holly Sugar was by far the larger producer. Quicklime was used in the refining of sugar beets.

Phosphate Rock.—No phosphate rock was reported mined in Wyoming in 1982. Stauffer Chemical Co., however, continued operating its Leefe phosphate beneficiating plant west of Kemmerer in Lincoln County, using phosphate rock mined in Idaho.

J. R. Simplot Co.'s plans to open a new phosphate mine at Smoky Canyon just across the Idaho border from Afton, Wyo., would affect Afton and the surrounding Star Valley.

Chevron Chemical Co. announced plans to build a 2,000-ton-per-day fertilizer plant southeast of Rock Springs, bringing phosphate from Vernal, Utah, via an 84-mile pipeline and sulfur from Chevron's natural gas processing plant near Evanston, Wyo. Because of market conditions, Chevron postponed these plans at yearend.

Sand and Gravel.—As a result of the new canvassing procedures implemented by the U.S. Bureau of Mines in 1980, an annual survey of construction sand and gravel producers was not conducted for 1981. Based on partial production information for 1981, collected with the 1982 survey, final estimates of construction sand and gravel production in 1981 were generated and are given in table 1.

Production of construction sand and gravel in Wyoming in 1982 fell about 8% from the 1981 level. Output was by 39 companies operating at 48 sites in 21 of Wyoming's 23 counties. The largest production was in Natrona County, followed in order by Uinta, Fremont, and Laramie Counties. These four counties produced more than one-half of the State's total output of construction sand and gravel. About one-third of the total was by one-fifth of the companies from pits producing 100,000 to 200,000 tons per year; one-third of the companies produced from pits of 25,000-ton-per-year output, but contributed just 4% of total output. About 80% of the total was gravel, 11% was sand, and the balance unprocessed sand and gravel. About 40% was used in road base and coverings; 31% as concrete aggregate; 14% as asphaltic concrete aggregate; 9% as fill; and the remainder as plaster and gunite sand, concrete products, railroad ballast, and other uses. Almost all output was moved to point of consumption by truck. Average price was about $3.04 per ton.

The largest producer was Rocky Mountain Energy Co., which had two operations in Uinta County, followed in descending order by Gilpatrick Construction Co. Inc., one operation in Fremont County; Casper Concrete Co., one operation in Natrona County; Peter Kiewit & Sons Co., four pits in Campbell, Carbon, Laramie, and Sweetwater Counties; Teton Construction Co., one pit in Laramie County; and Summit Materials Inc., one pit in Crook County. These six largest producers accounted for about one-half of total output. More than 600 people were employed in sand and gravel mining.

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

Use	1981			1982		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	NA	NA	NA	367	$1,462	$3.99
Gravel	NA	NA	NA	2,700	8,031	2.97
Sand and gravel (unprocessed)	NA	NA	NA	315	786	2.49
Total or average	[e]3,680	[e]$10,120	[e]$2.75	3,382	10,279	3.04

[e]Estimated. NA Not available.

Table 5.—Wyoming: Construction sand and gravel sold or used in 1982, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,054	$4,090	$3.88
Plaster and gunite sands	21	118	5.50
Concrete products	W	W	3.61
Asphaltic concrete	459	1,482	3.23
Road base and coverings	1,365	3,233	2.37
Fill	310	757	2.44
Railroad ballast	W	W	2.21
Other	173	598	3.47
Total or average	3,382	[1]10,279	3.04

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Data do not add to total shown because of independent rounding.

Sodium Carbonate.—The Wyoming trona resource, from which sodium carbonate or soda ash is processed, is the largest such commercial deposit in the world. Estimated to contain from 67 billion to as much as 134 billion tons of trona, the deposit underlies approximately 1,300 square miles in southwestern Wyoming. The trona occurs in 42 beds; 24 are thicker than 5 feet, and 18 are thicker than 10 feet. It is Wyoming's most important nonfuel mineral product, constituting approximately 80% of the total value of the State's nonfuel mineral production. More than 85% of the Nation's natural soda ash was produced in Wyoming in 1982, and U.S. production of this commodity was nearly 90% of the world's supply. According to the U.S. Minerals Management Service and the Wyoming State Inspector of Mines, about 10.9 million tons of trona was produced in Wyoming in 1982, a decrease of 12.8% from that of 1981. Soda ash sales fell about 8.8%, to about 6 million tons. Of the amount produced, about 3.8 million tons of trona containing 2.2 million tons of soda ash were mined from leased Federal lands.

Production was by five companies, all within about 15 miles of each other near Green River in Sweetwater County. These companies and their approximate 1982 soda ash production, calculated at the average 75% of capacity operated during 1982, were FMC Corp., 2.1 million tons; Allied Chemical Corp., 1.6 million tons; Stauffer Chemical Co. of Wyoming, 1.4 million tons; Texasgulf Inc., 700,000 tons; and Tenneco Minerals, 300,000 tons. These mines and processing plants were operated at the lowest production level in recent years, representing a year of retrenchment and employee layoffs. Nevertheless, the industry was relatively stable compared with most other mineral producers in the State.

The level of stockpiles increased substantially during the year. About 350 miners, refinery workers, and salaried personnel were laid off during the year, leaving total employment in the industry at yearend at about 3,700. Soda ash markets were very tight; keen competition was based on product quality and deteriorating prices, both impinging on profit. The price of natural soda ash from Wyoming declined from $92 to $90 per ton in June, further reduced to $86 per ton in October, and to $84 per ton by yearend. By contrast, natural soda ash from California declined during the year from $109 per ton to $107 per ton; the price of synthetic soda ash produced at Syracuse, N.Y., remained steady at about $132 per ton. Transportation costs were critical for landlocked Wyoming producers.

Normally, glass products manufacture accounted for about 55% of soda ash use; however, recession in housing construction and the automobile industry and the increased use of plastics has reduced the demand for window glass and glass containers. In 1982, an estimated 49% was used in glass products, 15% in phosphates and detergents, 12% in chemicals, 10% in miscellaneous domestic uses, and about 14% was exported. Protective measures taken by the European Economic Community and a strong dollar somewhat limited the future of export markets for Wyoming soda ash. Prospects, however, were brightened by the Japanese Fair Trade Commission review of the exhorbitant unloading fees charged Wyoming soda ash at Japanese docks.

In May, BLM released a Sodium Mineral Development Environmental Assessment, setting up guidelines for leasing and prospecting on a 1-million-acre section of Sweetwater and Uinta Counties. Although 12 tracts were considered for lease, several years may transpire before leases are granted, depending on market conditions. Forty-two existing sodium leases were on Federal lands. BLM was expected to try to exchange leases held by Rocky Mountain Energy, a subsidiary of Union Pacific Corp., in the Flaming Gorge area south of Green River for leases elsewhere in the trona region.

In June, Allied Chemical began a multimillion dollar research project 20 miles south of Green River to determine whether solution mining of trona is commercially feasible. Allied thus joined FMC and Vulcan Minerals Co., whose solution mining projects produced a trona solution during the summer. The three companies estimated it would be 3 to 5 years before they would know the practicality of solution mining for trona. If, as FMC projects, mining costs are 25% less using solution mining, the competitive position of Wyoming trona will become even stronger.

With about 1,320 employees in 1982, FMC operated the world's largest trona mine, comprising 1,000 miles of underground workings. Because of the slump in soda ash demand, 32 employees were laid off in March. These workers were not reemployed in summer vacation replacement as expected; in fact, mine workers voted a 1-week vacation shutdown in July to avoid additional layoffs. Continuing poor markets, however, led to an additional layoff of 38 employees September 1.

Allied Chemical laid off 61 workers in April and 75 in December, reducing its normal employment level from about 1,200 to nearly 1,000. Plant improvements during the year included completion of a 22,000-square-foot office building. Allied produced a dense soda ash for the export market, accounting for about 25% of its output.

Employing about 680 people, Stauffer Chemical was the only one of the four older trona-soda ash facilities in the Green River area able to avoid layoffs during the year.

Texasgulf had planned to begin construction in October on a project to double its refined soda ash capacity to 2 million tons per year. The company canceled those plans in August and asked the Wyoming Industrial Siting Administration to terminate a permit issued for the work. In August, the company laid off 40 people and 53 more in December, reducing employment at the facility from a peak of over 500 to about 400. During the year, Texasgulf installed a short-wall mining system that it had been working on since 1979. The system, utilizing Jeffery HR Helimineers with 10 1/2-foot cutting heads, was the first to incorporate a shield-supported short-wall system in trona mining.

Despite unfavorable market conditions, Tenneco completed its new trona mine and soda ash processing facility just west of Green River south of the existing mines. Termed the most modern plant of its kind in the world, the 1-million-ton facility was the fifth trona-soda ash mine and processing plant in the area. The official opening was June 2, although soda ash production began in May. The $200 to $300 million facility initially employed 285 people. Brown and Root Inc. built the $65 million processing plant, which included about $30 million in environmental protection equipment. A 20-foot-diameter, double-compartment, 1,640-foot-deep shaft was sunk to the 24-foot-thick trona bed at about 1,500 feet; about 5 miles of underground workings with 8- by 10-foot entries were completed using Marietta continuous miners. Coal was the energy source used in processing the trona ore to soda ash.

Stone.—To reduce reporting burdens and costs, the U.S. Bureau of Mines implemented new canvassing procedures for its surveys of stone producers in 1981. The surveys will be conducted for odd-numbered years only, and only preliminary estimates for crushed and dimension stone production will be published for even-numbered years. The preliminary estimates will be revised and completed the following year.

In May, United States Steel Corp. announced plans to diversify the Atlantic City Mine by crushing and separating non-ore-bearing rock for sale as aggregate to railroads and construction companies. A contract was made with the Union Pacific Railroad for 300,000 tons of crushed rock to be used as railroad ballast.

Sulfur.—Sulfur was produced as a by-product of natural gas processing and petroleum refining in six counties: Carbon, Fremont, Laramie, Park, Sweetwater, and Uinta. Companies involved included Sinclair Oil Corp., Amoco Production Co., Husky Oil Co., and Colorado Interstate Gas Co. This was the first year that sulfur

production in Uinta County was reported. Processing of natural gas from the Overthrust Belt began in September at the large Amoco processing facility near Evanston. Built at a cost of about $310 million, it was rated to process 270 million cubic feet of gas daily from which 1,340 tons of liquid sulfur could be extracted. Chevron USA Inc. continued developing a similar facility just 8 miles away.

South of Rock Springs, Chevron proceeded with plans to build a fertilizer plant, which would use phosphate from Vernal, Utah, and the 1,000 tons of liquid sulfur to be produced daily at its 150-million-cubic-foot-per-day gas processing plant. The plant was to have an annual production capacity of more than 500,000 tons of phosphate fertilizer and employ 350 people. In November, Chevron announced a 2-year postponement of plans because of a downturn in the phosphate fertilizer market.

METALS

Gold.—Although no gold production was reported in the State in 1982, interest in gold was high. In January, the Geological Survey of Wyoming announced it had collected samples the preceding summer from a quartz vein containing 2.9 ounces of gold per ton and from a banded iron formation that contained 1.1 to 1.4 ounces of gold per ton. The Geological Survey of Wyoming later announced the location of its discovery as centering on the old Penn Mines about 30 miles north of Rawlins in the Seminoe Mountains, Carbon County; Timberline Minerals bought or leased 1,800 acres in the area. Reportedly, Timberline controlled 35,000 acres in the area, and other mineral companies staked claims around the Timberline group.

Other areas of interest included Park and Teton Counties and the South Pass area in Fremont and Sweetwater Counties. Gold miners in the Atlantic City-South Pass region moved to form a mining district in the area.

Iron Ore.—United States Steel's Atlantic City Mine was the only producing iron ore mine in Wyoming; Wyoming's other iron ore mine, CF&I Steel Corp.'s Sunrise Mine near Guernsey, was closed in 1980. Located in Fremont County at the southeastern end of the Wind River Mountains near South Pass and Lander, the Atlantic City Mine produced about 1.2 million tons of ore in 1982, according to the annual report of the Wyoming State Inspector of Mines. Output decreased nearly one-third from that of 1981.

The Atlantic City Mine functions as a "captive mine." Its taconite ore was beneficiated, pelletized, and shipped by railroad to United States Steel's Geneva Works near Provo, Utah, 355 miles to the southwest, where it was processed into iron and steel. Because of the recession and import-induced decline in demand for steel, the Geneva Works operated at about 50% of capacity in 1982; about 1,700 of its 4,900 workers were idled. To reduce iron ore inventories at the plant, the company announced in May that Atlantic City's normal 2-week shutdown for maintenance would be extended to 6 weeks, June 6 to July 18. The mine actually remained closed 11 weeks, until August 24. At that time, the mine was to be worked 6 weeks and closed again at the end of September; however, the mine closed again on September 21, 1 week earlier than planned because of a national railroad engineers strike. The mine reopened October 26, recalling all 490 wage employees and 90 salaried workers, and remained open through the end of the year.

Although ranked fourth among iron ore producing States, Wyoming produced an insignificant portion of the Nation's iron ore. At 8,300 feet above sea level, Atlantic City is the highest taconite mining and processing operation in the Western Hemisphere.

Lead, Silver, and Zinc.—Williams Strategic Metals, a wholly owned subsidiary of Williams Resources of Dallas, purchased Nedlog Technology Group Inc. from T. P. Clark in January. The firm's plant at Laramie recovered lead, silver, and zinc from smelter flue dust and dross obtained from various sources outside the State. Williams planned to continue operating the plant as a pilot and test facility.

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[1]State Liaison Officer, Bureau of Mines, Denver, Colo.
[2]State geologist and Executive Director, Geological Survey of Wyoming, Laramie, Wyo.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Monolith Portland Cement Co.[1]	Box 40 Laramie, WY 82070	Plant	Albany.
Clays:			
American Colloid Co	Box 818 Belle Fourche, SD 57717	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.	1002 Greenfield Rd. Montgomery, IL 60538	do	Crook and Weston.
International Minerals & Chemical Corp.	5401 Old Orchard Rd. Skokie, IL 60076	do	Crook.
Kaycee Bentonite Corp	Box 9 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	do	Goshen and Washakie.
Sand and gravel:			
Boatright Smith	Box 1129 Casper, WY 82602	Pit and plant	Natrona.
Casper Concrete Co	Box 561 Casper, WY 82601	do	Do.
Gilpatrick Construction Co. Inc	Box 973 Riverton, WY 82501	do	Fremont.
Peter Kiewit & Sons Co	Box 1009 Sheridan, WY 82801	Pits and plants	Campbell, Carbon, Laramie, Sweetwater.
Rawlins Sand & Gravel Co	2510 East Daley St., Box 1360 Rawlins, WY 82301	Pit and plant	Carbon.
Reeves Inc	Box 610 Buffalo, WY 82834	do	Johnson.
Rocky Mountain Energy Co	1001 Center St., Suite 36 Evanston, WY 82930	do	Uinta.
Summit Materials Inc	Box 129 Sundance, WY 82729	do	Crook.
Teton Construction Co	Box 3243 Cheyenne, WY 82003	Pit	Laramie.
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	Box 1167 Green River, WY 82935	do	Do.
Texasgulf Inc	Box 100 Granger, WY 82934	do	Do.

[1]Also clays.
[2]Also stone.