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Minerals Yearbook

1985

Volume II

AREA REPORTS: DOMESTIC

Prepared by staff of the

BUREAU OF MINES

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

BUREAU OF MINES • Robert C. Horton, Director

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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Foreword

This edition of the Minerals Yearbook discusses the performance of the worldwide minerals industry during 1985 and provides background information to assist in interpreting developments during the year being reviewed. Content of the individual volumes follows:

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

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

Volume III, Area Reports: International, contains the latest available mineral data on more than 150 foreign countries and discusses the importance of minerals to the economies of these nations. A separate chapter reviews the international minerals industry in general and its relationship to the world economy.

The Bureau of Mines continually strives to improve the value of its publications to 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 Mineral Officers of the Bureau of Mines, located throughout the country. Preparation of the chapters was coordinated by the Division of State Activities, Assistant Directorate, Mineral Data Analysis, which also prepared the table of economic indicators.

The Statistical Summary chapter and the tabular material covering total State mineral production and mineral production by county, were prepared in the Assistant Directorate, 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 Mines and Mineral Resources.
Arkansas: Arkansas Geological Commission.
California: California Department of Conservation, Division of Mines and Geology.
Colorado: Colorado Geological Survey.
Connecticut: State Geological and Natural History Survey of Connecticut, Department of Environmental Protection.
Delaware: Delaware Geological Survey.
Florida: Florida Bureau of Geology.
Georgia: Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources.
Hawaii: Department of Land and Natural Resources.
Idaho: Idaho Geological Survey, University of Idaho.
Illinois: State Geological Survey Division, Illinois Department of Energy and Natural Resources.
Indiana: Geological Survey, Indiana Department of Natural Resources.
Iowa: Iowa Geological Survey.
Kansas: Kansas Geological Survey.
Kentucky: Kentucky Geological Survey.
Louisiana: Louisiana Geological Survey.
Maine: Maine Geological Survey.
Maryland: Maryland Geological Survey.
Massachusetts: Massachusetts Department of Environmental Quality, Office of the State Geologist.
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: Missouri Department of Natural Resources, Division of Geology and Land Survey.
Montana: Montana Bureau of Mines and Geology.
Nebraska: Conservation and Survey Division of the University of Nebraska (Nebraska Geological Survey).
Nevada: Nevada Bureau of Mines and Geology.
New Hampshire: New Hampshire Department of Resources and Economic Development.
New Jersey: Geological Survey, Division of Water Resources, New Jersey Department of Environmental Protection.
New Mexico: New Mexico Bureau of Mines and Mineral Resources.
New York: New York State Education Department, New York 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: 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, Commonwealth of Puerto Rico.
Rhode Island: Department of Environmental Management.
South Carolina: South Carolina Geological Survey, State Division of Research and Statistical Services.
South Dakota: South Dakota Geological Survey.
Tennessee: Tennessee Division of Geology.
Texas: Bureau of Economic Geology, The University of Texas at Austin.
Utah: Utah Geological and Mineral Survey.
Vermont: Office of the State Geologist, Agency of Environmental Conservation.
Virginia: Virginia Division of Mineral Resources.
Washington: Washington Division of Geology and Earth Resources.
West Virginia: West Virginia Geological and Economic Survey.
Wisconsin: Wisconsin Geological and Natural History Survey.
Wyoming: Geological Survey of Wyoming.

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

Contents

Statistical Summary

By Sarah P. Guerrino[1]

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

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

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

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

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[1]Mineral data specialist, Division of Ferrous Metals. The author was assisted in preparation of this chapter by Barbara M. Carrico, mineral data specialist, Division of Nonferrous Metals; Barbara E. Gunn, mineral data assistant, Division of Industrial Minerals; Wanda West, program assistant, Division of State Activities; and William L. Zajac, mineral data specialist, Division of International Minerals.

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

Mineral	1983		1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS						
Antimony ore and concentrate short tons, antimony content	838	W	557	W	W	W
Bauxite thousand metric tons, dried equivalent	679	$11,309	856	$15,643	674	$12,855
Copper (recoverable content of ores, etc.) metric tons	1,038,098	1,751,476	r1,102,613	r1,625,116	1,105,758	1,632,483
Gold (recoverable content of ores, etc.) troy ounces	r2,002,526	r849,071	r2,084,615	r751,833	2,475,436	786,345
Iron ore, usable (excluding byproduct iron sinter) thousand long tons, gross weight	44,295	1,938,496	W	W	W	W
Iron oxide pigments, crude short tons	41,875	2,427	53,017	2,819	46,585	2,826
Lead (recoverable content of ores, etc.) metric tons	r449,295	r214,745	r322,677	r181,745	413,955	174,008
Manganiferous ore (5% to 35% Mn) short tons, gross weight	33,523	216	88,423	860	19,882	W
Mercury 76-pound flasks	25,070	W	19,048	W	16,530	W
Molybdenum (content of ore and concentrate) thousand pounds	48,805	166,612	102,405	326,780	111,936	347,812
Nickel (content of ore and concentrate) short tons	--	--	14,540	W	6,127	W
Silver (recoverable content of ores, etc.) thousand troy ounces	r43,431	r496,850	r44,592	r363,006	39,357	241,740
Tungsten ore and concentrate metric tons, contained W	1,016	10,528	1,173	13,409	983	9,143
Vanadium (recoverable in ore and concentrate) short tons	2,171	30,675	1,617	24,551	W	W
Zinc (recoverable content of ores, etc.) metric tons	275,294	251,204	252,768	270,833	226,545	201,607
Combined value of beryllium concentrates, magnesium chloride for magnesium metal, rare-earth metal concentrate, tin, titanium concentrate (ilmenite and rutile), zircon concentrate, and values indicated by symbol W	XX	133,220	XX	2,427,624	XX	2,212,104
Total	XX	r5,857,000	XX	r6,004,000	XX	5,621,000
INDUSTRIAL MINERALS (EXCEPT FUELS)						
Abrasive stones[2] short tons	1,101	482	1,290	602	1,157	515
Asbestos metric tons	69,906	27,866	57,422	24,238	57,457	20,485
Barite thousand short tons	754	29,203	775	25,445	739	21,501
Boron minerals do.	1,303	439,181	1,367	456,687	1,269	404,775
Bromine[e] thousand pounds	370,000	91,000	385,000	95,000	320,000	80,000
Calcium chloride short tons	W	W	e838,000	e93,000	W	W
Cement:						
Masonry thousand short tons	2,921	186,240	3,281	219,877	3,187	213,096
Portland do.	67,183	3,315,690	74,376	3,810,446	74,250	3,817,335
Clays do.	40,858	931,091	r43,702	r1,032,127	44,974	1,011,377
Diatomite do.	619	114,279	627	120,926	635	127,030
Feldspar short tons	710,000	22,500	710,000	23,500	700,000	22,800
Fluorspar do.	e61,000	e10,000	e72,000	W	66,000	W
Garnet (abrasive) do.	29,767	2,533	29,647	e2,487	36,727	2,973
Gem stones[e]	NA	7,425	NA	7,450	NA	7,425
Gypsum thousand short tons	12,884	101,361	14,319	113,671	14,726	114,229
Helium (Grade-A) million cubic feet	31,299	345,465	r1,642	r61,575	1,865	69,938
Lime thousand short tons	14,867	757,611	15,922	811,183	15,690	809,000
Magnesium compounds short tons	618,227	182,495	W	W	W	W
Mica (scrap) thousand short tons	140	6,479	161	7,139	138	6,330
Peat do.	725	18,667	814	19,907	882	21,892
Perlite short tons	474,000	15,664	498,000	16,638	507,000	17,160
Phosphate rock thousand metric tons	42,573	1,021,095	49,197	1,182,244	50,835	1,203,265
Potassium salts (K_2O equivalent) do.	1,513	220,800	1,639	241,800	1,266	178,400

See footnotes at end of table.

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

Mineral	1983		1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
INDUSTRIAL MINERALS (EXCEPT FUELS) —Continued						
Pumice thousand short tons	449	$4,486	502	$4,929	508	$4,553
Salt do	34,573	597,081	39,225	675,099	39,484	741,799
Sand and gravel:						
Construction do	e655,100	e1,935,000	773,900	2,244,000	e800,100	e2,438,000
Industrial do	26,620	335,200	29,380	377,200	29,430	374,070
Sodium sulfate (natural) do	423	39,425	435	40,125	389	35,860
Stone:[4]						
Crushed do	861,600	3,327,000	e956,000	e3,755,600	1,000,800	4,053,000
Dimension do	1,090	147,843	e1,157	e154,949	1,121	171,667
Sulfur, Frasch process thousand metric tons	4,111	414,210	5,001	546,106	4,678	573,570
Talc and pyrophyllite thousand short tons	1,066	20,280	r1,127	r23,167	1,269	29,188
Tripoli short tons	111,020	649	124,482	699	W	W
Vermiculite thousand short tons	282	27,170	315	31,500	314	32,400
Combined value of aplite, asphalt (native), emery, graphite (1983-84), helium (crude), iodine, kyanite, lithium minerals, magnesite, marl (greensand), olivine, pyrites, sodium carbonate (natural), staurolite, wollastonite, and values indicated by symbol W	XX	867,486	XX	r937,900	XX	1,007,903
Total	XX	15,263,000	XX	r17,157,000	XX	17,612,000
Grand total	XX	r21,120,000	XX	r23,161,000	XX	23,232,000

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

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

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

[3]Excludes output in New Mexico; withheld to avoid disclosing company proprietary data; included with industrial minerals "Combined value" figure for 1983.

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

Table 2.—Nonfuel minerals produced in the United States and principal producing States in 1985

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

Table 3.—Value of nonfuel mineral production in the United States and principal nonfuel minerals produced in 1985

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
Alabama	$405,915	20	1.75	Cement, stone (crushed), lime, sand and gravel (construction).
Alaska	89,969	42	.39	Sand and gravel (construction), gold, stone (crushed), tin.
Arizona	1,550,085	4	6.68	Copper, sand and gravel (construction), cement, molybdenum.
Arkansas	256,697	29	1.11	Bromine, cement, stone (crushed), sand and gravel (construction).
California	2,094,796	1	9.02	Cement, sand and gravel (construction), boron minerals, stone (crushed).
Colorado	408,178	19	1.76	Molybdenum, cement, sand and gravel (construction), stone (crushed).
Connecticut	72,386	43	.31	Stone (crushed), sand and gravel (construction), feldspar, sand and gravel (industrial).
Delaware	[1]4,029	50	.02	Magnesium compounds, sand and gravel (construction), marl.
Florida	1,559,266	3	6.71	Phosphate rock, stone (crushed), cement, sand and gravel (construction).
Georgia	946,075	7	4.07	Clays, stone (crushed), cement, stone (dimension).
Hawaii	53,272	44	.23	Stone (crushed), cement, sand and gravel (construction), lime.
Idaho	348,154	22	1.50	Silver, phosphate rock, molybdenum, lead.
Illinois	459,920	17	1.98	Stone (crushed), cement, sand and gravel (construction), sand and gravel (industrial).
Indiana	302,954	25	1.30	Cement, stone (crushed), sand and gravel (construction), lime.
Iowa	228,017	32	.98	Stone (crushed), cement, sand and gravel (construction), gypsum.
Kansas	322,170	23	1.39	Cement, salt, stone (crushed), helium (Grade-A).
Kentucky	267,558	27	1.15	Stone (crushed), lime, cement, sand and gravel (construction).
Louisiana	522,268	15	2.25	Sulfur (Frasch), salt, sand and gravel (construction), cement.
Maine	41,108	46	.18	Sand and gravel (construction), cement, stone (crushed), garnet.
Maryland	258,274	28	1.11	Stone (crushed), cement, sand and gravel (construction), clays.
Massachusetts	117,205	38	.50	Sand and gravel (construction), stone (crushed), stone (dimension), lime.
Michigan	1,347,853	6	5.80	Iron ore, cement, magnesium compounds, stone (crushed).
Minnesota	1,547,958	5	6.66	Iron ore, sand and gravel (construction), stone (crushed), sand and gravel (industrial).
Mississippi	102,793	40	.44	Sand and gravel (construction), clays, cement, stone (crushed).
Missouri	734,960	9	3.16	Cement, stone (crushed), lead, lime.
Montana	200,272	34	.86	Gold, sand and gravel (construction), silver, copper.
Nebraska	99,970	41	.43	Cement, sand and gravel (construction), stone (crushed), clays.
Nevada	630,883	12	2.72	Gold, diatomite, cement, silver.
New Hampshire	32,900	47	.14	Sand and gravel (construction), stone (dimension), stone (crushed), clays.
New Jersey	177,576	35	.76	Stone (crushed), sand and gravel (construction), sand and gravel (industrial), zinc.
New Mexico	656,889	11	2.83	Copper, potassium salts, molybdenum, cement.
New York	657,308	10	2.83	Stone (crushed), cement, salt, sand and gravel (construction).
North Carolina	432,756	18	1.86	Stone (crushed), phosphate rock, lithium compounds, sand and gravel (construction).
North Dakota	24,184	48	.10	Sand and gravel (construction), lime, salt, clays.
Ohio	607,127	13	2.61	Salt, stone (crushed), sand and gravel (construction), cement.
Oklahoma	251,607	30	1.08	Stone (crushed), cement, sand and gravel (construction), sand and gravel (industrial).
Oregon	130,296	36	.56	Stone (crushed), sand and gravel (construction), cement, lime.
Pennsylvania	804,474	8	3.46	Stone (crushed), cement, lime, sand and gravel (construction).
Rhode Island	12,192	49	.05	Stone (crushed), sand and gravel (construction), sand and gravel (industrial).
South Carolina	275,929	26	1.19	Cement, stone (crushed), clays, sand and gravel (industrial).
South Dakota	207,339	33	.89	Gold, cement, stone (dimension), sand and gravel (construction).
Tennessee	472,287	16	2.03	Stone (crushed), zinc, cement, pyrites.
Texas	1,733,359	2	7.46	Cement, sulfur (Frasch), stone (crushed), sand and gravel (construction).
Utah	312,359	24	1.34	Cement, copper, gold, sand and gravel (construction).
Vermont	49,854	45	.21	Stone (dimension), stone (crushed), sand and gravel (construction), talc.
Virginia	381,276	21	1.64	Stone (crushed), cement, sand and gravel (construction), lime.
Washington	243,670	31	1.05	Cement, sand and gravel (construction), gold, stone (crushed).

See footnotes at end of table.

Table 3.—Value of nonfuel mineral production in the United States and principal nonfuel minerals produced in 1985 —Continued

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
West Virginia	$105,409	39	0.45	Stone (crushed), cement, sand and gravel (industrial), salt.
Wisconsin	125,110	37	.54	Stone (crushed), sand and gravel (construction), lime, sand and gravel (industrial).
Wyoming	552,463	14	2.38	Sodium carbonate, clays, cement (portland), sand and gravel (construction).
Total	23,232,000	XX	100.00	

XX Not applicable.
[1]Incomplete total.

Table 4.—Value of nonfuel mineral production per capita and per square mile in 1985, by State

State	Area (square miles)	Population (thousands)	Value of mineral production				
			Total (thousands)	Per square mile		Per capita	
				Dollars	Rank	Dollars	Rank
Alabama	51,705	4,021	$405,915	7,851	24	101	20
Alaska	591,004	521	89,969	152	50	173	10
Arizona	114,000	3,187	1,550,085	13,597	11	486	3
Arkansas	53,187	2,359	256,697	4,826	31	109	18
California	158,706	26,365	2,094,796	13,199	13	79	24
Colorado	104,091	3,231	408,178	3,921	35	126	16
Connecticut	5,018	3,174	72,386	14,425	9	23	47
Delaware	2,044	622	[1]4,029	1,971	44	6	50
Florida	58,664	11,366	1,559,266	26,580	1	137	14
Georgia	58,910	5,976	946,075	16,060	7	158	11
Hawaii	6,471	1,054	53,272	8,232	21	51	37
Idaho	83,564	1,005	348,154	4,166	33	346	6
Illinois	56,345	11,535	459,920	8,163	23	40	39
Indiana	36,185	5,499	302,954	8,372	20	55	35
Iowa	56,275	2,884	228,017	4,052	34	79	25
Kansas	82,277	2,450	322,170	3,916	36	131	15
Kentucky	40,409	3,726	267,558	6,621	25	72	27
Louisiana	47,751	4,481	522,268	10,937	15	117	17
Maine	33,265	1,164	41,108	1,236	48	35	42
Maryland	10,460	4,392	258,274	24,692	2	59	32
Massachusetts	8,284	5,822	117,205	14,148	10	20	48
Michigan	58,527	9,088	1,347,853	23,030	3	148	12
Minnesota	84,402	4,193	1,547,958	18,340	5	369	5
Mississippi	47,689	2,613	102,793	2,155	43	39	40
Missouri	69,697	5,029	734,960	10,545	16	146	13
Montana	147,046	826	200,272	1,362	45	242	8
Nebraska	77,355	1,606	99,970	1,292	47	62	31
Nevada	110,561	936	630,883	5,706	27	674	2
New Hampshire	9,279	998	32,900	3,546	40	33	44
New Jersey	7,787	7,562	177,576	22,804	4	23	46
New Mexico	121,593	1,450	656,889	5,402	29	453	4
New York	49,108	17,783	657,308	13,385	12	37	41
North Carolina	52,669	6,255	432,756	8,217	22	69	28
North Dakota	70,703	685	24,184	342	49	35	43
Ohio	41,330	10,744	607,127	14,690	8	57	33
Oklahoma	69,956	3,301	251,607	3,597	38	76	26
Oregon	97,073	2,687	130,296	1,342	46	48	38
Pennsylvania	45,308	11,853	804,474	17,756	6	68	29
Rhode Island	1,212	968	12,192	10,059	17	13	49
South Carolina	31,113	3,347	275,929	8,869	19	82	23
South Dakota	77,116	708	207,339	2,689	41	293	7
Tennessee	42,144	4,762	472,287	11,207	14	99	21
Texas	266,807	16,370	1,733,359	6,497	26	106	19
Utah	84,899	1,645	312,359	3,679	37	190	9
Vermont	9,614	535	49,854	5,186	30	93	22
Virginia	40,767	5,706	381,276	9,353	18	67	30
Washington	68,138	4,409	243,670	3,576	39	55	34
West Virginia	24,231	1,936	105,409	4,350	32	54	36
Wisconsin	56,153	4,775	125,110	2,228	42	26	45
Wyoming	97,809	509	552,463	5,648	28	1,085	1
Total[2] or average	3,618,701	238,114	23,232,000	6,416	XX	98	XX

XX Not applicable.
[1]Incomplete total.
[2]Excludes Washington, DC (which has no mineral production), with an area of 69 square miles and a population of 626,000.

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

Mineral	1983 Quantity	1983 Value (thousands)	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
ALABAMA						
Cement:						
Masonry thousand short tons	210	$13,417	259	$17,247	268	$18,113
Portland do	3,279	150,255	3,656	167,191	3,721	165,972
Clays[2] do	1,863	20,758	1,906	30,500	1,873	13,139
Gem stones	NA	1	NA	1	NA	1
Lime thousand short tons	981	41,149	1,163	50,560	1,216	52,295
Sand and gravel:						
Construction do	e8,600	e23,500	10,348	26,188	e11,000	e32,000
Industrial do	418	3,256	442	3,600	524	4,533
Stone:						
Crushed do	20,558	95,374	e22,000	e98,500	25,853	109,176
Dimension do	7	2,661	e8	e2,674	11	2,881
Combined value of bauxite, clays (bentonite), phosphate rock (1983), and salt	XX	10,956	XX	13,380	XX	7,805
Total	XX	361,327	XX	409,841	XX	405,915
ALASKA						
Gem stones	NA	$60	NA	$60	NA	$60
Gold (recoverable content of ores, etc.) troy ounces	39,523	16,758	r19,433	r7,009	44,733	14,210
Sand and gravel (construction) thousand short tons	e45,200	e97,200	30,861	66,883	e29,000	e63,000
Silver (recoverable content of ores, etc.) thousand troy ounces	4	47	r(3)	r1	W	W
Stone (crushed) thousand short tons	1,981	9,460	e2,500	e10,800	1,907	8,535
Combined value of cement (portland, 1984-85), copper (1983), lead (1983), tin, and values indicated by symbol W	XX	971	XX	r2,543	XX	4,164
Total	XX	124,496	XX	r87,296	XX	89,969
ARIZONA						
Clays thousand short tons	151	$1,425	138	$819	186	$1,503
Copper (recoverable content of ores, etc.) metric tons	678,216	1,144,285	746,453	1,100,182	796,556	1,175,995
Gem stones	NA	2,800	NA	2,700	NA	2,700
Gold (recoverable content of ores, etc.) troy ounces	61,991	26,284	r54,897	r19,799	52,053	16,535
Gypsum thousand short tons	265	1,929	261	2,332	251	1,926
Lead (recoverable content of ores, etc.) metric tons	r234	r112	W	W	581	244
Lime thousand short tons	340	16,700	359	17,304	476	21,226
Molybdenum (content of concentrate) thousand pounds	23,934	80,210	24,013	76,112	24,125	63,389
Pumice thousand short tons	2	15	2	21	W	2
Sand and gravel (construction) do	e23,200	e75,000	30,439	101,959	e37,000	e118,000
Silver (recoverable content of ores, etc.) thousand troy ounces	4,492	51,383	r4,247	r34,570	4,885	30,007
Stone:						
Crushed thousand short tons	4,755	24,079	e5,200	e27,300	5,929	23,111
Dimension do	(3)	1	e(3)	e(3)	W	W
Combined value of cement, perlite, pyrites, salt (1984), sand and gravel (industrial), tin (1984), and values indicated by symbol W	XX	87,449	XX	102,839	XX	95,447
Total	XX	r1,511,672	XX	r1,485,937	XX	1,550,085
ARKANSAS						
Clays thousand short tons	879	$9,956	1,019	$7,838	1,052	$10,769
Gem stones	NA	200	NA	200	NA	200
Sand and gravel:						
Construction thousand short tons	e6,900	e19,600	8,334	23,786	e8,500	e24,400
Industrial do	386	4,796	459	6,207	412	5,414
Stone:						
Crushed do	13,448	51,267	e15,200	e59,800	14,815	60,874
Dimension do	9	573	--	--	5	305
Talc do	7	66	W	W	W	W
Combined value of abrasives, bauxite, bromine, cement, gypsum, lime, tripoli (1983-84), vanadium (1984-85), and values indicated by symbol W	XX	159,972	XX	174,797	XX	154,735
Total	XX	246,430	XX	272,628	XX	256,697

See footnotes at end of table.

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

Mineral	1983 Quantity	1983 Value (thousands)	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
CALIFORNIA						
Boron minerals thousand short tons	1,303	$439,181	1,367	$456,687	1,269	$404,775
Cement, portland do	7,567	420,949	8,715	520,026	9,462	601,506
Clays[2] do	1,816	18,255	2,100	23,868	2,203	26,600
Gem stones	NA	300	NA	500	NA	550
Gold (recoverable content of ores, etc.) troy ounces	38,443	16,300	85,858	30,965	165,101	52,446
Gypsum thousand short tons	1,213	10,668	1,382	12,443	1,332	12,201
Lime do	358	22,994	406	26,827	367	24,733
Peat do	13	612	W	W	W	W
Pumice do	65	1,582	80	1,600	78	1,491
Sand and gravel:						
Construction do	e91,000	e308,700	102,420	360,427	e112,800	e430,000
Industrial do	2,150	34,066	2,281	39,176	2,255	37,434
Silver (recoverable content of ores, etc.) thousand troy ounces	27	308	W	W	115	709
Stone:						
Crushed thousand short tons	35,582	146,289	e38,600	e158,000	41,199	174,395
Dimension do	20	2,839	e22	e2,990	23	2,449
Talc and pyrophyllite do	71	1,289	74	1,642	100	2,493
Combined value of asbestos, calcium chloride, cement (masonry), clays (fire clay), copper, diatomite, feldspar, iron ore, lead (1984), magnesium compounds, molybdenum (1984-85), perlite, potassium salts, rare-earth metal concentrates, salt, sodium carbonate, sodium sulfate, tungsten ore and concentrate, wollastonite (1983-84), and values indicated by symbol W	XX	359,218	XX	r360,085	XX	323,014
Total	XX	1,783,550	XX	r1,995,236	XX	2,094,796
COLORADO						
Clays thousand short tons	459	$2,650	308	$2,111	303	$1,743
Gem stones	NA	80	NA	80	NA	80
Gold (recoverable content of ores, etc.) troy ounces	63,063	26,739	60,010	21,643	43,301	13,755
Gypsum thousand short tons	W	W	291	W	233	1,800
Sand and gravel:						
Construction do	e21,200	e81,600	28,024	87,324	e27,500	e88,000
Industrial do	212	3,233	149	2,213	W	W
Silver (recoverable content of ores, etc.) thousand troy ounces	2,146	24,546	2,200	17,909	549	3,370
Stone:						
Crushed thousand short tons	6,790	22,749	e7,200	e26,200	7,037	25,930
Dimension do	1	86	e1	e87	2	204
Combined value of cement, copper, iron ore, lead, lime, molybdenum, peat, perlite, pyrites (1984-85), salt (1984), tin (1984-85), tungsten ore and concentrate, vanadium (1983-84), zinc, and values indicated by symbol W	XX	175,969	XX	r278,609	XX	273,296
Total	XX	337,652	XX	r436,176	XX	408,178
CONNECTICUT						
Clays thousand short tons	86	$515	99	$565	106	$632
Lime do	5	400	W	W	--	--
Sand and gravel (construction) do	e5,000	e17,900	6,718	22,817	e6,000	e21,000
Stone:						
Crushed do	7,692	45,890	e8,300	e49,400	7,277	43,937
Dimension do	18	1,028	e18	e1,080	20	1,285
Combined value of feldspar, gem stones, mica (scrap), sand and gravel (industrial), and value indicated by symbol W	XX	5,480	XX	5,834	XX	5,532
Total	XX	71,213	XX	79,696	XX	72,386
DELAWARE						
Marl (greensand) thousand short tons	--	--	1	$18	2	$29
Sand and gravel (construction) do	e1,400	e$3,200	1,003	2,795	e1,300	e4,000
Total[4]	XX	3,200	XX	2,813	XX	4,029

See footnotes at end of table.

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

Mineral	1983 Quantity	1983 Value (thousands)	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
FLORIDA						
Cement:						
Masonry ____ thousand short tons	313	$19,557	383	$24,624	316	$17,137
Portland ____ do	3,329	164,048	3,564	172,548	3,282	148,908
Clays ____ do	684	31,566	772	34,048	672	33,074
Gem stones	NA	6	NA	6	NA	6
Lime ____ thousand short tons	W	13,881	171	9,379	W	W
Peat ____ do	114	1,999	263	5,454	243	5,333
Sand and gravel:						
Construction ____ do	e14,900	e31,500	21,032	48,494	e22,500	e49,500
Industrial ____ do	329	3,447	1,533	9,815	2,123	12,642
Stone (crushed) ____ do	57,282	235,700	e68,500	e290,000	69,266	287,237
Combined value of magnesium compounds, phosphate rock, rare-earth metal concentrates, staurolite, titanium concentrates (ilmenite and rutile), zircon concentrates, and value indicated by symbol W ____	XX	774,122	XX	915,996	XX	1,005,429
Total ____	XX	1,275,826	XX	1,510,364	XX	1,559,266
GEORGIA						
Clays ____ thousand short tons	7,859	$560,005	8,679	$600,029	8,671	$575,097
Gem stones	NA	20	NA	20	NA	20
Sand and gravel:						
Construction ____ thousand short tons	e3,800	e9,400	5,347	13,623	e5,000	e13,400
Industrial ____ do	539	7,298	478	6,795	571	6,675
Stone:						
Crushed ____ do	41,100	186,193	e45,900	e220,000	52,062	256,588
Dimension ____ do	183	21,019	e202	e20,007	185	19,466
Talc ____ do	14	101	15	104	16	111
Combined value of barite, bauxite (1983-84), cement, feldspar, iron oxide pigments (crude), kyanite, mica (scrap), and peat ____	XX	65,536	XX	79,914	XX	74,718
Total ____	XX	849,572	XX	940,492	XX	946,075
HAWAII						
Cement:						
Masonry ____ thousand short tons	6	$641	5	$792	7	$588
Portland ____ do	216	20,673	186	18,282	215	16,050
Sand and gravel (construction) do	e440	e1,000	436	2,031	e500	e2,100
Stone:						
Crushed ____ do	5,532	29,703	e5,400	e29,700	5,627	34,183
Dimension ____ do	(3)	3	--	--	--	--
Combined value of other industrial minerals	XX	391	XX	442	XX	351
Total ____	XX	52,411	XX	51,247	XX	53,272
IDAHO						
Antimony ore and concentrate, antimony content ____ short tons	585	W	557	W	W	W
Clays ____ thousand short tons	6	$91	r1	W	r2	W
Copper (recoverable content of ores, etc.) metric tons	3,556	6,000	3,701	$5,455	3,551	$5,242
Gem stones	NA	100	NA	150	NA	175
Gold (recoverable content of ores, etc.) troy ounces	W	W	W	W	44,306	14,074
Lead (recoverable content of ores, etc.) metric tons	25,893	12,376	W	W	33,707	14,169
Lime ____ thousand short tons	85	7,686	87	5,616	93	5,803
Phosphate rock ____ thousand metric tons	W	W	4,722	126,586	3,784	102,430
Sand and gravel (construction) thousand short tons	e3,000	e9,800	4,725	13,509	e4,000	e11,400
Silver (recoverable content of ores, etc.) thousand troy ounces	17,684	202,308	18,869	153,608	18,828	115,645
Stone (crushed) ____ thousand short tons	1,935	7,480	e1,800	e7,100	2,019	6,977

See footnotes at end of table.

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

Mineral	1983 Quantity	1983 Value (thousands)	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
IDAHO—Continued						
Combined value of cement, clays (bentonite and fire clay, 1984-85; fuller's earth, 1985) garnet (abrasive), gypsum (1984), molybdenum (1984-85), perlite, pumice, sand and gravel (industrial), stone (dimension), tungsten ore and concentrate (1983), vanadium (1984-85), zinc, and values indicated by symbol W	XX	$169,318	XX	r$100,326	XX	$72,239
Total	XX	415,159	XX	r412,350	XX	348,154
ILLINOIS						
Cement (portland) thousand short tons	1,857	$74,975	1,997	$82,622	2,101	$86,211
Clays[2] do.	717	3,360	253	940	265	876
Gem stones	NA	15	NA	15	NA	15
Peat thousand short tons	W	W	49	W	W	W
Sand and gravel:						
Construction do.	e21,100	e58,400	25,969	72,477	e26,600	e77,000
Industrial do.	4,060	42,871	4,100	52,197	4,056	56,915
Stone:						
Crushed do.	42,761	166,860	e48,500	e191,600	41,044	164,117
Dimension do.	2	71	--	--	2	107
Combined value of barite, cement (masonry), clays (fuller's earth), copper (1985), fluorspar, lead, lime, silver, tripoli, zinc, and values indicated by symbol W	XX	60,355	XX	72,010	XX	74,679
Total	XX	406,907	XX	471,861	XX	459,920
INDIANA						
Clays thousand short tons	2558	2$1,421	2653	2$2,085	740	$2,776
Gem stones	NA	1	NA	1	NA	1
Peat thousand short tons	81	1,973	61	1,358	54	W
Sand and gravel:						
Construction do.	e14,400	e37,900	16,071	44,744	e18,600	e55,800
Industrial do.	W	W	194	1,129	182	1,209
Stone:						
Crushed do.	24,051	82,782	e26,700	e99,400	e23,384	e81,119
Dimension do.	144	11,015	e159	e14,269	188	20,186
Combined value of abrasives (natural), cement, clays (fire clay, 1983-84), gypsum, lime, stone (crushed marl, 1985), and values indicated by symbol W	XX	115,450	XX	130,250	XX	141,863
Total	XX	250,542	XX	293,236	XX	302,954
IOWA						
Cement:						
Masonry thousand short tons	37	$3,425	42	$3,260	39	$3,372
Portland do.	1,644	87,836	1,730	92,699	1,618	77,890
Clays do.	576	3,258	623	2,695	503	2,450
Gem stones	NA	1	NA	W	NA	1
Gypsum thousand short tons	1,612	13,518	1,527	12,421	1,639	13,682
Peat do.	W	W	11	400	11	415
Sand and gravel (construction) do.	e11,800	e32,800	13,882	37,027	e12,000	e30,500
Stone (crushed) do.	24,844	101,097	e23,800	e100,000	23,657	94,496
Combined value of lime, stone (dimension, 1983, 1985), and values indicated by symbol W	XX	5,425	XX	4,943	XX	5,211
Total	XX	247,360	XX	253,445	XX	228,017
KANSAS						
Clays thousand short tons	718	$3,921	918	$5,537	878	$5,326
Gem stones	NA	1	NA	1	NA	1
Helium:						
Crude million cubic feet	188	3,572	402	8,844	W	W
Grade-A do.	775	27,125	1,015	38,063	W	W
Salt[7] thousand short tons	1,719	67,195	1,712	71,558	1,790	71,970

See footnotes at end of table.

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

Mineral	1983		1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
KANSAS—Continued						
Sand and gravel:						
Construction thousand short tons	e12,400	e$26,600	11,796	$26,358	e13,200	e$31,800
Industrial do.	199	2,184	W	W	134	1,124
Stone (crushed) do.	12,687	45,121	e13,600	e48,500	15,653	57,155
Combined value of cement, gypsum, lime (1983-84), pumice, salt (brine), stone (dimension), and values indicated by symbol W	XX	91,866	XX	113,149	XX	154,794
Total	XX	267,585	XX	312,010	XX	322,170
KENTUCKY						
Clays thousand short tons	2669	2$2,142	r 2662	r 2$2,533	775	$6,487
Gem stones	NA	1	NA	1	NA	1
Sand and gravel:						
Construction thousand short tons	e5,500	e13,000	7,839	18,252	e7,600	e19,000
Industrial do.	10	124	W	W	W	W
Stone (crushed) do.	33,399	117,842	e37,300	e133,000	e38,022	e134,978
Combined value of cement, clays (ball clay, 1983-84, fire clay, 1983), lime, stone (crushed sandstone, 1985), zinc, and values indicated by symbol W	XX	91,408	XX	r103,422	XX	107,092
Total	XX	224,517	XX	r257,208	XX	267,558
LOUISIANA						
Clays thousand short tons	2505	$10,793	547	2$10,858	334	$7,017
Gem stones	NA	1	NA	1	NA	1
Salt thousand short tons	11,544	100,936	13,101	112,142	12,325	138,955
Sand and gravel:						
Construction do.	e14,200	e46,600	17,040	54,664	e15,000	e48,000
Industrial do.	291	4,252	266	3,757	267	3,838
Stone (crushed) do.	5,758	25,702	e4,100	e19,500	e4,820	e25,956
Sulfur (Frasch) thousand metric tons	1,643	W	2,007	W	1,698	W
Combined value of cement, clays (bentonite, 1984), gypsum, lime, stone (crushed miscellaneous, 1985), and values indicated by symbol W	XX	258,477	XX	310,548	XX	298,501
Total	XX	446,761	XX	511,470	XX	522,268
MAINE						
Clays thousand short tons	43	$93	43	$97	50	$100
Gem stones	NA	W	NA	400	NA	400
Sand and gravel (construction) thousand short tons	e4,800	e12,100	7,885	19,228	e7,200	e18,000
Stone (crushed) do.	848	2,851	e1,300	e4,400	1,459	5,114
Combined value of cement, garnet (abrasive), peat (1983-84), and stone (dimension)	XX	11,319	XX	r13,814	XX	17,494
Total	XX	26,363	XX	37,939	XX	41,108
MARYLAND						
Clays[2] thousand short tons	484	$1,747	347	$1,484	336	$1,647
Gem stones	NA	2	NA	2	NA	2
Lime thousand short tons	7	383	7	419	10	608
Peat do.	4	W	5	W	W	W
Sand and gravel (construction) do.	e10,600	e37,800	14,234	46,671	e17,000	e58,000
Stone:						
Crushed do.	19,284	80,429	e22,100	e94,000	24,406	98,584
Dimension do.	12	682	e17	e864	18	1,218
Combined value of cement, clays (ball clay), sand and gravel (industrial, 1984-85), and values indicated by symbol W	XX	78,366	XX	98,261	XX	98,215
Total	XX	199,409	XX	241,701	XX	258,274

See footnotes at end of table.

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

Mineral	1983		1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MASSACHUSETTS						
Clays thousand short tons	237	$1,298	240	$1,212	265	$1,388
Lime do.	156	10,671	171	12,426	159	10,935
Sand and gravel (construction) do.	e10,400	e36,200	14,168	42,139	e14,900	e47,500
Stone:						
Crushed do.	7,740	36,002	e8,400	e39,000	9,354	42,881
Dimension do.	51	10,488	e57	e11,657	73	13,724
Combined value of gem stones, peat, and sand and gravel (industrial)	XX	1,016	XX	898	XX	777
Total	XX	95,675	XX	107,332	XX	117,205
MICHIGAN						
Clays thousand short tons	1,199	$5,693	1,321	$5,052	1,477	$5,514
Gem stones	NA	15	NA	15	NA	15
Gypsum thousand short tons	1,097	8,104	1,534	10,304	1,772	11,883
Iron ore (usable) thousand long tons, gross weight	10,713	W	13,263	W	12,629	W
Lime thousand short tons	503	23,142	622	30,092	535	24,790
Peat do.	215	4,286	227	4,341	282	5,414
Salt do.	1,355	93,306	1,491	93,860	991	75,030
Sand and gravel:						
Construction do.	e23,000	e52,300	36,071	76,540	e38,000	e93,000
Industrial do.	3,545	27,577	3,400	33,060	3,345	25,469
Stone:						
Crushed do.	24,763	82,152	e28,100	e92,000	30,685	95,953
Dimension do.	4	112	e4	e129	4	113
Combined value of bromine, calcium chloride, cement, copper (1985), gold (1985), iodine, iron oxide pigments (crude), magnesium compounds, silver (1985), and values indicated by symbol W	XX	882,239	XX	1,063,214	XX	1,010,672
Total	XX	1,178,926	XX	1,408,607	XX	1,347,853
MINNESOTA						
Gem stones	NA	$5	NA	$5	NA	$5
Iron ore (usable) thousand long tons, gross weight	30,699	1,342,455	35,602	1,561,516	34,977	1,430,353
Manganiferous ore short tons	11,314	W	68,019	W		
Peat thousand short tons	W	W	24	W	34	1,720
Sand and gravel:						
Construction do.	e24,600	e53,000	22,612	49,087	e25,000	e55,500
Industrial do.	685	12,932	W	W	884	16,910
Stone:						
Crushed do.	8,580	25,320	e8,900	e25,800	7,756	22,601
Dimension do.	28	11,365	e39	e13,369	37	13,598
Combined values of clays, lime, and values indicated by symbol W	XX	9,953	XX	26,470	XX	7,271
Total	XX	1,455,030	XX	1,676,247	XX	1,547,958
MISSISSIPPI						
Clays thousand short tons	1,446	$23,846	r 2 1,274	r 2 $10,366	1,558	$34,864
Sand and gravel (construction) do.	e11,000	e34,600	12,205	34,955	e13,400	e42,000
Stone (crushed) do.	1,651	4,377	e2,000	e5,800	1,582	4,282
Combined value of cement, clays (ball clay and fuller's earth, 1984), and sand and gravel (industrial)	XX	26,882	XX	r42,016	XX	21,647
Total	XX	89,705	XX	r93,137	XX	102,793
MISSOURI						
Barite thousand short tons	W	W	W	W	47	$2,791
Cement:						
Masonry do.	146	$7,339	143	$7,033	139	6,630
Portland do.	3,499	157,249	3,981	178,225	3,669	159,757
Clays[2] do.	1,418	11,848	1,575	14,666	1,545	10,271
Copper (recoverable content of ores, etc.) metric tons	7,725	13,033	5,818	8,575	13,410	19,797
Gem stones	NA	10	NA	10	NA	10
Iron ore (usable) thousand long tons, gross weight	877	27,054	1,370	W	1,110	W
Lead (recoverable content of ores, etc.) metric tons	409,280	195,620	278,329	156,766	371,008	155,955

See footnotes at end of table.

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

Mineral	1983		1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MISSOURI—Continued						
Sand and gravel:						
Construction thousand short tons	e7,700	e$17,700	7,967	$19,364	e7,500	e$20,000
Industrial do.	600	7,541	614	8,129	535	7,330
Silver (recoverable content of ores, etc.) thousand troy ounces	2,021	23,124	1,401	11,406	1,635	10,044
Stone (crushed) thousand short tons	39,454	120,700	e41,600	e137,000	50,646	162,097
Zinc (recoverable content of ores, etc.) metric tons	57,044	52,052	45,458	48,707	49,340	43,908
Combined value of clays (fuller's earth), iron oxide pigments (crude), lime, stone (dimension), and values indicated by symbol W	XX	92,598	XX	142,016	XX	136,370
Total	XX	725,868	XX	731,897	XX	734,960
MONTANA						
Antimony short tons	253	W	—	—	—	—
Barite thousand short tons	10	$750	W	W	W	W
Clays do.	194	6,205	r229	r$5,642	279	$8,296
Copper (recoverable content of ores, etc.) metric tons	33,337	56,245	W	W	15,092	22,281
Gem stones	NA	300	NA	450	NA	400
Gold (recoverable content of ores, etc.) troy ounces	161,436	68,449	181,190	65,348	160,262	50,909
Lead (recoverable content of ores, etc.) metric tons	1,163	556	W	W	846	356
Lime thousand short tons	86	W	89	5,097	W	W
Sand and gravel (construction) do.	e5,000	e10,200	7,776	21,269	e9,000	e26,000
Silver (recoverable content of ores, etc.) thousand troy ounces	5,708	65,299	5,653	46,018	4,010	24,630
Stone (crushed) thousand short tons	872	2,320	e950	e2,400	101,730	105,044
Combined value of cement, graphite (1983-84), gypsum, iron ore, molybdenum (1983), peat, phosphate rock, sand and gravel (industrial), stone (crushed traprock, 1985), stone (dimension), talc, vermiculite, and values indicated by symbol W	XX	81,644	XX	r93,811	XX	62,356
Total	XX	291,968	XX	r240,035	XX	200,272
NEBRASKA						
Clays thousand short tons	164	$501	180	$556	244	$718
Gem stones	NA	W	NA	W	NA	10
Sand and gravel:						
Construction thousand short tons	e10,100	e25,000	11,839	27,791	e11,600	e28,800
Industrial do.	4	W	W	W	W	W
Stone (crushed) do.	4,442	22,612	e4,500	e23,400	4,175	19,134
Combined value of cement, lime, and values indicated by symbol W	XX	39,296	XX	48,621	XX	51,308
Total	XX	87,409	XX	100,368	XX	99,970
NEVADA						
Barite thousand short tons	663	$21,736	615	$14,924	590	$10,904
Clays do.	58	2,348	220	21,191	280	23,776
Gem stones	NA	1,200	NA	1,300	NA	1,300
Gold (recoverable content of ores, etc.) troy ounces	r960,657	r407,319	r1,020,546	r368,068	1,276,114	405,369
Gypsum thousand short tons	998	7,896	1,192	8,860	1,207	8,942
Lead (recoverable content of ores, etc.) metric tons	14	7	W	W	(3)	(3)
Mercury 76-pound flasks	25,070	W	19,048	W	16,530	W
Sand and gravel:						
Construction thousand short tons	e7,500	e16,200	8,202	20,505	e9,500	e24,800
Industrial do.	W	W	489	W	479	W
Silver (recoverable content of ores, etc.) thousand troy ounces	r5,179	r59,252	6,477	52,727	4,947	30,383
Stone (crushed) thousand short tons	1,269	5,358	e1,100	e4,700	1,334	6,218
Combined value of cement (portland), clays (fuller's earth and kaolin, 1984-85), copper, diatomite, fluorspar, iron ore, lime, lithium compounds, magnesite, molybdenum, perlite, salt, tungsten ore and concentrate (1984), and values indicated by symbol W	XX	111,178	XX	151,787	XX	139,191
Total	XX	r632,494	XX	r624,062	XX	630,883

See footnotes at end of table.

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

Mineral	1983 Quantity	1983 Value (thousands)	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
NEW HAMPSHIRE						
Sand and gravel (construction) thousand short tons	e4,000	e$12,100	5,637	$16,054	e6,300	e$19,800
Stone:						
Crushed do	946	2,853	e850	e2,700	1,612	6,434
Dimension do	58	4,032	e59	e4,198	79	6,532
Combined value of other industrial minerals	XX	101	XX	160	XX	134
Total	XX	19,086	XX	23,112	XX	32,900
NEW JERSEY						
Clays thousand short tons	62	$596	r62	$611	130	$2,050
Gem stones	NA	1	NA	1	NA	1
Peat thousand short tons	W	W	5	128	W	311
Sand and gravel:						
Construction do	e10,800	e34,300	9,545	$31,878	e10,600	e36,700
Industrial do	2,386	31,819	2,712	32,287	2,820	31,119
Stone (crushed) do	12,301	70,421	e13,500	e75,000	15,692	94,339
Zinc (recoverable content of ores, etc.) metric tons	16,475	15,033	W	W	W	W
Combined value of magnesium compounds (1983), marl (greensand), stone (dimension, 1983-84), and values indicated by symbol W	XX	2,445	XX	16,331	XX	13,056
Total	XX	154,615	XX	156,236	XX	177,576
NEW MEXICO						
Clays thousand short tons	50	$115	67	$143	60	$161
Gem stones	NA	200	NA	200	NA	200
Gold (recoverable content of ores, etc.) troy ounces	W	W	W	W	45,045	14,309
Gypsum thousand short tons	169	1,016	318	1,622	350	1,570
Lead (recoverable content of ores, etc.) metric tons	258	123	--	--	W	W
Lime thousand short tons	17	W	--	--	--	--
Perlite do	394	13,297	416	14,115	419	14,521
Potassium salts thousand metric tons	1,278	174,700	1,418	204,100	1,120	156,000
Pumice thousand short tons	110	1,070	132	1,269	152	1,114
Sand and gravel (construction) do	e7,000	e20,000	8,363	22,389	e8,400	e22,800
Stone:						
Crushed do	4,730	15,118	e4,700	e17,000	3,641	15,232
Dimension do	18	141	e19	e149	20	277
Combined value of cement, copper, helium (Grade-A), mica (scrap), molybdenum, salt, silver, tungsten ore and concentrate (1984), and values indicated by symbol W	XX	291,411	XX	r374,855	XX	430,705
Total	XX	517,191	XX	r635,842	XX	656,889
NEW YORK						
Clays thousand short tons	2371	2$869	2543	2$2,435	700	$3,129
Gem stones	NA	30	NA	30	NA	30
Lead (recoverable content of ores, etc.) metric tons	1,299	621	W	W	W	W
Peat thousand short tons	18	W	W	W	W	W
Salt do	4,859	100,119	5,644	123,755	6,928	142,318
Sand and gravel:						
Construction do	e18,700	e54,200	25,968	80,866	e28,000	e88,500
Industrial do	W	W	25	260	W	W
Silver (recoverable content of ores, etc.) thousand troy ounces	33	379	W	W	W	W
Stone:						
Crushed thousand short tons	31,991	134,752	e33,100	e135,000	35,139	165,136
Dimension do	24	4,310	e15	e4,271	16	3,666
Zinc (recoverable content of ores, etc.) metric tons	56,748	51,783	W	W	W	W
Combined value of cement, clays (ball clay, 1983-84), emery, garnet (abrasive), gypsum, lime, talc, titanium concentrate (ilmenite, 1983-84), wollastonite, and values indicated by symbol W	XX	156,351	XX	265,873	XX	254,529
Total	XX	503,414	XX	612,490	XX	657,308

See footnotes at end of table.

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

Mineral	1983		1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NORTH CAROLINA						
Clays thousand short tons	[2]2,068	[2]$6,681	2,327	$8,987	2,688	$10,477
Feldspar short tons	508,641	13,610	510,275	13,994	490,993	13,351
Gem stones	NA	50	NA	50	NA	50
Mica (scrap) thousand short tons	69	4,266	79	3,762	80	3,726
Sand and gravel:						
Construction do	e5,600	e16,900	6,312	18,159	e6,100	e19,500
Industrial do	1,066	11,689	1,158	12,864	1,294	13,086
Stone:						
Crushed do	33,694	145,001	e38,100	e168,000	41,771	194,818
Dimension do	87	8,267	W	W	35	6,132
Talc and pyrophyllite do	89	1,452	87	1,587	85	1,604
Combined value of cement (1983), clays (kaolin, 1983), lithium compounds, olivine, peat, phosphate rock, and value indicated by symbol W	XX	190,641	XX	224,077	XX	170,012
Total	XX	398,557	XX	451,480	XX	432,756
NORTH DAKOTA						
Gem stones	NA	$2	NA	$2	NA	$2
Lime thousand short tons	57	6,798	60	5,912	56	5,562
Sand and gravel (construction) do	e3,800	e15,000	6,426	11,351	e6,900	e13,800
Combined value of clays, peat, salt, and stone (crushed, 1985)	XX	3,570	XX	4,529	XX	4,820
Total	XX	25,370	XX	21,794	XX	24,184
OHIO						
Cement:						
Masonry thousand short tons	97	$7,454	101	$8,092	110	$10,412
Portland do	1,575	71,599	1,525	69,810	1,769	84,929
Clays do	1,716	8,061	1,960	10,473	2,114	10,581
Gem stones	NA	W	NA	W	NA	10
Lime thousand short tons	1,906	84,928	1,859	87,951	1,730	84,142
Peat do	W	W	13	345	16	413
Salt do	2,565	85,988	W	W	4,783	143,949
Sand and gravel:						
Construction do	e27,200	e84,600	31,748	104,709	e33,000	e109,000
Industrial do	1,226	17,848	1,506	20,829	1,312	21,945
Stone:						
Crushed do	32,937	114,059	e38,500	e139,000	38,310	136,544
Dimension do	49	2,923	e37	e3,454	53	3,661
Combined value of abrasives, gypsum, and values indicated by symbol W	XX	1,684	XX	108,240	XX	1,541
Total	XX	479,144	XX	552,903	XX	607,127
OKLAHOMA						
Cement:						
Masonry thousand short tons	45	$3,074	49	$3,506	43	$2,854
Portland do	1,719	83,685	1,732	84,701	1,589	72,583
Clays do	862	2,288	979	2,498	997	2,338
Gem stones	NA	2	NA	2	NA	2
Gypsum thousand short tons	1,351	11,571	1,549	13,485	1,595	12,548
Pumice do	1	W	W	W	W	W
Sand and gravel:						
Construction do	e7,500	e17,300	10,984	26,582	e12,600	e32,300
Industrial do	1,184	13,221	W	W	W	W
Stone:						
Crushed do	23,865	76,941	e25,500	e86,000	31,173	98,811
Dimension do	10	737	e12	e771	11	836
Combined value of feldspar, iodine, lime, salt, tripoli, and values indicated by symbol W	XX	17,367	XX	28,187	XX	29,335
Total	XX	226,186	XX	245,732	XX	251,607

See footnotes at end of table.

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

Mineral	1983 Quantity	1983 Value (thousands)	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
OREGON						
Clays thousand short tons	188	$275	189	$288	188	$285
Gem stones	NA	600	NA	400	NA	350
Gold (recoverable content of ores, etc.) troy ounces	322	137	W	W	W	W
Nickel (content of ores and concentrates) short tons	--	--	14,540	W	6,127	W
Sand and gravel (construction) thousand short tons	e11,000	e37,000	12,776	37,117	e12,500	e36,800
Silver (recoverable content of ores, etc.) thousand troy ounces	1	10	W	W	--	--
Stone (crushed) thousand short tons	13,089	39,873	e12,500	e37,500	15,336	54,244
Talc and soapstone do.	(3)	123	(3)	66	(3)	30
Combined value of cement, copper (1983), diatomite, lead (1983), lime, pumice, sand and gravel (industrial, 1983), stone (dimension, 1983 and 1985), and values indicated by symbol W	XX	32,922	XX	45,031	XX	38,587
Total	XX	110,940	XX	120,402	XX	130,296
PENNSYLVANIA						
Cement:						
Masonry thousand short tons	262	$17,095	298	$20,849	303	$20,970
Portland do.	5,154	218,539	5,735	281,590	5,535	288,036
Clays[2] do.	916	4,311	963	4,050	1,142	5,293
Gem stones	NA	5	NA	5	NA	5
Lime thousand short tons	1,507	81,682	1,620	90,182	1,492	85,269
Peat do.	22	628	24	693	21	602
Sand and gravel:						
Construction do.	e11,800	e52,000	14,472	64,285	e17,000	e74,000
Industrial do.	W	W	W	W	693	9,846
Stone:						
Crushed do.	51,523	226,948	e56,200	e228,000	64,765	310,859
Dimension do.	53	5,799	e44	e6,001	51	8,214
Zinc (recoverable content of ores, etc.) metric tons	16,792	15,322	--	--	--	--
Combined value of clays (kaolin), mica (scrap), and values indicated by symbol W	XX	12,812	XX	12,701	XX	1,380
Total	XX	635,141	XX	708,356	XX	804,474
RHODE ISLAND						
Sand and gravel (construction) thousand short tons	e1,000	e$2,400	1,483	$5,282	e1,200	e$4,600
Stone (crushed) do.	971	5,507	e1,000	e5,800	10e1,135	10e7,016
Combined value of gem stones, sand and gravel (industrial, 1984-85), and stone (crushed traprock, 1985)	XX	23	XX	486	XX	576
Total	XX	7,930	XX	11,568	XX	12,192
SOUTH CAROLINA						
Cement, portland thousand short tons	W	W	2,319	$103,891	2,207	$104,705
Clays[2] do.	1,813	$34,830	1,834	36,809	1,896	37,695
Gem stones	NA	10	NA	10	NA	10
Manganiferous ore thousand short tons	22	W	20	W	20	W
Peat do.	W	W	5	W	W	173
Sand and gravel:						
Construction do.	e5,200	e15,000	5,845	17,097	e4,900	e14,000
Industrial do.	842	13,169	882	14,889	794	14,092
Stone:						
Crushed do.	15,786	61,054	e17,900	e72,500	17,079	72,520
Dimension do.	17	1,165	e16	e1,092	8	541
Combined value of cement (masonry), clays (fuller's earth), gold (1985), mica (scrap), silver (1985), vermiculite, and values indicated by symbol W	XX	105,366	XX	29,562	XX	32,193
Total	XX	230,594	XX	275,850	XX	275,929

See footnotes at end of table.

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

Mineral	1983		1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
SOUTH DAKOTA						
Cement:						
Masonry ____ thousand short tons	4	$359	5	$283	4	W
Portland ____ do	603	37,435	619	30,773	655	W
Clays[2] ____ do	123	353	119	343	117	$309
Feldspar ____ short tons	7,109	107	7,219	124	13,721	W
Gem stones	NA	70	NA	70	NA	70
Gold (recoverable content of ores, etc.) troy ounces	309,784	131,348	310,527	111,994	356,103	113,119
Gypsum ____ thousand short tons	W	W	W	W	34	269
Sand and gravel (construction) ____ do	e5,100	e11,500	5,786	12,168	e6,400	e16,000
Silver (recoverable content of ores, etc.) thousand troy ounces	62	713	50	407	63	388
Stone:						
Crushed ____ thousand short tons	3,906	12,982	e3,800	e12,800	4,071	14,412
Dimension ____ do	42	15,794	e60	e18,642	W	W
Combined value of beryllium, clays (bentonite), lime, mica (scrap), and values indicated by symbol W	XX	11,432	XX	r11,265	XX	62,772
Total	XX	222,093	XX	r198,869	XX	207,339
TENNESSEE						
Clays ____ thousand short tons	1,066	$26,516	r 21,165	r 2$21,690	21,244	2$25,913
Gem stones	NA	5	NA	5	NA	5
Phosphate rock ____ thousand metric tons	1,193	29,073	1,368	33,275	1,233	27,600
Sand and gravel:						
Construction ____ thousand short tons	e6,100	e18,700	6,304	19,830	e7,200	e22,000
Industrial ____ do	483	5,455	650	6,903	569	6,156
Stone:						
Crushed ____ do	30,578	111,573	e36,200	e138,000	e37,939	e155,760
Dimension ____ do	7	1,161	e7	e1,097	5	773
Zinc (recoverable content of ores, etc.) metric tons	109,958	100,336	116,526	124,854	104,471	92,971
Combined value of barite, cement, clays (fuller's earth, 1984-85), copper, lead (1984-85), lime, pyrites, silver, and stone (crushed granite, 1985)	XX	114,493	XX	r131,918	XX	141,109
Total	XX	407,312	XX	r477,572	XX	472,287
TEXAS						
Cement:						
Masonry ____ thousand short tons	276	$19,704	291	$24,409	263	$22,114
Portland ____ do	9,760	534,298	10,423	557,421	10,242	532,494
Clays ____ do	3,955	22,575	r 23,517	r 217,091	4,107	28,059
Gem stones	NA	225	NA	175	NA	175
Gypsum ____ thousand short tons	2,049	16,357	2,166	19,431	1,981	17,299
Helium (Grade-A) ____ million cubic feet	524	18,340	W	W	W	W
Lime ____ thousand short tons	1,067	60,193	1,157	61,214	1,192	65,927
Salt ____ do	8,028	65,670	8,184	69,672	8,390	80,434
Sand and gravel:						
Construction ____ do	e58,500	e208,000	62,389	199,461	e57,800	e198,000
Industrial ____ do	1,788	29,637	2,028	29,282	1,968	29,095
Stone:						
Crushed ____ do	76,328	239,187	e89,200	e300,000	85,764	306,821
Dimension ____ do	50	11,071	e47	e11,236	37	11,760
Sulfur (Frasch) ____ thousand metric tons	2,468	W	2,994	W	2,979	W
Talc and pyrophyllite thousand short tons	250	3,933	r240	r4,125	261	5,245
Combined value of asphalt (native, 1984-85), clays (fuller's earth and kaolin, 1984), fluorspar, helium (crude), iron ore, magnesium chloride, magnesium compounds, mica (scrap, 1984-85), sodium sulfate, and values indicated by symbol W	XX	279,291	XX	r419,861	XX	435,936
Total	XX	1,508,481	XX	r1,713,378	XX	1,733,359

See footnotes at end of table.

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

Mineral	1983 Quantity	1983 Value (thousands)	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
UTAH						
Beryllium concentrate short tons	W	W	6,030	$6	5,738	$6
Clays thousand short tons	[2]227	[2]$1,569	[2]315	[2]2,223	332	2,509
Copper (recoverable content of ores, etc.) metric tons	169,751	286,403	W	W	W	W
Gem stones	NA	80	NA	80	NA	80
Gold (recoverable content of ores, etc.) troy ounces	238,459	101,107	W	W	135,489	43,039
Gypsum thousand short tons	305	2,736	277	2,671	413	4,033
Lime do.	315	16,771	297	16,471	225	11,912
Salt do.	936	23,184	1,246	28,651	1,189	28,468
Sand and gravel:						
Construction do.	[e]9,800	[e]19,800	15,217	34,507	[e]14,000	[e]36,400
Industrial do.	24	W	11	W	W	W
Silver (recoverable content of ores, etc.) thousand troy ounces	4,567	52,242	W	W	W	W
Stone (crushed) thousand short tons	4,407	14,636	[e]5,200	[e]16,400	4,657	14,180
Combined value of asphalt (native), cement, clays (fuller's earth, 1983-84), iron ore (usable, 1983), lead (1984), magnesium compounds, molybdenum, perlite (1983), phosphate rock, potassium salts, sodium sulfate, stone (dimension, 1983 and 1985), vanadium (1983-84), zinc (1984), and values indicated by symbol W	XX	138,051	XX	[r]424,323	XX	171,732
Total	XX	656,579	XX	[r]525,332	XX	312,359
VERMONT						
Sand and gravel (construction) thousand short tons	[e]3,000	[e]$6,200	3,802	$8,071	[e]2,700	[e]$7,000
Stone:						
Crushed do.	1,339	5,579	[e]1,800	[e]7,000	1,689	7,468
Dimension do.	116	19,995	[e]116	[e]20,462	116	26,346
Combined value of talc and other industrial minerals	XX	10,355	XX	9,565	XX	9,040
Total	XX	42,129	XX	45,098	XX	49,854
VIRGINIA						
Clays thousand short tons	784	$5,467	712	$6,004	814	$6,977
Gem stones	NA	20	NA	20	NA	20
Iron oxide pigments, crude short tons	W	W	W	W	2,280	W
Lime thousand short tons	557	24,637	562	24,799	633	28,103
Sand and gravel (construction) do.	[e]7,200	[e]30,800	8,860	37,359	[e]10,200	[e]42,000
Stone:						
Crushed do.	37,959	159,553	[e]47,200	[e]196,000	51,686	221,900
Dimension do.	93	2,238	[e]22	[e]3,052	10	3,136
Combined value of aplite, cement, gypsum, kyanite, sand and gravel (industrial), talc (soapstone), vermiculite, and values indicated by symbol W	XX	66,629	XX	74,355	XX	79,140
Total	XX	289,344	XX	341,589	XX	381,276
WASHINGTON						
Clays thousand short tons	[2]282	[2]$1,715	292	[r 2]$1,598	243	$1,402
Gem stones	NA	200	NA	200	NA	200
Peat thousand short tons	W	W	W	W	12	292
Sand and gravel:						
Construction do.	[e]15,800	[e]50,300	23,369	61,070	[e]22,700	[e]62,300
Industrial do.	337	4,581	356	5,201	322	5,589
Stone:						
Crushed do.	10,451	29,607	[e]10,400	[e]31,700	9,543	31,052
Dimension do.	1	37	--	--	1	53
Combined value of barite, calcium chloride (natural, 1985), cement, clays (fire clay, 1983-84) diatomite, gold, gypsum, lime, olivine, silver, talc (1983-84), and values indicated by symbol W	XX	101,025	XX	[r]102,855	XX	142,782
Total	XX	187,465	XX	202,624	XX	243,670

See footnotes at end of table.

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

Mineral	1983 Quantity	1983 Value (thousands)	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
WEST VIRGINIA						
Clays ____ thousand short tons	[2]249	[2]$532	381	$3,410	331	$3,342
Salt ____ do	1,026	W	1,004	W	895	W
Sand and gravel (construction) ____ do	[e]700	[e]3,400	976	3,198	[e]900	[e]3,000
Stone (crushed) ____ do	9,439	37,962	[e]9,100	[e]37,300	9,393	38,348
Combined value of cement, clays (fire clay, 1983), lime, sand and gravel (industrial), and values indicated by symbol W	XX	62,079	XX	68,279	XX	60,719
Total	XX	103,973	XX	112,187	XX	105,409
WISCONSIN						
Lime ____ thousand short tons	319	$17,624	373	$19,892	341	$19,001
Peat ____ do	9	W	9	W	10	W
Sand and gravel:						
Construction ____ do	[e]14,200	[e]28,800	17,785	38,245	[e]16,000	[e]36,000
Industrial ____ do	621	7,208	1,060	11,821	1,197	14,624
Stone:						
Crushed ____ do	14,252	39,896	[e]15,800	[e]45,000	14,496	42,380
Dimension ____ do	24	2,884	[e]24	[e]2,863	22	2,733
Combined value of abrasive stone, cement, and values indicated by symbol W	XX	4,779	XX	11,527	XX	10,372
Total	XX	101,191	XX	129,348	XX	125,110
WYOMING						
Clays ____ thousand short tons	2,140	$49,059	[r]2,628	[r]$67,921	2,302	$64,146
Gem stones	NA	250	NA	225	NA	225
Gypsum ____ thousand short tons	382	2,963	376	2,618	576	4,488
Sand and gravel (construction) ____ do	[e]2,400	[e]8,000	4,586	13,372	[e]3,500	[e]11,000
Stone (crushed) ____ do	2,019	7,769	[e]1,900	[e]7,600	[9]2,030	[9]7,329
Combined value of beryllium concentrate (1983), cement (portland), iron ore (1983), lime, sodium carbonate, and stone (crushed granite, 1985)	XX	561,860	XX	458,187	XX	465,275
Total	XX	629,901	XX	[r]549,923	XX	552,463

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

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes certain clays; value included with "Combined value" figure.
[3]Less than 1/2 unit.
[4]Partial total, excludes the values of magnesium compounds, which must be concealed to avoid disclosing company proprietary data.
[5]Excludes bentonite and fire clay.
[6]Excludes marl; value included with "Combined value" figure.
[7]Excludes salt in brines; value included with "Combined value" figure.
[8]Excludes sandstone; value included with "Combined value" figure.
[9]Excludes other stone; value included with "Combined value" figure.
[10]Excludes traprock; value included with "Combined value" figure.

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

(Thousand short tons and thousand dollars)

Area and mineral	1983 Quantity	1983 Value	1984 Quantity	1984 Value	1985 Quantity	1985 Value
American Samoa: Stone	NA	NA	NA	NA	([2])	1
Guam: Stone	329	2,192	[e]345	[e]2,280	548	3,731
Virgin Islands: Stone	237	2,305	[e]249	[e]2,397	214	2,405

[e]Estimated. NA Not available.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Less than 1/2 unit.

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

(Thousand short tons and thousand dollars)

Mineral	1983		1984		1985	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement (portland)	931	82,509	997	87,568	962	72,602
Clays	125	251	128	266	118	264
Lime	35	3,885	35	4,531	23	3,249
Sand and gravel	NA	NA	43	W	--	--
Stone:						
Crushed	5,536	26,611	e5,813	e27,675	5,493	25,799
Dimension	W	W	e35	e455	--	--
Total[2]	XX	113,256	XX	120,495	XX	101,914

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

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

[2]Total does not include value of items not available or withheld.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS				
Aluminum:				
Ingots, slabs, crude (metric tons)	259,598	$396,798	347,292	$441,598
Scrap (do.)	258,404	275,686	374,646	350,669
Plates, sheets, bars, etc (do.)	198,399	496,841	167,874	411,337
Castings and forgings (do.)	11,590	69,845	12,408	74,498
Aluminum sulfate (do.)	2,789	1,185	5,698	1,178
Other aluminum compounds (do.)	37,616	31,700	32,390	27,829
Antimony, metals and alloys, crude (short tons)	511	915	362	876
Bauxite including bauxite concentrate (thousand metric tons)	82	12,735	56	6,407
Beryllium (pounds)	39,315	2,562	119,428	6,375
Bismuth, metals and alloys (do.)	311,511	1,091	268,669	603
Cadmium metal (metric tons)	106	208	86	342
Chromium:				
Ore and concentrate:				
Exports (thousand short tons)	55	2,957	101	4,600
Reexports (do.)	4	864	4	670
Ferrochromium (do.)	15	10,542	10	7,688
Cobalt (content) (thousand pounds)	670	7,661	627	7,355
Copper:				
Ore, concentrate, composition metal, unrefined (copper content) (metric tons)	74,528	91,558	168,024	175,307
Scrap (do.)	80,810	96,266	134,300	132,386
Refined copper and semimanufactures (do.)	135,885	351,999	101,121	448,227
Other copper manufactures (do.)	13,817	30,438	7,883	17,522
Ferroalloys not elsewhere listed:				
Ferrophosphorus (short tons)	39,603	5,279	49,674	5,776
Ferroalloys, n.e.c (do.)	27,485	16,158	14,498	24,581
Gold:				
Ore and base bullion (troy ounces)	1,498,617	528,284	1,078,369	334,331
Bullion, refined (do.)	3,482,473	1,284,718	2,888,309	919,433
Iron ore (thousand long tons)	4,993	239,257	5,033	240,557
Iron and steel:				
Pig iron (short tons)	56,674	5,685	31,614	3,543
Iron and steel products (major):				
Steel mill products (do.)	977,284	904,011	929,954	855,078
Other steel products (do.)	261,246	513,942	200,387	465,672
Iron and steel scrap: Ferrous scrap including rerolling materials, ships, boats, other vessels for scrapping (thousand short tons)	9,840	938,402	10,191	940,416
Lead:				
Ore and concentrate (metric tons)	11,858	4,760	9,987	4,503
Pigs, bars, anodes, sheets, etc (do.)	7,445	15,214	27,342	20,977
Scrap (do.)	45,097	11,575	59,949	12,963
Magnesium, metal and alloys, scrap, semimanufactured forms, n.e.c (short tons)	48,337	136,661	40,322	113,600
Manganese:				
Ore and concentrate (do.)	237,606	15,643	56,040	4,286
Ferromanganese (do.)	6,764	4,397	6,927	4,762
Silicomanganese (do.)	5,333	2,237	3,089	1,359
Metal (do.)	4,082	5,915	5,162	7,242

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

Mineral	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
METALS —Continued				
Molybdenum:				
Ore and concentrate (molybdenum content) thousand pounds	63,366	$242,770	63,859	$247,690
Metal and alloys, crude and scrap do	306	1,209	574	2,365
Wire do	474	5,954	546	6,130
Semimanufactured forms, n.e.c do	257	6,368	408	8,390
Powder do	461	3,272	369	2,298
Ferromolybdenum do	650	1,567	1,262	2,698
Compounds do	26,602	56,453	23,769	46,109
Nickel:[1]				
Primary (unwrought commercially pure, anodes, ferronickel, powder and flakes) short tons	35,807	131,480	24,354	96,503
Wrought (bars, rods, angles, shapes, sections; plates, sheets, strip; tubes, pipes, blanks, fittings, hollow bar; wire) do	6,857	75,219	8,155	89,289
Compound catalysts and waste and scrap do	15,861	38,722	18,920	49,516
Platinum-group metals:				
Ore and scrap troy ounces	r563,345	123,349	362,384	76,993
Palladium, rhodium, iridium, osmiridium, ruthenium, osmium (metal and alloys including scrap) do	r377,802	74,748	339,254	56,116
Platinum (metal and alloys) do	220,885	76,749	187,013	54,052
Rare-earth metals: Ferrocerium and alloys short tons	34	309	29	317
Selenium kilograms	122,929	1,587	154,122	1,431
Silicon:				
Ferrosilicon short tons	29,364	21,135	12,969	12,671
Silicon carbide, crude and in grains (including reexports) do	6,023	8,613	5,186	7,446
Silver:				
Ore, concentrate, waste, sweepings thousand troy ounces	14,108	119,965	12,145	79,086
Bullion, refined do	10,340	86,339	12,611	81,746
Tantalum:				
Ore, metal, other forms thousand pounds	508	24,603	491	19,265
Powder do	151	17,026	143	15,188
Tin:				
Ingots, pigs, bars, etc.: Exports metric tons	1,429	14,409	1,478	16,744
Tinplate and terneplate do	154,679	93,033	155,119	85,000
Titanium:				
Ore and concentrate short tons	8,651	1,936	27,759	6,953
Unwrought and scrap metal do	4,484	9,359	6,992	17,475
Intermediate mill shapes and mill products, n.e.c do	2,849	61,502	3,395	70,423
Pigments and oxides do	108,247	102,828	103,201	112,870
Tungsten (tungsten content):				
Ore and concentrate metric tons	129	1,240	124	831
Carbide powder do	448	12,415	661	15,734
Alloy powder do	816	17,329	1,449	33,331
Vanadium:				
Ore and concentrate (vanadium content) thousand pounds	24	109	5	9
Pentoxide, etc do	7,423	14,514	3,053	6,300
Ferrovanadium do	938	5,205	908	4,791
Zinc:				
Slabs, pigs, or blocks metric tons	760	975	1,011	1,525
Sheets, plates, strips, other forms, n.e.c do	975	2,421	776	1,973
Waste, scrap, dust (zinc content) do	42,079	23,871	45,984	22,080
Semifabricated forms, n.e.c do	1,428	2,349	2,674	3,500
Ore and concentrate do	30,579	13,353	23,264	8,216
Zirconium:				
Ore and concentrate short tons	9,528	2,647	16,855	3,965
Oxide do	422	1,263	1,048	3,332
Metals, alloys, other forms do	808	42,523	1,153	51,558
INDUSTRIAL MINERALS				
Abrasives (includes reexports):				
Industrial diamond, natural or synthetic:				
Powder or dust thousand carats	47,992	74,337	51,593	81,806
Other do	3,301	30,441	3,291	29,530
Diamond grinding wheels do	536	5,141	553	6,603
Other natural and artificial metallic abrasives and products	XX	[2]99,719	XX	[2]89,716
Asbestos:				
Exports:				
Unmanufactured metric tons	39,779	18,221	45,075	16,366
Products	XX	162,690	XX	193,476
Reexports:				
Unmanufactured metric tons	140	125	581	123
Products	XX	657	XX	289
Barite: Natural barium sulfate short tons	1,449	574	5,876	692

See footnotes at end of table.

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

Mineral	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
INDUSTRIAL MINERALS—Continued				
Boron:				
Boric acid short tons	44,728	$24,402	49,457	$21,598
Sodium borates, refined do	r576,231	134,000	623,375	151,000
Bromine compounds thousand pounds	53,200	16,200	61,000	23,400
Calcium:				
Other calcium compounds including precipitated calcium carbonate short tons	37,000	17,000	49,000	25,000
Chloride do	34,062	20,568	26,143	6,343
Dicalcium phosphate do	40,000	33,000	58,600	43,000
Cement: Hydraulic and clinker do	80,007	13,496	97,897	21,478
Clays:				
Kaolin or china clay thousand short tons	1,418	170,137	1,381	174,204
Bentonite do	563	45,375	640	44,973
Other do	718	80,221	759	90,694
Diatomite do	127	29,461	120	28,519
Feldspar, leucite, nepheline syenite short tons	10,080	920	9,280	680
Fluorspar do	12,266	1,292	9,671	1,063
Gem stones (including reexports):				
Diamond thousand carats	2,273	574,719	2,378	571,300
Pearls	XX	8,265	XX	3,600
Other	XX	98,150	XX	56,500
Graphite, natural short tons	7,096	2,807	10,159	3,830
Gypsum:				
Crude, crushed or calcined thousand short tons	131	12,711	83	13,021
Manufactured, wallboard and plaster articles	XX	17,141	XX	13,398
Helium million cubic feet	392	21,461	439	25,316
Lime short tons	24,714	6,805	19,383	5,155
Lithium compounds:				
Lithium carbonate thousand pounds	18,069	24,487	13,916	19,006
Lithium hydroxide do	8,198	14,108	7,853	13,709
Other lithium compounds do	5,430	9,765	5,608	12,453
Magnesium compounds:				
Magnesite, dead-burned short tons	17,275	3,641	24,805	5,529
Magnesite, crude, caustic-calcined, lump or ground do	32,053	14,026	21,567	9,773
Mica:				
Waste, scrap, ground thousand pounds	15,306	2,038	17,378	2,370
Block, film, splittings do	348	549	82	159
Manufactured, cut or stamped, built-up do	NA	4,519	NA	5,103
Mineral-earth pigments, iron oxide, natural and synthetic short tons	32,428	31,832	29,720	27,574
Nitrogen compounds (major) thousand short tons	10,439	1,635,430	10,799	1,553,387
Phosphate rock thousand metric tons	r11,316	r392,032	10,284	281,515
Phosphatic fertilizers:				
Phosphoric acid do	r867	r181,055	716	141,162
Superphosphates do	2,847	r149,150	5,524	176,515
Diammonium phosphates do	6,346	1,200,579	6,131	1,048,322
Elemental phosphorus metric tons	14,852	22,375	17,131	27,024
Pigments and compounds: Zinc oxide (metal content) do	288	627	359	1,005
Potash:				
Potassium chloride do	621,820	57,200	699,770	NA
Potassium sulfate do	67,320	13,940	91,000	NA
Quartz, crystal:				
Cultured thousand pounds	277	11,021	185	3,723
Natural do	42	234	60	290
Salt:				
Crude and refined thousand short tons	820	15,299	904	15,988
Shipments to noncontiguous territories do	r18	2,301	23	5,196
Sand and gravel:				
Construction:				
Sand do	1,210	8,094	997	6,212
Gravel do	635	2,231	516	2,723
Industrial sand do	1,193	27,656	866	22,580
Sodium compounds:				
Sodium carbonate do	1,648	160,774	1,771	186,064
Sodium sulfate do	76	9,587	119	11,899
Stone:				
Crushed do	2,378	23,970	2,372	29,347
Dimension do	NA	r23,007	NA	13,835
Sulfur, crude thousand metric tons	1,334	156,067	1,365	189,248
Talc, crude and ground thousand short tons	256	16,162	237	14,282
Total	XX	r13,988,499	XX	13,065,121

rRevised. NA Not available. XX Not applicable.
[1]Not comparable to prior years owing to regrouping of nickel forms.
[2]Silicon carbide (crude and refined) has been deducted and is shown separately elsewhere in this table.

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

Mineral		1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
METALS					
Aluminum:					
Metal	metric tons	881,956	$1,292,724	868,674	$1,017,453
Scrap	do	137,675	145,748	127,501	108,625
Plates, sheets, bars, etc	do	457,562	1,027,631	423,769	847,476
Aluminum oxide (alumina)	thousand metric tons	4,466	976,364	3,979	809,664
Antimony:					
Ore and concentrate (antimony content)	short tons	4,299	6,798	6,638	12,381
Sulfide including needle or liquated	do	72	157	167	256
Metal	do	3,898	8,037	5,129	10,983
Oxide	do	17,884	26,348	10,620	20,765
Arsenic:					
White (As_2O_3 content)	do	13,985	9,454	16,472	14,059
Metallic	do	304	2,127	407	2,150
Bauxite, crude	thousand metric tons	r10,228	NA	7,944	NA
Beryllium ore	short tons	1,332	1,177	1,646	1,427
Bismuth, metals and alloys (gross weight)	pounds	1,948,394	5,892	1,998,865	10,172
Cadmium metal	metric tons	1,889	5,133	1,988	4,122
Calcium metal	pounds	248,973	670	492,244	1,395
Cesium compounds and chloride	do	53,652	1,552	50,537	1,595
Chromium:					
Ore and concentrate (Cr_2O_3 content)	thousand short tons	134	15,477	176	20,170
Ferrochromium (gross weight)	do	426	183,451	331	156,546
Ferrochromium-silicon	do	8	3,736	4	2,085
Metal	do	5	24,073	4	19,615
Cobalt:					
Metal	thousand pounds	23,316	202,954	16,613	181,379
Oxide (gross weight)	do	706	5,285	246	2,258
Salts and compounds (gross weight)	do	2,284	5,371	1,413	4,431
Columbium ore	do	3,265	6,030	2,899	4,673
Copper (copper content):					
Ore and concentrate	metric tons	11,056	9,863	2,869	1,739
Matte	do	2,094	2,586	3,997	6,997
Blister	do	38,949	52,950	12,979	15,529
Refined in ingots, etc	do	444,699	620,674	377,725	491,798
Scrap	do	23,005	28,925	23,014	25,680
Ferroalloys not elsewhere listed, including spiegeleisen	short tons	5,321	27,304	5,225	25,969
Gallium	kilograms	9,669	4,050	7,961	3,447
Germanium	do	116,719	7,539	14,841	8,829
Gold:					
Ore and base bullion	troy ounces	1,837,052	653,307	1,865,022	587,002
Bullion, refined	do	6,031,550	2,293,606	6,360,977	2,109,475
Hafnium	short tons	1	115	1	185
Indium	thousand troy ounces	1,022	4,577	980	3,480
Iron ore	thousand long tons	17,187	529,065	15,771	452,240
Iron and steel:					
Pig iron	short tons	702,355	83,985	338,258	50,619
Iron and steel products (major):					
Steel mill products	do	r26,169,048	r10,201,074	24,278,482	9,565,642
Other products	do	r1,146,133	r1,155,386	1,211,146	1,308,921
Scrap including tinplate	thousand short tons	572	46,946	601	45,620
Lead:					
Ore, flue dust, matte (lead content)	metric tons	29,888	11,923	2,649	979
Base bullion (lead content)	do	43	57	760	398
Pigs and bars (lead content)	do	161,489	86,189	131,353	53,864
Reclaimed scrap, etc. (lead content)	do	5,026	2,029	3,168	1,212
Sheets, pipes, shot	do	1,667	4,044	1,981	2,517
Magnesium:					
Metal and scrap	short tons	5,296	12,260	4,866	10,303
Alloys (magnesium content)	do	3,596	10,791	3,651	12,774
Sheets, tubing, ribbons, wire, other forms (magnesium content)	do	489	2,620	754	2,010
Manganese:					
Ore (35% or more contained manganese)	do	338,094	16,024	386,859	22,561
Ferromanganese	do	409,310	117,678	366,874	104,389
Ferrosilicon-manganese (manganese content)	do	91,339	44,746	109,719	51,423
Metal	do	13,314	12,978	8,566	9,052
Mercury:					
Compounds	pounds	r249,083	r1,111	329,889	1,625
Metal	76-pound flasks	25,327	7,274	18,890	5,337

See footnotes at end of table.

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

Mineral	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
METALS —Continued				
Molybdenum:				
Ore and concentrate (molybdenum content) thousand pounds	28	$183	112	$566
Waste and scrap (gross weight) do	NA	2,565	NA	2,830
Metal:				
Unwrought (molybdenum content) do	142	2,170	145	2,370
Wrought (gross weight) do	132	3,023	94	2,301
Ferromolybdenum (gross weight) do	2,086	4,438	1,424	3,721
Material in chief value molybdenum (molybdenum content) do	5,266	19,441	2,239	7,329
Compounds (gross weight) do	3,437	6,251	3,815	6,678
Nickel:				
Pigs, ingots, shot, cathodes short tons	103,017	461,371	97,779	446,009
Plates, bars, etc do	8,650	58,120	10,100	89,660
Slurry do	82,509	116,956	68,210	101,101
Scrap do	6,199	20,542	5,552	16,430
Powder and flakes do	15,829	78,736	12,753	67,717
Ferronickel do	43,048	68,429	36,528	60,253
Oxide do	5,526	22,413	5,079	20,722
Platinum-group metals:				
Unwrought:				
Grains and nuggets (platinum) troy ounces	19,786	5,647	20,827	6,807
Sponge (platinum) do	1,527,841	617,888	1,464,645	542,133
Sweepings, waste, scrap do	526,738	61,920	530,724	62,342
Iridium do	18,225	7,472	20,972	9,615
Palladium do	1,795,939	273,222	1,396,810	174,333
Rhodium do	155,671	83,979	201,028	173,310
Ruthenium do	198,257	16,652	162,887	16,474
Other platinum-group metals do	10,602	3,796	15,701	4,707
Semimanufactured:				
Platinum do	60,140	22,682	78,206	23,946
Palladium do	158,012	24,192	84,492	9,532
Rhodium do	2,389	516	145	73
Other platinum-group metals do	506	122	13,157	2,422
Rare-earth metals:				
Ferrocerium and other cerium alloys kilograms	138,128	1,651	113,385	1,302
Monazite metric tons	5,661	2,202	5,694	1,984
Metals including scandium and yttrium kilograms	4,316	619	3,185	285
Rhenium:				
Metal including scrap pounds	1,962	450	4,943	1,225
Ammonium perrhenate (rhenium content) do	r4,754	1,052	3,325	669
Selenium and selenium compounds (selenium content) kilograms	376,946	8,054	400,658	8,358
Silicon:				
Metal (over 96% silicon content) short tons	25,221	55,381	51,801	83,367
Ferrosilicon do	143,651	72,874	155,421	74,019
Silver:				
Ore and base bullion thousand troy ounces	13,018	105,587	3,533	20,180
Bullion, refined do	93,546	784,838	137,398	855,550
Sweepings, waste, doré do	8,402	72,772	11,671	76,218
Tantalum ore thousand pounds	2,199	19,054	737	8,187
Tellurium (tellurium content) kilograms	r35,383	725	30,050	871
Thallium pounds	2,964	96	2,655	50
Tin:				
Concentrate (tin content) metric tons	3,272	20,862	1,636	10,659
Dross, skimmings, scrap, residue, tin alloys, n.s.p.f. do	1,211	1,318	877	2,804
Tinfoil, powder, flitters, etc	XX	3,292	XX	3,290
Tin compounds metric tons	838	5,301	827	5,164
Titanium:				
Ilmenite[1] short tons	619,444	43,846	798,632	66,821
Rutile do	180,508	44,910	179,663	43,967
Metal do	5,533	35,469	5,479	39,408
Ferrotitanium and ferrosilicon titanium do	579	861	483	982
Pigments do	193,501	186,952	196,213	206,809
Tungsten ore and concentrate (tungsten content) metric tons	5,807	51,715	4,746	36,706
Vanadium (vanadium content):				
Ferrovanadium thousand pounds	2,341	11,839	1,557	7,757
Pentoxide do	297	1,269	22	180
Vanadium-bearing materials do	1,266	552	605	535
Zinc:				
Ore (zinc content) metric tons	86,172	29,186	90,186	33,626
Blocks, pigs, slabs do	639,228	635,940	610,900	508,003
Sheets, etc do	850	1,308	3,559	2,757
Fume (zinc content) do	314	171	—	—
Waste and scrap do	6,259	3,940	3,247	1,848
Dross and skimmings do	5,027	3,161	4,942	2,419
Dust, powder, flakes do	7,572	9,505	8,681	10,781
Manufactured	XX	927	XX	713

See footnotes at end of table.

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

Mineral	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
METALS —Continued				
Zirconium:				
Ore including zirconium sand ____ short tons	66,436	$7,548	43,787	$4,599
Metal, scrap, compounds ____ do	1,844	20,330	4,202	24,962
INDUSTRIAL MINERALS				
Abrasives:				
Diamond (industrial) ____ thousand carats	43,710	113,632	46,222	127,191
Other ____	XX	268,062	XX	255,686
Asbestos ____ metric tons	209,963	64,749	142,431	44,093
Barite:				
Crude and ground ____ thousand short tons	1,776	74,945	2,127	82,913
Witherite ____ short tons	226	153	142	74
Chemicals ____ do	35,208	20,524	32,907	19,978
Boron:				
Boric acid (contained boron oxide) ____ do	r4,000	3,449	6,000	5,121
Colemanite (contained boron oxide) thousand short tons	20,000	12,123	33,000	24,620
Ulexite ____ do	47,000	10,202	31,000	11,120
Bromine (contained in compounds) thousand pounds	16,080	10,996	17,079	11,065
Calcium chloride ____ short tons	22,078	1,817	77,736	10,967
Cement: Hydraulic and clinker thousand short tons	8,846	r294,207	14,487	437,429
Clays ____ short tons	31,585	4,868	40,902	5,981
Cryolite ____ do	22,722	13,124	16,596	10,003
Feldspar:				
Crude ____ do	2	1	936	1,126
Ground and crushed ____ do	23	14	16	25
Fluorspar ____ do	703,711	65,241	552,959	49,639
Gem stones:				
Diamond ____ thousand carats	r8,228	2,905,317	8,151	3,006,762
Emeralds ____ do	4,410	154,644	2,741	139,000
Other ____	XX	591,555	XX	534,113
Graphite, natural ____ short tons	58,246	14,579	52,737	16,186
Gypsum:				
Crude, ground, calcined ____ thousand short tons	8,915	74,357	9,924	64,331
Manufactured ____	XX	95,310	XX	91,091
Iodine, crude ____ thousand pounds	5,067	r24,803	4,971	26,761
Lime:				
Hydrated ____ short tons	59,906	3,669	48,827	3,407
Other ____ do	187,579	9,722	145,230	8,810
Lithium:				
Ore ____ do	r150	r33	4,716	1,277
Compounds ____ do	462	2,313	1,402	5,774
Magnesium compounds:				
Crude magnesite ____ do	r758	232	1,350	332
Lump or ground caustic-calcined magnesia ____ do	r54,893	9,594	65,709	10,407
Refractory magnesia, dead-burned, fused magnesite, dead-burned dolomite ____ do	155,162	r26,186	179,207	32,075
Compounds ____ do	46,153	10,036	36,751	10,085
Mica:				
Waste, scrap, ground ____ thousand pounds	23,198	3,251	20,057	2,920
Block, film, splittings ____ do	1,480	644	1,684	1,080
Manufactured, cut or stamped, built-up ____ do	856	2,836	978	3,154
Mineral-earth pigments, iron oxide:				
Ocher, crude and refined ____ short tons	7	31	26	22
Siennas, crude and refined ____ do	160	72	270	49
Umber, crude and refined ____ do	6,401	1,012	4,921	795
Vandyke brown ____ do	659	244	404	140
Other natural and refined ____ do	996	444	1,026	561
Synthetic ____ do	30,015	19,720	33,151	20,999
Nepheline syenite:				
Crude ____ do	410	17	920	62
Ground, crushed, etc ____ do	377,535	14,201	331,684	11,373
Nitrogen compounds (major) including urea thousand short tons	8,476	984,524	8,544	880,348
Peat:				
Fertilizer-grade ____ short tons	453,387	53,491	452,018	54,244
Poultry- and stable-grade ____ do	31,685	4,318	25,370	3,606
Phosphates, crude and apatite thousand metric tons	9	274	34	1,593
Phosphatic fertilizers:				
Fertilizer and fertilizer materials ____ do	119	7,536	30	5,929
Elemental phosphorus ____ do	r4	6,482	2	3,530
Other ____ do	11	1,550	3	492

See footnotes at end of table.

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

Mineral	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
INDUSTRIAL MINERALS —Continued				
Pigments and salts:				
Lead pigments and compounds ____ metric tons	19,081	$15,022	16,272	$12,468
Zinc pigments and compounds ____ do	52,432	48,178	52,310	48,244
Potash ____ do	7,947,700	658,100	7,570,900	499,100
Pumice:				
Crude or unmanufactured ____ short tons	16,703	402	781	198
Wholly or partly manufactured ____ do	r192	r48	357	103
Manufactured, n.s.p.f ____	XX	r48	XX	218
Quartz crystal (Brazilian lascas) __ thousand pounds	569	373	173	99
Salt ____ thousand short tons	7,545	74,100	6,207	65,593
Sand and gravel:				
Industrial sand ____ do	26	926	81	1,513
Other sand and gravel ____ do	151	1,603	246	1,572
Sodium compounds:				
Sodium carbonate ____ do	17	2,301	56	8,089
Sodium sulfate ____ do	265	21,198	194	14,492
Stone:				
Crushed ____ do	2,923	15,071	2,725	10,209
Dimension ____	XX	r223,150	XX	295,094
Calcium carbonate fines ____ thousand short tons	292	2,471	281	1,432
Strontium:				
Minerals ____ short tons	48,852	4,293	37,552	3,321
Compounds ____ do	4,755	3,386	7,403	5,586
Sulfur and compounds, sulfur ore and other forms, n.e.s ____ thousand metric tons	r2,557	r200,189	2,104	199,240
Talc, unmanufactured ____ thousand short tons	45	9,156	47	9,532
Total ____	XX	r31,497,367	XX	29,450,174

rRevised. NA Not available. XX Not applicable.
[1]Includes titanium slag averaging about 70% TiO_2. For details, see "Titanium" chapter.

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

(Thousand short tons unless otherwise specified)

Mineral	1984 World production[1]	1984 U.S. production	1984 U.S. percent of world production	1985[p] World production[1]	1985[p] U.S. production	1985[p] U.S. percent of world production
METALS, MINE BASIS						
Antimony (content of ore and concentrate) short tons	60,396	557	1	60,621	W	NA
Arsenic trioxide[2] ____ metric tons	44,099	6,800	15	45,030	2,200	5
Bauxite[3] ____ thousand metric tons	88,173	856	1	85,133	674	1
Beryl ____ short tons	9,838	6,030	61	9,688	5,738	59
Bismuth ____ thousand pounds	8,415	W	NA	9,175	W	NA
Chromite ____	10,312	--	--	10,951	--	--
Cobalt (content of ore and concentrate) short tons	35,869	--	--	39,867	--	--
Columbium-tantalum concentrate (gross weight) ____ thousand pounds	78,827	--	--	83,857	--	--
Copper (content of ore and concentrate) thousand metric tons	7,986	1,103	14	8,114	1,106	14
Gold (content of ore and concentrate) thousand troy ounces	46,408	2,085	4	48,217	2,475	5
Iron ore (gross weight) thousand long tons	817,428	51,269	6	845,251	48,751	6
Lead (content of ore and concentrate) thousand metric tons	3,256	334	10	3,392	424	12
Manganese ore gross weight) ____	26,027	--	--	26,922	--	--
Mercury ____ thousand 76-pound flasks	195	19	10	196	17	9
Molybdenum (content of ore and concentrate) ____ thousand pounds	214,506	103,664	48	215,139	108,409	50
Nickel (content of ore and concentrate) __	833	15	2	857	6	1
Platinum-group metals[2] thousand troy ounces	7,648	15	(4)	7,951	W	NA

See footnotes at end of table.

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

(Thousand short tons unless otherwise specified)

Mineral	1984			1985[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 —Continued						
Silver (content of ore and concentrate) thousand troy ounces	415,239	44,592	11	412,273	39,357	10
Tin (content of ore and concentrate) metric tons	198,432	W	NA	191,103	W	NA
Titanium concentrates (gross weight):						
Ilmenite	3,402	W	NA	3,654	W	NA
Rutile	388	W	NA	402	W	NA
Tungsten ore and concentrate (contained tungsten) metric tons	46,478	1,203	3	46,989	996	2
Vanadium (content of ore and concentrate) short tons	34,291	1,617	5	33,665	W	NA
Zinc (content of ore and concentrate) thousand metric tons	6,564	278	4	6,676	252	4
METALS, SMELTER BASIS						
Aluminum (primary only) do.	15,664	4,099	26	15,289	3,500	23
Cadmium metric tons	19,171	1,686	9	18,662	1,603	9
Cobalt short tons	25,608	--	--	28,217	--	--
Copper smelter (primary and secondary)[5] thousand metric tons	8,344	1,183	14	8,331	1,138	14
Iron, pig	546,317	51,961	10	555,222	49,963	9
Lead, smelter (primary and secondary)[6] thousand metric tons	5,494	1,072	20	5,569	1,124	20
Magnesium (primary)	360	159	44	361	150	42
Nickel[7]	771	45	6	782	36	5
Selenium[8] kilograms	1,350,702	253,598	19	1,122,835	W	NA
Steel, raw	782,008	[9]92,528	12	788,119	[9]88,259	11
Tellurium[8] kilograms	99,594	W	NA	98,500	W	NA
Tin metric tons	199,669	[10]4,000	2	193,715	[10]3,000	2
Zinc (primary and secondary) thousand metric tons	6,463	331	5	6,567	312	5
INDUSTRIAL MINERALS						
Asbestos do.	4,106	57	1	4,111	57	1
Barite	6,352	[11]775	12	6,671	[11]739	11
Boron minerals	2,775	1,367	49	2,679	1,269	47
Bromine thousand pounds	873,550	[11]385,000	44	835,090	[11]320,000	38
Cement, hydraulic	1,045,468	[12]78,699	8	1,071,225	[12]78,859	7
Clays:						
Bentonite[8]	6,493	[11]3,438	53	6,245	[11]3,195	51
Fuller's earth[8]	2,528	[11]1,899	75	2,704	[11]2,059	76
Kaolin[2]	23,354	[11]7,953	34	23,361	[11]7,793	33
Corundum short tons	16,265	--	--	16,805	--	--
Diamond thousand carats	63,517	--	--	66,371	--	--
Diatomite	1,933	627	32	1,951	635	33
Feldspar	4,167	710	17	4,294	700	16
Fluorspar	5,270	72	1	5,268	66	1
Graphite short tons	685,507	W	NA	676,740	W	NA
Gypsum	86,767	14,319	17	89,220	14,726	17
Iodine, crude thousand pounds	27,419	W	NA	27,141	W	NA
Lime	125,630	[11] [12]15,956	13	123,531	[11] [12]15,713	13
Magnesite	13,121	W	NA	13,208	W	NA
Mica (including scrap and ground) thousand pounds	608,700	322,000	53	537,792	275,100	51
Nitrogen, N content of ammonia	93,029	13,368	14	94,302	13,238	14
Peat	282,719	800	([4])	283,106	839	([4])
Perlite	1,808	[11]498	28	1,798	[11]507	28
Phosphate rock (gross weight) thousand metric tons	152,488	49,197	32	151,363	50,835	34
Potash (K_2O equivalent) do.	29,348	1,564	5	28,618	1,296	5
Pumice[8]	12,662	[11]502	4	12,110	[11]508	4
Salt	188,699	[11] [12]39,256	21	187,693	[11] [12]39,519	21

See footnotes at end of table.

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

(Thousand short tons unless otherwise specified)

Mineral	1984			1985[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
INDUSTRIAL MINERALS —Continued						
Sodium compounds, natural and manufactured:						
Sodium carbonate	31,126	8,511	27	31,628	8,597	27
Sodium sulfate	4,697	872	19	4,647	827	18
Strontium[8] short tons	137,236	--	--	138,700	--	--
Sulfur, all forms thousand metric tons	52,607	10,652	20	54,856	11,609	21
Talc and pyrophyllite	8,351	1,127	14	8,305	1,269	15
Vermiculite[8]	545	315	58	556	314	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 1985 was $405.9 million, a slight decrease from the record high of 1984. With the exception of clays, output of most nonfuel minerals increased over that of 1984.

Alabama was second in the Nation in production of crushed marble and bauxite; third in fire clay; fourth in masonry cement and kaolin; fifth in portland cement and lime; and sixth in ferroalloys and recovered sulfur. Alabama ranked 20th in the Nation in value of nonfuel minerals produced, but ranked 13th in value of industrial minerals. Valuewise, Alabama produced 2.4% of the Nation's industrial minerals.

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

Mineral		1984		1985	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	259	$17,247	268	$18,113
Portland	do.	3,656	167,191	3,721	165,972
Clays[2]	do.	1,906	30,500	1,873	13,139
Gem stones		NA	1	NA	1
Lime	thousand short tons	1,163	50,560	1,216	52,295
Sand and gravel:					
Construction	do.	10,348	26,188	e11,000	e32,000
Industrial	do.	442	3,600	524	4,533
Stone:					
Crushed	do.	e22,000	e98,500	25,853	109,176
Dimension	do.	e8	e2,674	11	2,881
Combined value of bauxite, clays (bentonite), and salt		XX	13,380	XX	7,805
Total		XX	409,841	XX	405,915

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

Table 2.—Nonfuel minerals produced in Alabama in 1984, by county[1]

County	Minerals produced in order of value
Autauga	Sand and gravel (construction).
Baldwin	Clays.
Barbour	Clays, bauxite, sand and gravel (construction).
Bibb	Clays.
Blount	Cement, sand and gravel (construction).
Calhoun	Clays, sand and gravel (construction).
Chilton	Sand and gravel (construction), clays.
Clarke	Sand and gravel (construction).
Clay	Do.
Coffee	Do.
Colbert	Do.
Dale	Do.
Dallas	Sand and gravel (construction), clays.
Elmore	Do.
Escambia	Sand and gravel (construction).
Etowah	Do.
Fayette	Do.
Franklin	Do.
Geneva	Do.
Greene	Do.
Hale	Do.
Henry	Clays.
Jefferson	Cement, clays.
Lowndes	Clays.
Macon	Sand and gravel (construction), sand and gravel (industrial).
Madison	Sand and gravel (construction), clays.
Marengo	Cement.
Marion	Sand and gravel (construction).
Marshall	Clays.
Mobile	Cement, sand and gravel (construction), sand and gravel (industrial), clays.
Monroe	Sand and gravel (construction).
Montgomery	Sand and gravel (construction), sand and gravel (industrial).
Pickens	Sand and gravel (construction).
Russell	Clays, sand and gravel (construction).
St. Clair	Cement, clays.
Shelby	Lime, cement, clays.
Sumter	Clays, sand and gravel (construction).
Tuscaloosa	Sand and gravel (construction), sand and gravel (industrial).
Walker	Clays.
Washington	Salt, sand and gravel (construction).
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Trends and Developments.—Overall, moderate economic recovery continued in the State as the unemployment rate dropped to below 10% for the first time since 1980. In the minerals sector, the results were mixed. Although employment in the primary metals sector was unchanged, employment and earnings in the construction industries increased and positively impacted the nonfuels minerals industry. In the Birmingham area, a record high $2 billion worth of construction was announced in 1985.

Activity in the State's metals industry was unsteady during the year as the steel industry operated at normal levels while the aluminum industry shut down. United States Steel Corp. (USS) operated at stable levels, although its pipe mill was shut down for short periods of time. USS planned construction of a $110 million second continuous slab caster at the Fairfield Works. The facility was scheduled to be started by early 1986 with completion by late 1987. Gulf States Steel Corp., Gadsden, under a divestiture order, had offers from two sources for a buyout. Late in the year, the U.S. Department of Justice recommended sale to an Ohio-based group. Tuscaloosa Steel Corp. completed construction of its $75 million, 600,000-ton-per-year minimill. British Steel Corp., a minority owner, will initially supply 250,000 tons of slab per year. Revere Copper & Brass Inc.'s aluminum smelter at Scottsboro remained closed. Noranda USA Inc. purchased Revere's sheet rolling mill for $50 million early in 1984 with plans to use aluminum from its smelter in New Madrid, MO. Reynolds Metals Co. closed its last two operating potlines at Listerhill in April and received aluminum ingots from Canadian Reynolds Metals

Table 3.—Indicators of Alabama business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	3,960	3,989	4,021
Total civilian labor force	do.	1,758	1,792	1,803
Unemployment	percent	13.7	11.1	8.9
Employment (nonagricultural):				
Mining total[1]	thousands	13.7	14.2	14.5
Nonmetallic minerals except fuels[2]	do.	2.1	2.3	2.4
Coal mining	do.	9.7	9.8	10.1
Oil and gas extraction[2]	do.	1.8	1.9	1.8
Manufacturing total	do.	340.9	359.8	356.5
Primary metal industries	do.	24.8	26.5	26.5
Stone, clay, and glass products	do.	8.7	8.9	9.0
Chemicals and allied products	do.	11.8	11.9	11.8
Petroleum and coal products[2]	do.	1.5	1.4	1.5
Construction	do.	59.8	64.8	71.1
Transportation and public utilities	do.	69.7	72.1	72.8
Wholesale and retail trade	do.	273.2	291.3	303.2
Finance, insurance, real estate	do.	59.9	62.8	65.6
Services	do.	218.9	229.3	241.4
Government and government enterprises	do.	292.7	293.4	297.3
Total	do.	1,328.8	1,387.7	1,422.4
Personal income:				
Total	millions	$36,980	$40,250	$42,913
Per capita		$9,338	$10,092	$10,673
Hours and earnings:				
Total average weekly hours, production workers		40.7	41.0	40.8
Mining		41.4	42.6	43.0
Total average hourly earnings, production workers		$7.6	$8.0	$8.5
Mining		$12.5	$13.2	$13.7
Earnings by industry:				
Farm income	millions	$488	$768	$621
Nonfarm	do.	$26,076	$28,475	$30,763
Mining total	do.	$483	$552	$591
Nonmetallic minerals except fuels	do.	$48	$56	$59
Coal mining	do.	W	$410	$449
Oil and gas extraction	do.	$72	$85	$83
Manufacturing total	do.	$6,795	$7,537	$7,867
Primary metal industries	do.	$722	$798	$826
Stone, clay, and glass products	do.	$188	$199	$211
Chemicals and allied products	do.	$352	$377	$394
Petroleum and coal products	do.	$49	$51	$52
Construction	do.	$1,447	$1,571	$1,767
Transportation and public utilities	do.	$2,053	$2,203	$2,265
Wholesale and retail trade	do.	$3,978	$4,361	$4,703
Finance, insurance, real estate	do.	$1,182	$1,280	$1,473
Services	do.	$4,451	$4,960	$5,540
Government and government enterprises	do.	$5,532	$5,839	$6,405
Construction activity:				
Number of private and public residential units authorized[3]		17,732	15,358	17,237
Value of nonresidential construction[3]	millions	$539.6	$746.9	$655.4
Value of State road contract awards	do.	$232.0	$290.7	$304.2
Shipments of portland and masonry cement to and within the State	thousand short tons	1,173	1,298	1,406
Nonfuel mineral production value:				
Total crude mineral value	millions	$361.3	$409.8	$405.9
Value per capita		$91	$103	$101

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

Co. Ltd. Aluminum Co. of America's (Alcoa) alumina refinery in Mobile, temporarily closed in 1982, was permanently closed in 1985; part of the facility will be used to store imported potash. Kerr McGee Corp.'s synthetic rutile plant in Mobile was expanded to meet the needs of the company's expanded titanium dioxide plant at Hamilton, MS.

The relative importance of the steel industry was reflected in its share of the gross State product. In 1974, the steel industry's share was 5.6%, dropping to 2.1% in 1983, and by 1985 had risen to only 2.3%. The rise was attributed to USS' efforts in the Birmingham area where about $1.3 billion was expended to upgrade and modernize the Fairfield steelworks. Reduced import competition along with declines in the value of the dollar were expected to help manufacturers in the State.

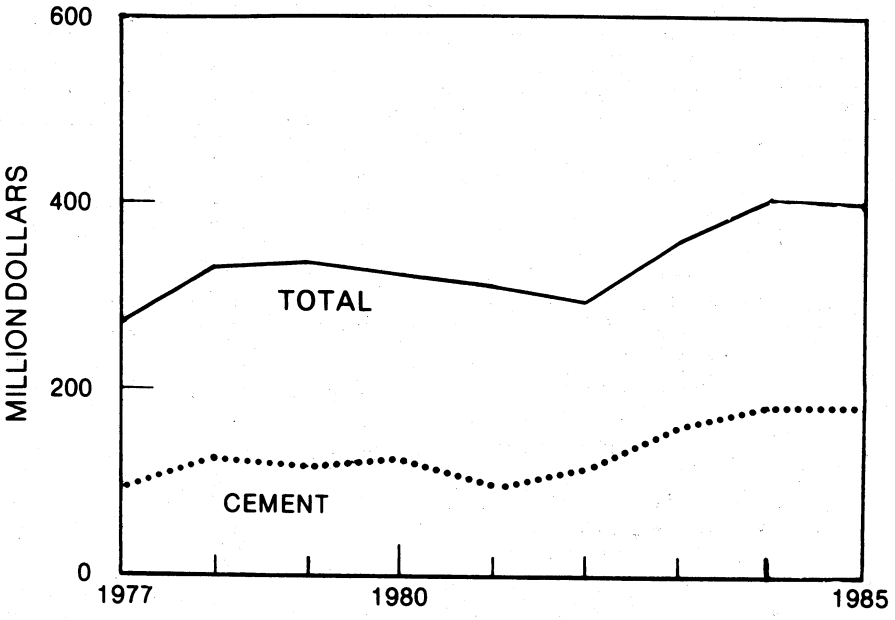

Figure 1.—Value of cement and total value of nonfuel mineral production in Alabama.

The Tennessee-Tombigbee Waterway was dedicated early in the year, ahead of schedule. By yearend, nearly 2 million short tons of commodities valued at $158 million was shipped on the waterway. Leading commodities included salt and crushed stone.

The Alabama State Docks at the Port of Mobile handled 28 million tons of cargo in fiscal year 1985 compared with 24.8 million tons in fiscal year 1984. The Alabama State Docks handled imports of several mineral commodities during the year. To assist in handling commodities, a second unloading tower was installed increasing the rated unloading capacity of the bulk plant to 3,000 short tons per hour. A 60,000-ton-capacity warehouse was converted for storage of potash. The dock's coal export plant was the largest on the gulf coast and second largest in the Nation. The plant could hold 2 million short tons of coal with an annual throughput capacity of 23 million short tons. Minerals handled included iron ore (1,100,000 tons), cement (900,000 tons), ilmenite (180,000 tons), potash (150,000 tons), sand (50,000 tons), manganese (35,000 tons), and rutile (16,000 tons).

The Department of Industrial Relations reported that coal production for fiscal year 1985 increased slightly to 26.6 million tons. Of the coal operations, 19 were underground and 131 were surface mines; tonnage was nearly equally split between surface and underground mines. Four mines produced in excess of 1 million tons; all were underground.

Sunbelt Chemicals Inc., Atmore, a manufacturer of agricultural and industrial sulfur, completed expansion for producing liquid sulfur. Sunbelt utilized sulfur recovered from local natural gas processing plants.

The Alabama Development Office announced that capital investments on new and expanding industry decreased from $1.6 billion in 1984 to $1.2 billion in 1985. In the mineral-related sectors, mining and quarrying of nonmetallic minerals had 6 expansions totaling $4.5 million; stone, clay, glass, and concrete products had 3 new operations and 54 expansions totaling $35.0 million; and primary metals had 5 new operations and 46 expansions totaling $190.7 million. The largest industrial announcement in terms of value was the previously cited $110 million by USS in Fairfield.

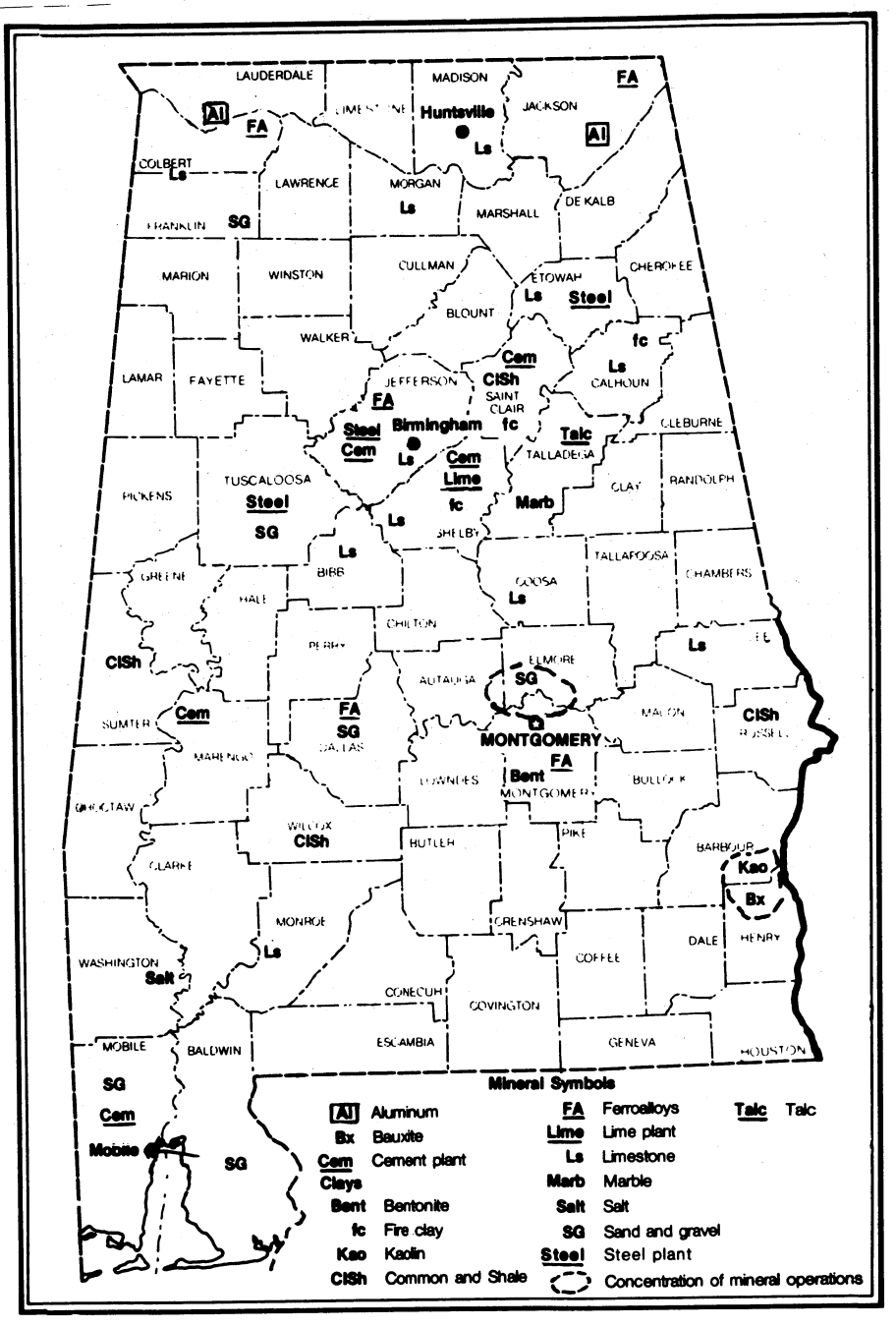

Figure 2.—Principal mineral producing localities in Alabama.

Employment.—Alabama's unemployment rate dropped from 11.1% in 1984 to 8.9% in 1985. The State had the largest decline in unemployment rates in the Nation. The rate dropped slowly to a low of 7.8% in October 1985 and increased to 8.0% by yearend. Total mining and construction employment increased while primary metals employment was unchanged. The decline of the steel industry is attributed to undercapitalization and aging plants.

Legislation and Government Programs.—The Geological Survey of Alabama (GSA) continued comprehensive programs, which included assessment of the mineral, energy, and water resources of the State. GSA provided resource information and evaluations to other State agencies to assist in development of baseline data for sound regulatory decisions. GSA maintained a geochemistry laboratory, an earth-science library, a well-cuttings and core sample library, and a geocartographic division.

Water resource investigations continued on watersheds in the Warrior Coalfield, potential saltwater encroachment in coastal Alabama, and the influence of coalbed methane development on ground water supplies. Work was completed on a study of the potential impact of excessive ground water discharge on the aquifers of southeastern Alabama. Cooperative studies were conducted with the U.S. Geological Survey (USGS) involving the collection of surface water, ground water, water quality, and water use data. Mineral resource studies of carbonite rock and cobalt-bearing manganese resources were completed. Studies of coal underclays, gold, granite, kyanite, marble, and zeolite resources were initiated. Projects in the Energy Resources Division included collection of samples of various coalbeds for analysis, an inventory of underground mines, a coal map of Walker County, and a compilation of all available data on Alabama lignite. The oil and gas potential of the Black Warrior Basin continued to be examined, as well as possible development of coalbed methane gas. The Environmental Geology Division collected baseline biological, sediment, and water quality data concerning the effects of surface mining and methane gas production on aquatic ecosystems in the Warrior Coalfield. Similar studies were conducted on other energy-resource areas in Alabama. The Geologic Mapping Division continued upgrading of existing maps and field mapping for preparation of a new State geologic map. Field investigations continued with emphasis on the Coastal Plain, Valley and Ridge, and Piedmont Provinces.

The Mineral Resources Institute of the University of Alabama at Tuscaloosa received funding from the U.S. Bureau of Mines during fiscal year 1985 to encourage the training of mining engineers and other scientists involved in mineral-related studies and to continue research in mineral exploration, mining, processing, utilization, and conservation. Although primary emphases were on energy-related projects, nonfuel research was also conducted on metallic and nonmetallic mineral resources. At the end of the fiscal year, the basic clay testing work done by the Bureau of Mines was transferred to the Mineral Resources Institute. Other research by the institute included rock characterization in deep coal mines, comparison between diesel and electric shuttle cars, subsidence study of Alabama coalfields, and holographic testing methods of earth material for surface mining.

The responsibility of the State Lands Division of the Department of Conservation and Natural Resources is to manage State lands not being used for specific purposes. The division had two major nonfuel leases, one in waterways of south Alabama and one on the Tennessee River. In fiscal year 1984, royalty receipts totaled $4.7 million, with $3.0 million from oil and gas, $673,000 from coal, $210,000 from sand and gravel, and $47,000 from shell. The balance was from permits, miscellaneous fees, and easements.

The University of Alabama announced plans to develop a Metal Casting Technology Center on the campus at Tuscaloosa. The aim is the progressive development of metal casting through expanded research, technological utilization, and industry assistance. The proposed center would provide a wide range of services to fill the needs of varying sizes and types of foundries. These services would include basic research, applied research, and service and assistance programs.

During the year, the State legislature passed Act 85-760, which would create an Alabama Mining Academy at the Walker State Technical College at Sumiton. Major emphasis would be on coal mining activities.

USGS continued its cooperative agreement with GSA in regards to water resource investigation. USGS studied authigenic K-feldspars, origins of natural gas, character-

istics of coalbeds, coal geochemistry, Talladega slate belt, and the fossiliferous marine sediments of western Alabama.

In fiscal year 1985, the Bureau of Mines had several contracts in the State. Wyle Laboratories, Huntsville, had three projects: extension of low coal canopy technology to include coal drilling and cutting machines, investigation and control of noise generated during coal drilling, and engineering evaluation of environmental cabs for control of dust. A commercially produced cutting bit, based on a Bureau-developed "anti-ignition" concept, was tested on a continuous mining machine of Jim Walter Resources Inc.'s No. 3 Mine. In addition to preventing ignition, the new bit reportedly had a longer expected life than that of conventional bits.

The Bureau of Mines Tuscaloosa Research Center conducted several mineral-related projects in Alabama. These studies resulted in Report of Investigation (RI) 8954, "Ground-Penetrating Radar for Strata Control"; RI 8958, "Recovery of Zircon From Investment Casting Molds"; RI 8962, "Volume Expansion of Acidproof Brick Exposed to 20 Wt Pct HCl at 90° C"; and RI 8980, "High-Temperature Properties of Magnesia-Refractory Brick Treated With Oxide and Salt Solutions." Other publications pertinent to the State were RI 8971, "Measurement of Air Velocity in Mines"; Information Circular 9010, "Mining Health and Safety In-House and Contract Research in Fiscal Year 1985"; and Bulletin 681, "Dewatering of Mineral Wastes Using the Flocculant Polyethylene Oxide."

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Industrial minerals accounted for the bulk of the value of Alabama's total nonfuel mineral production. Construction minerals output increased primarily because of increased construction activity.

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

Cement.—Cement accounted for over one-third of the value of nonmetallic minerals produced in Alabama, with both masonry and portland cements being produced. Nationally, Alabama ranked fourth and fifth in the production of masonry and portland cement, respectively. Production of both types of cement increased slightly.

Portland cement was produced at six plants in Alabama, two in Jefferson County, and one each in Marengo, Mobile, St. Clair, and Shelby Counties. Five plants used the dry process while Allied Products Co. used the wet process. The six companies operated eight kilns. Seven plants produced masonry cement, with Cheney Lime & Cement Co. being one of two plants nationally that produced masonry cement exclusively. Of the six companies operating, four were owned by foreign companies. Principal raw materials used in making cement included cement rock, chalk, clays, gypsum, iron ore, limestone, sand, and shale; coal was used as a fuel.

Ideal Basic Industries Inc., shut down since the end of 1984, ground clinker imported from Mexico. The plant employed only 70 people out of a regular employee base of 250. On the market during the year, the company suffered a $20 million loss over the first 6 months. Ideal completed an agreement with Alcoa to purchase its limestone operation in the Dominican Republic; Ideal's domestic source of limestone contained too much moisture. In the fourth quarter, Ideal took a $200 million write-down of its Theodore operations.

National Cement Co. Inc., Ragland, completed work on improving its clinker handling system to make it more efficient and dust free; pan conveyors and enclosed bucket conveyors were installed. National, as part of a $6.2 million expansion program, completed work on a crushing conveying system and a 1,000-short-ton-per-hour portable crusher. National has an annual capacity of 900,000 short tons per year and expanded its product line to better handle a regional market.

Table 4.—Alabama: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1984	1985
Number of active plants	7	7
Production	236,274	255,681
Shipments from mills:		
Quantity	258,831	268,367
Value	$17,247,161	$18,113,262
Stocks at mills, Dec. 31	29,341	36,859

Table 5.—Alabama: Portland cement salient statistics

(Short tons unless otherwise specified)

	1984	1985
Number of active plants	6	6
Production	3,677,767	3,723,034
Shipments from mills:		
Quantity	3,656,445	3,721,434
Value	$167,191,212	$165,971,931
Stocks at mills, Dec. 31	389,730	378,386

Clays.—Clays produced in Alabama included common clay, fire clay, bentonite, and kaolin. Output and value of total clays decreased from that of 1984. Alabama ranked third nationally in the production of fire clay and kaolin. Clays ranked fifth in mineral value in Alabama in 1985 as 22 companies mined clay at 33 pits in 16 counties.

Common clay was mined by 13 companies at 21 pits in 12 counties. Leading counties were Jefferson, Shelby, and Sumter. Production increased while value decreased; major uses were brick, cement, and concrete block, with tonnages used in brick manufacture increasing. C-E Refractories purchased the specialty refractory product line of the Donoho Clay Co., Anniston. Donoho agreed to manufacture a range of C-E specialties at the Anniston plant. Vulcan Materials Co. operated its lightweight agregate plant at Parkwood at reduced levels of output.

Fire clay was mined by four companies at five pits in Calhoun, St. Clair, and Shelby Counties. Production and value decreased from that of 1984.

American Colloid Co. mined bentonite at its operation in Lowndes County for use in drilling muds and the foundry industry; production decreased. The company operated three pits where the material was dried, crushed, and shipped to markets nationwide.

Kaolin was mined by four companies at six pits in Barbour and St. Clair Counties. Production and value decreased substantially. Major uses were in firebrick and other refractories. Kaolin occurs in association with bauxite, which was also used for refractory purposes. Mining companies continued to operate at substantially reduced levels during the year.

Fluorspar.—International Minerals & Chemical Corp. operated a fluosilicic acid plant at Florence. 3M Corp.'s Specialty Chemicals Div. operated a plant at Decatur to manufacture chemical-resistant products for the rubber industry. The company produced a fluoroelastomer used in nonmetallic ducting-system expansion joints for pollution control and a general purpose gumstock without curatives.

Lime.—Alabama ranked fifth nationally in the production of lime, which was the third leading commodity, valuewise, produced in the State in 1985. Production and value increased over that of 1984. Four companies produced lime in five plants in Shelby County. Output of hydrated lime decreased while that of quicklime increased. In the Birmingham area, reportedly, there is a 30% lime kiln overcapacity.

Mullite (Synthetic).—Synthetic mullite was produced by Harbison-Walker Refractories Co. Inc. at Eufaula. The output, a high-temperature sintered variety, was used primarily for the manufacture of refractories, with demand reflecting steel industry activities. Alabama was one of three States with a recorded production of synthetic mullite, a product of sintering a mixture of aluminous and siliceous material.

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

Use	1984		1985	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Paper and pulp	371,450	$15,937	365,478	$15,512
Water purification	176,742	7,599	196,405	8,692
Sewage treatment	77,078	3,954	74,492	3,159
Road and soil stabilization	25,239	1,071	21,709	940
Sugar refining	10,851	642	W	W
Other[1]	501,956	21,357	557,958	23,992
Total	1,163,316	50,560	1,216,042	52,295

W Withheld to avoid disclosing company proprietary data.

[1]Includes acid water neutralization, agriculture, alkalies, animal and human food, aluminum and bauxite, basic oxygen steel, electric steel, fertilizer (1984), finishing lime, magnesia from seawater or brine, mason's lime, open-hearth steel (1984), other ore concentration, other chemical and industrial uses, other construction lime (1984), petroleum refining, rubber (1984), sulfur removal from stack gases (1984), tanning, and use indicated by symbol W.

Nitrogen.—Anhydrous ammonia was produced by Tennessee Valley Authority, Muscle Shoals, and U.S.S. Agri-Chemicals Inc., Cherokee. Total annual capacity of the two plants was 249,000 short tons. The Alabama Directory of Mining and Manufacturing also listed Estech Corp., Dothan, and Hercules Inc., Bessemer, as having anhyrous ammonia in their product line.

Perlite (Expanded).—W. R. Grace & Co., Birmingham, and National Gypsum Co., Mobile, expanded perlite from ore shipped in from the Western United States. Production and value increased significantly over that of 1984, with a slight increase in unit values. The expanded perlite was used for formed products, horticultural purposes, and concrete aggegate.

Salt.—Alabama ranked 10th nationally in output of salt. Olin Corp., Washington County, produced salt from brine wells by solution mining a near-surface salt dome. Three basic products were produced by Olin: chlorine, sodium hydroxide, and sodium chlorate. Production decreased while unit value increased slightly. A portion of the solid salt produced was shipped to Olin's chloralkali plant in Augusta, GA. Alby Klorate AB and Olin announced the formation of a jointly owned firm, Alby Olin Chlorates Co.; the firm will handle the production and sale of sodium chlorate in North America for the two firms. Alby Olin will take over Olin's chlorate plant in MacIntosh, Washington County.

Sand and Gravel.—Alabama produced both construction and industrial sand and gravel in 1985. Total sand and gravel production and value were estimated to have increased over that of 1984; unit values increased.

Construction.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel ranked fourth in terms of mineral value in 1985 with production increasing, reflecting increased construction activities throughout the State. Most operations were relatively small, with no individual pit producing over 1 million short tons.

Industrial.—Five companies produced industrial sand and gravel with output increasing along with unit values. Industrial sand and gravel was used primarily by foundries for molds and cores. Production for use at silicon alloy plants increased because of increased output from alloy plants. All industrial sand and gravel producers were relatively small with individual output under 250,000 short tons per year.

Slag—Iron and Steel.—Alabama was 1 of 26 States that reported processing and utilization of iron and steel slag. Total output and value increased 13.0% and 14.8%, respectively. Both output and value of iron slag and that of steel slag increased. Jim Walter Resources, Birmingham, and Vulcan, Fairfield and Gadsden, air-cooled blast furnace slag, which is typically used as road base, railroad ballast, and as asphaltic concrete. Vulcan sold steel slag for the same basic uses.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend. Of the Nation's top 150 quarries, rated as to production, 7 were in operation in Alabama.

Crushed.—Crushed stone ranked second in mineral value in Alabama with output increasing over that of 1984. Material mined included limestone, dolomite, marble, and granite. Alabama was second in the Nation in output of crushed marble. Crushed stone was produced by 30 companies at 45 operations in 20 counties. Crushed stone was used primarily in cement manufacture, as concrete aggregate, and as a road base. Principal production was from Shelby, Jefferson, and Madison Counties. Nine companies produced in excess of 1 million short tons per year and accounted for 82% of all crushed stone. Shipments were mainly by truck, with minor tonnages shipped by rail or waterway.

Both Hoover Inc. and Vulcan opened quarries in Madison County in north Alabama. Both companies received environmental complaints because of the proximity of their operations to Huntsville residential areas. Wade Sand and Gravel Co. remodeled its crushing and screening facilities at its quarry in Birmingham. Southern Stone Co. closed its Dolonah Quarry near Bessemer because of water problems. Dolcito Quarry Co., Tarrant, continued its $2.1 million expansion, which included fine grind facilities for mine dust, filler, and aglime. Dolcito plans to construct a manufactured sand plant in 1986 and automate its crushing and screening plant.

Table 7.—Alabama: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	372	1,375
Filter stone	75	371
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,907	8,850
Bituminous aggregate, coarse	1,717	7,091
Bituminous surface-treatment aggregate	1,702	6,935
Railroad ballast	543	1,959
Fine aggregate (-3/8 inch):		
Stone sand, concrete	639	2,844
Other fine aggregate	134	503
Combined coarse and fine aggregates:		
Graded road base or subbase	2,304	9,686
Unpaved road surfacing	144	573
Terrazzo and exposed aggregate	76	352
Crusher run, fill, or waste	2,062	8,639
Other construction[2]	1,278	5,485
Agricultural: Agricultural limestone	305	1,875
Chemical and metallurgical:		
Cement manufacture	2,625	7,703
Sulfur oxide removal	212	544
Special:		
Whiting or whiting substitute	254	3,381
Other fillers or extenders	497	4,683
Other miscellaneous[3]	1,567	6,366
Other unspecified[4]	7,440	29,964
Total	25,853	[5]109,176

[1]Includes limestone, dolomite, granite, and marble.
[2]Includes stone used in macadam, drain fields, stone sand bituminous mix or seal, and stone used for other construction and maintenance purposes.
[3]Includes stone used in lime manufacture, chemical stone, abrasives, flux stone, mine dusting or acid water treatment, asphalt fillers or extenders, stucco, and waste material.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data do not add to total shown because of independent rounding.

Dimension.—Production of dimension stone increased 40% with a decrease in unit values. Alabama ranked fourth nationally in output of dimension marble. Marble was quarried in Talladega County; limestone, from an underground operation in Franklin County; and sandstone, in Blount County. Moretti-Harrah Marble Co., Sylacauga, completed modernization of its dimension marble plant. The plant will produce small items such as floor tile. Alabama Limestone Inc., Franklin County, was one of the top producers of dimension limestone in the Nation.

Sulfur (Recovered).—Alabama ranked sixth nationally in output of recovered sulfur. Two companies recovered sulfur from natural gas processing plants in Escambia and Washington Counties. Exxon Co., Hunt Oil Co., Phillips Petroleum Co., and Union Oil Co. sold 367,000 metric tons valued at $35.4 million, a decrease of 3.4% in quantity from that of 1984; unit prices increased 6.3%. The State Revenue Department indicated it may attempt to collect severance taxes on recovered sulfur. Although no final decision was made, the Governor's office proposed to the 1986 legislature that a severance tax be collected on recovered sulfur.

Talc.—Cyprus Industrial Minerals Co. ground talc from out of State at its plant near Alpine; output increased. The product was used primarily in paper, cosmetics, paint, plastics, rubber, and ceramics.

Vermiculite (Exfoliated).—W. R. Grace, Irondale, exfoliated vermiculite from crude ore shipped into the State. Primary uses were in concrete aggregate, block insulation, loose fill insulation, and as a sand conditioner. Production and value decreased from that of 1984.

METALS

Primary metal production has been one of the most important industries in the State; however, its impact has decreased over the last decade. In 1974, the steel industry's share of the gross State product was 5.6%, but by 1985 it had decreased to 2.3%. Most of the State's adverse economic conditions can be traced to the downward trend of the metals industry. The industry in Alabama consists of aluminum, ferroalloys, steel, and various foundries with aluminum being impacted more than the others.

Aluminum.—Alabama was 1 of 17 States

with primary aluminum production facilities. Two companies, Revere in Scottsboro and Reynolds in Sheffield, have facilities for producing aluminum. Reynolds operated early in the year and then shut down, while Revere was shut down for the third straight year; output dropped considerably. Both facilities were considered high-unit-cost operations because of relatively high power costs. At the beginning of the year, Reynolds operated two potlines out of seven; one shut down in February and the other in April. Reynolds permanently closed the seven potlines at yearend as part of a $313.5 million third-quarter writedown. The last time all potlines were in operation was in 1980 when 1,500 people were employed. Cited as the primary reason for the shutdown was the high cost of power—37 mills per kilowatt hour; estimated cost to produce aluminum was more than $0.70 per pound. To supply aluminum to the rest of the plant, Reynolds started up its secondary aluminum facility capable of handling 50,000 short tons per year. Additionally, aluminum ingots were shipped to Mobile from Canadian Reynolds Metals at Baie Comeau, Quebec, Canada. The ingots were shipped by barge from Mobile by way of the Tennessee-Tombigbee Waterway. Revere won court approval to sell its 75,000-ton-per-year rolling mill for $50 million to Noranda. The plant will receive ingots from Noranda's smelter in New Madrid, MO. The mill produces various rolled sheet and plant products. The U.S. Die Casting and Development Corp. purchased Ford Motor Co.'s aluminum diecasting plant in Muscle Shoals late in the year. Present plans call for renovation with startup in February 1986.

National Aluminum Corp. planned to build an extrusion plant in Anniston to be operational by late 1986.

Mitsubishi Corp. of Japan and Thermal Components Inc., Montgomery, announced plans to construct a 36,000-ton-per-year aluminum extrusion plant in Montgomery. The new company, Thermalex Inc., expected the plant to be operational by mid-1986.

Bauxite.—Alabama was one of two States producing bauxite. Three companies mined bauxite in Barbour and Henry Counties for use in refractories. Production and value decreased considerably. All producers continued to operate intermittently during the year; only one company mined while the others operated out of stocks. Mullite Co. of America became the first company to ship product by barge down the Chattahoochee River; the product was shipped to Mexico for use as a refractory.

Ferroalloys.—Alabama ranked sixth nationally in shipments of ferroalloys with output and value decreasing 43% and 22%, respectively. Products included ferrosilicon and silicon metal. During the year, many of the ferroalloy plants operated at reduced levels. Reynolds announced a $1 million renovation of its silicon plant at Sheffield. Ohio Ferro-Alloy Corp. secured a 5-year agreement to sell silicon metal from its 54-megawatt plant at Mount Meigs to General Electric's Silicon Products Div. The Mount Meigs facility operated at near capacity of its three furnaces utilizing local gravel. Ohio Ferro-Alloy secured a $3 million loan from General Electric Credit Corp. to remain in operation.

Gold.—Developments in Alabama were generally restricted to recreational gold mining with limited exploration by various companies. Several thousand acres in east Alabama remain under lease, mostly in areas of abandoned base metal mines.

Iron and Steel.—Alabama was 1 of 13 States that produced pig iron; shipments increased along with unit values. Gulf States Steel, Gadsden, and USS, Fairfield, were the major iron and steel companies; both companies operated intermittently as market conditions warranted. Early in the year, USS shut down its 2,500-short-ton blast furnace and started up its 5,000-ton blast furnace to meet increased demand for hot metal. The company announced plans to build a second continuous caster that will produce a wide, flat steel slab. The $110 million facility was scheduled to be operational in 1987. Additionally, USS announced improvements at the hot-strip mill, which would include two new slab reheat furnaces and improvements to the runout table cooling system. During the last 10 years, USS expended more than $1.3 billion to modernize the Fairfield Works. Gulf States Steel, under a divesture order, had two serious bidders, the Brenlin Group and former company employees. The plant has not made a profit since 1980, and losses for 1985 were projected at $33 million. In December, a Federal judge ruled that Gulf States must be sold to the Brenlin Group. The cost would be from $50 to $70 million, depending on inventory, with closure expected early in 1986. The Brenlin Group plans to close the plant for minor repairs

and rehire about three-fourths of the workers on reopening. Planned capital improvements, $250 million, would include relining the blast furnace, installation of two electric furnaces, and a continuous caster.

Tuscaloosa Steel, Tuscaloosa, started operations at its new $75 million hot rolling mill late in the year. The mill was constructed after a 7-year contract with British Steel Corp. was signed providing 300,000 tons of semifinished steel slabs the first year and up to 600,000 tons per year by 1989. A steel pact between the United Kingdom and the United States will allow imports of only 200,000 tons of slab per year. Possible sources for the balance could be USS in Birmingham. O'Neal Steel Inc., Birmingham, will be exclusive representative to sell products from Tuscaloosa Steel.

SMI Steel Inc.'s minimill in Birmingham, formerly owned by Connors Steel Co., operated profitably in 1985, approaching an output of 200,000 tons. Construction began on a new steel finishing facility, which when completed in 1986, should increase output to 240,000 tons per year.

McWane Cast Iron Pipe Co., Birmingham, announced plans to purchase Clow Corp. of Jacksonville, FL, which makes pipes, valves, and fittings. Birmingham Steel Corp., Birmingham, plans to install pollution control equipment and a 50-ton electric arc furnace. Most of the $12.7 million cost will be obtained through industrial bonds and pollution control bonds.

Ferrous Foundries.—Iron and steel foundries were an important industry that directly affected mineral producers in the State and region. Raw materials used included clay, limestone, sand, and scrap, most of which came from sources in the region. The Alabama Directory of Mining and Manufacturing listed 42 grey iron foundries, 24 steel foundries, and 6 steel investment foundries. In addition, there were 6 aluminum smelters and 14 secondary nonferrous smelters.

Manganese.—Manganese dioxide, along with chromite, was ground by N. K. Industries Inc. at its facilities in Phenix City for use in brick colorization. Source of the manganese was Australia, while chromite was received from Montana. The company is undergoing a $600,000 expansion to add a second ball mill; completion was scheduled for 1986.

Rutile (Synthetic).—Kerr-McGee, Mobile, operated its synthetic rutile plant with output shipped to Hamilton, MS, for processing to titanium dioxide pigments. Kerr-McGee was the sole domestic producer of synthetic rutile at its 110,000-short-ton-per-year plant. Ilmenite from Australia was used as feed material for the synthetic rutile plant; about 180,000 short tons was imported through the Port of Mobile. The plant was expanded to satisfy outside sales and meet increased feedstock requirements at Hamilton.

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

[2]State geologist, Geological Survey of Alabama, Tuscaloosa, AL.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum (smelters):			
Revere Copper & Brass Inc	Box 191 Rome, NY 13440	Plant	Jackson.
Reynolds Metals Co	Reynolds Metals Bldg. Richmond, VA 23218	do	Colbert.
Bauxite:			
A. P. Green Refractories Co.,[1] a subsidiary of USG Corp.	Mexico, MO 65265	Mine and plant	Barbour.
Harbison-Walker Refractories Co. Inc.,[2] a division of Dresser Industries Inc.	Dale Rd. Route 1, Box 58 Eufaula, AL 36027	do	Barbour and Henry.
Mullite Co. of America	901 East 8th Ave. King of Prussia, PA 19406	Mines	Do.
Cement:			
Allied Products Co.[3]	Box 36130 Birmingham, AL 35236	Plant	Jefferson.
Blue Circle Inc.[4]	Box 182 Calera, AL 35040	do	Shelby.
Citadel Cement Corp	2625 Cumberland Parkway, NW. Atlanta, GA 30339	do	Marengo.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Cement —Continued			
Ideal Basic Industries Inc.[4]	950 17th St. Box 8789 Denver, CO 80201	Plants	Mobile.
Lehigh Portland Cement Co	Box 1882 718 Hamilton Mall Allentown, PA 18105	Plant	Jefferson.
National Cement Co. Inc	Box 7348 Mountain Brook Station Birmingham, AL 35223	do	St. Clair.
Clays:			
Bickerstaff Clay Products Co. Inc	Box 517 Bessemer, AL 35020	Mines	Jefferson and Russell.
Blue Circle Inc	18th Floor, Daniel Bldg. Birmingham, AL 35233	Mine	Shelby.
Jenkins Brick Co	Box 91 Montgomery, AL 37101	Mines	Chilton, Elmore, Montgomery.
Livlite Corp	Box 25247 Nashville, TN 37202	Mine	Sumter.
Ferroalloys:			
Interlake Inc., Globe Metalurgical Div.	Box 348 Selma, AL 36701	Electric furnace	Dallas.
International Minerals & Chemical Corp., TAC Alloys Div.	Garner Rd. Bridgeport, AL 35740	do	Jackson.
Ohio Ferro-Alloys Corp	Box 68 Montgomery, AL 36057	do	Montgomery.
Reynolds Metals Co	Box 191 Sheffield, AL 35660	do	Colbert.
Lime:			
Allied Products Co	Box 36130 Birmingham, AL 35236	Plants	Shelby.
Blue Circle Inc	15 South 20th St. Birmingham, AL 35233	Plant	Do.
Cheney Lime & Cement Co	Allgood, AL 35013	do	Do.
S. I. Lime Co	Suite 204 Three Riverchase Office Plaza Birmingham, AL 35244	do	Do.
Pig iron:			
Gulf States Steel Corp	174 South 26th St. Gadsden, AL 35901	Furnaces and mills.	Etowah and Jefferson.
United States Steel Corp	Box 599 Fairfield, AL 35064	do	Jefferson.
Jim Walter Resources Inc	330 1st Ave., North Birmingham, AL 35202	Furnaces	Do.
Salt:			
Olin Corp	120 Long Ridge Rd. Stamford, CT 06904	Brine wells	Washington.
Sand and gravel (1984):			
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.	Box 2068 Mobile, AL 36601	do	Mobile and Montgomery.
C. T. Thackston Sand & Gravel Inc.	Box 3211 Montgomery, AL 36109	do	Montgomery.
Stone:			
Allied Products Co	Box 628 Alabaster, AL 35007	Quarries	Jefferson and Shelby.
Dolcito Quarry Co	Box 6566 Birmingham, AL 35217	Quarry	Jefferson.
Ideal Basic Industries Inc	950 17th St. Box 8789 Denver, CO 80201	do	Monroe.
Southern Stone Co. Inc.[5]	Box C-200 Birmingham, AL 35283	Quarries	Jefferson, Lee, Shelby.
Vulcan Materials Co.[6]	Box 7324-A Birmingham, AL 35253	do	Calhoun, Colbert, Etowah, Franklin, Jackson, Jefferson, Madison, Morgan, Shelby.
Talc:			
Cyprus Industrial Minerals Co	Alpine, AL 35014	Plant	Talladega.

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

The Mineral Industry of Alaska

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

By Tom L. Pittman[1]

The value of nonfuel mineral production reported in Alaska in 1985 was $90 million; in 1984, the value was $87.3 million. The increase in 1985 was mostly due to the increased production of gold. No production of antimony, mercury, or platinum-group metals was reported to the U.S. Bureau of Mines in 1985. Alaska ranked 42d in the United States in nonfuel mineral production, the same as in 1984.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$60	NA	$60
Gold (recoverable content of ores, etc.) troy ounces	r19,433	r7,009	44,733	14,210
Sand and gravel (construction) thousand short tons	30,861	66,883	e29,000	e63,000
Stone do.	e2,500	e10,800	1,907	8,535
Combined value of cement (portland), silver, and tin	XX	r2,544	XX	4,164
Total	XX	r87,296	XX	89,969

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

Table 2.—Nonfuel minerals produced in Alaska in 1984, by region[1]

Region	Minerals produced in order of value
Cook Inlet-Susitna	Sand and gravel (construction), cement, gold.
Copper River	Gold, sand and gravel (construction).
Kenai Peninsula	Sand and gravel (construction).
Seward Peninsula	Gold, tin, silver.
Southeastern Alaska	Sand and gravel (construction).
Yukon River	Gold, sand and gravel (construction), silver.
Undistributed[2]	Stone (crushed), gem stones.

[1]No production of nonfuel mineral commodities was reported for regions not listed.
[2]Data not available by region for minerals listed.

Table 3.—Indicators of Alaska business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	482	505	521
Total civilian labor force	do	234	247	253
Unemployment	percent	10.3	10.0	9.7
Employment (nonagricultural):				
Mining total[1]	thousands	8.2	8.7	9.4
Metal mining[2]	do	W	W	.4
Manufacturing total	do	11.9	11.3	11.8
Stone, clay, and glass products[2]	do	.3	.3	.3
Petroleum and coal products[2]	do	.2	.2	.2
Construction	do	20.8	20.4	18.6
Transportation and public utilities	do	18.6	19.2	19.1
Wholesale and retail trade	do	41.4	44.5	46.3
Finance, insurance, real estate	do	10.7	12.2	12.8
Services	do	39.8	43.0	45.4
Government and government enterprises	do	63.0	66.5	68.1
Total[3]	do	214.3	225.7	231.4
Personal income:				
Total	millions	$8,690	$9,080	$9,476
Per capita		$18,018	$17,996	$18,187
Hours and earnings:				
Total average weekly hours, production workers		36.2	39.3	40.7
Mining		49.9	50.4	51.6
Total average hourly earnings, production workers		$12.3	$12.3	$12.2
Mining		$23.4	$23.3	$23.9
Earnings by industry:				
Farm income	millions	$7	$7	$10
Nonfarm	do	$8,026	$8,447	$8,664
Mining total	do	$511	$562	$640
Metal mining	do	$26	$20	$19
Nonmetallic minerals except fuels	do	$4	W	W
Coal mining	do	$8	W	W
Oil and gas extraction	do	$472	$528	$603
Manufacturing total	do	$350	$343	$353
Primary metal industries	do	$1	$2	$2
Stone, clay, and glass products	do	$18	$21	$21
Petroleum and coal products	do	$13	$14	$17
Construction	do	$1,406	$1,394	$1,251
Transportation and public utilities	do	$803	$833	$817
Wholesale and retail trade	do	$992	$1,065	$1,091
Finance, insurance, real estate	do	$307	$347	$375
Services	do	$1,264	$1,406	$1,481
Government and government enterprises	do	$2,294	$2,455	$2,614
Construction activity:				
Number of private and public residential units authorized[4]		11,272	6,481	4,029
Value of nonresidential construction[4]	millions	$357.2	$405.9	$299.0
Value of State road contract awards	do	$123.0	$156.0	$159.0
Shipments of portland cement to and within the State	thousand short tons	180	197	156
Nonfuel mineral production value:				
Total crude mineral value	millions	$124.5	$87.3	$90.0
Value per capita		$250	$173	$173

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]Data may not add to totals shown because of independent rounding.
[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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.—In 1985, there were about 6,800 new mining claims located and recorded, a 19% decrease from the 8,348 new claims in 1984. The largest number of claims recorded in any recent year was 27,397 in 1981. Nonfuel exploration expenditures in 1985 were about $8.9 million, according to State surveys, down from about $20.2 million in 1984 and the recent record high of $42.7 million in 1982. Development outlays were $31.7 million in 1985, an increase over the $26.3 million in 1984. The largest outlay in recent years was $33.8 million in 1982. Continued low base metal prices and decreasing precious metal prices caused the withdrawal of many smaller companies and several large companies from mineral activities in Alaska. The average prices for gold and silver in 1985 were $317.66 and $6.10 per troy ounce, respectively, and in 1984, the prices were $360.68 (revised) and $7.95 (revised) per troy ounce. Decreased earnings and the resulting budget cuts resulted in several mining companies closing their local offices and directing their Alaska programs from out of

the State. Anaconda Minerals Co. was dissolved on April 30, 1985, by the owner, Atlantic Richfield Co. Anaconda was the most active exploration company in Alaska since about the mid-1970's. Sand and gravel use and production decreased in the urban areas because of less residential and public building and development. Gravel production on the North Slope was unusually high in 1985 due to the construction of a causeway to Endicott Field, two gravel islands, and other infrastructure for development and production in the North Slope oilfields.

Placer gold production increased because of larger amounts of material treated by some of the major operators and the economic necessity for many operators to mine their higher grade reserves. Increasingly stringent enforcement of Federal and State water quality and waste discharge regulations resulted in cleaner but higher cost mining for many operators and increased the incentives to use settling ponds more efficiently, recycle or use less process water, increase the recovery of fine gold, and generally upgrade operations. Several court suits were filed by enforcement agencies against miners cited for alleged violations of settleable-solids, turbidity, and heavy-metal standards in placer effluents. Several of the Placer Mining Demonstration Grant projects funded by the State and various mines were resulting in improved practices. Preliminary work with flocculants by the U.S. Bureau of Mines and by several operators and consultants indicate these reagents may be helpful to some of the mines that have severe water quality problems. Several lawsuits pending in the courts against Federal and State land management agencies have possible grave implications for segments of the mining industry and especially for many placer miners. A suit against the National Park Service (NPS) alleged that the NPS failed to conduct adequate environmental studies of the effect of mining operations on Alaskan lands it administers. A court order directed that 30 mining operations be closed down at the end of the 1985 season in October. Most of these operations were placer mines in the Denali National Park and Preserve, the Wrangell National Park and Preserve, and the Yukon-Charley Rivers National Preserve. Most of the affected mining companies submitted their 1986 operating plans

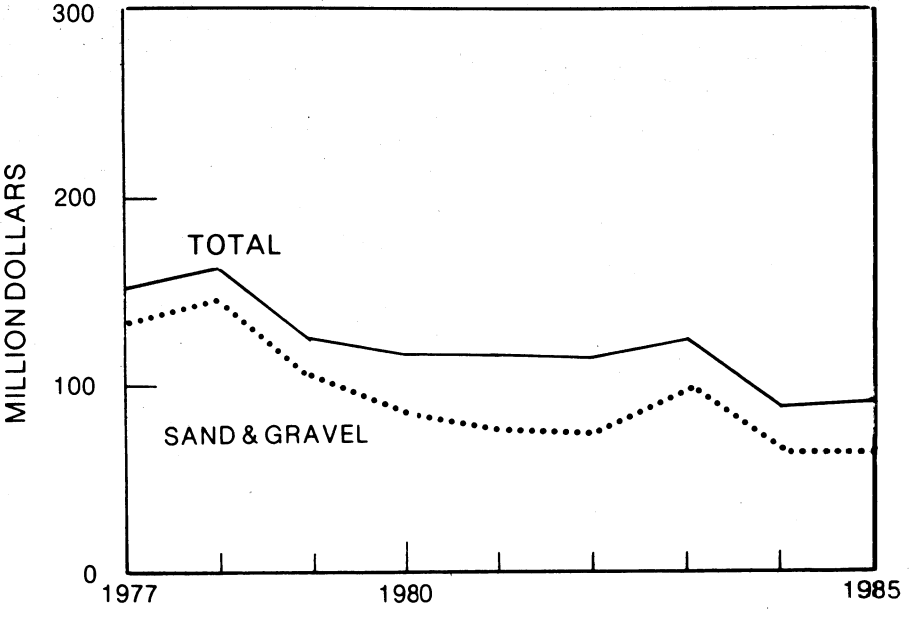

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Alaska.

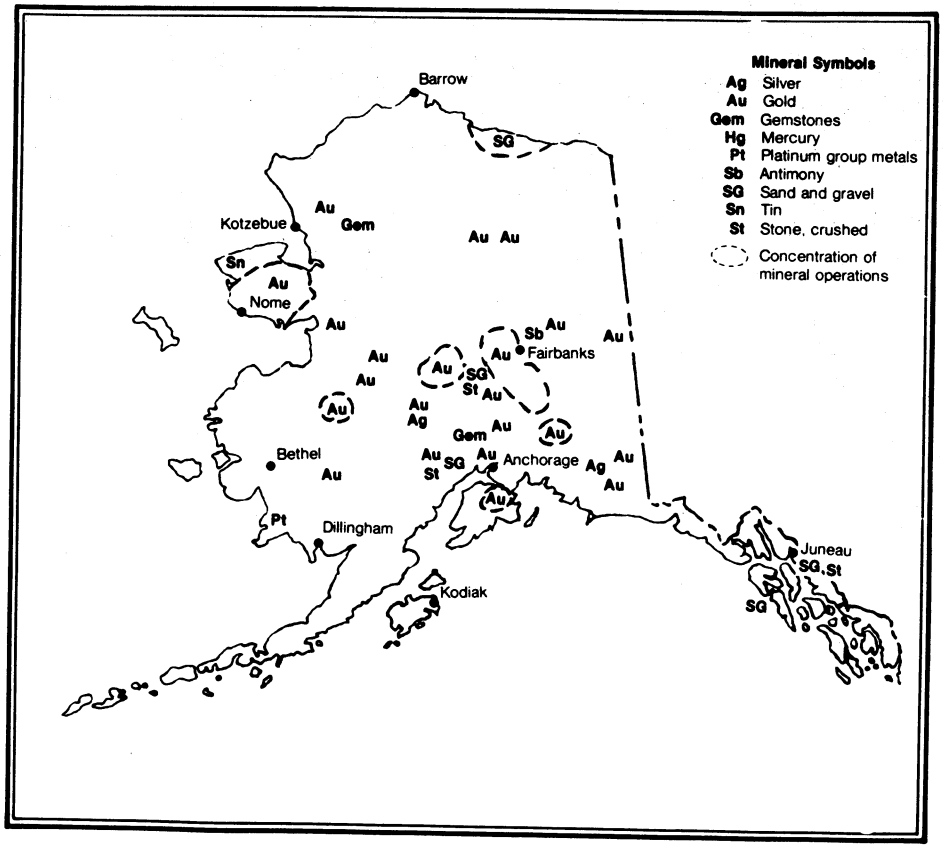

Figure 2.—Principal mineral producing localities in Alaska.

early, hoping that the NPS would be able to comply with the court order and allow mining next season. Another lawsuit alleges that the U.S. Bureau of Land Management (BLM) permits exploration and mining on its lands without preparation of environmental assessments before approving the required notices or operating plans submitted by miners. The suit also charges violations of other statutes and BLM regulations. Miners were worried about the possible consequences of this suit in the 1986 season.

Employment.—The State estimates about 3,625 people were employed in the nonfuel mineral industries in 1985. About 1,435 worked seasonally in the sand and gravel industries. Total seasonal employees in the placer industry was 2,226, including production, exploration, assessment, and recreational activities. About 355 people were employed in antimony, jade, soapstone, stone, and tin production. People working in seasonal mineral industries often are employed on different commodities at different times of the year.

Exploration Activities.—State surveys of contract drilling in 1985 list 211,700 feet of placer and hard-rock nonfuel mineral drilling. In 1984, the reported drilling was 305,000 feet. Contractors reported 46,000 feet of placer exploration drilling and 34,000 feet of thaw-field drilling for thawing frozen placer gravels, for a total of 80,000 feet of placer drilling. Contracted hard-rock drilling reported was 131,000 feet in 1985, down from the 176,000 feet reported in 1984. An unknown footage of in-house drilling was done by mine operators. The State listed 21 drilling contractors active in Alaska in 1985, compared with 23 contractors in 1984. About 4,100 feet of geotechnical drilling was completed at the Red Dog Mine project for port, road, and millsites. This drilling was not included in the contract totals cited above.

Legislation and Government Programs.—The Alaska Industrial Development Authority (AIDA) was authorized by two acts passed by the Alaska legislature to finance up to $175 million of port and road construction and facilities for the Red Dog Mine and possibly other mineral projects in the DeLong Mountains area. An agreement between AIDA, the mine owner, and the mine operator mandates the State-financed loan will be repaid at an interest rate of 6.5%. The NANA Regional Corp. is the property owner. Cominco Alaska Inc. is the operator and will prepare and equip the property for production. Initial port construction is planned for 1986 with road work to begin in 1987. This State-funded project is known as the DeLong Mountains Transportation System. Three other laws enacted by the 1985 session of the legislature of interest to the mineral industry provide for extralateral rights of Federal lode claims under shores, tidelands, and submerged lands; established a State economic policy regarding natural resources; and designated the Nelchina Public Use area. The Nelchina Act is to protect and maintain fish and wildlife habitat and perpetuate public recreation in the area of over 2 million acres. Existing mineral leases and land use permits will remain valid but regulated for compatibility. A resolution was passed requesting Congress to exclude the township containing the Dunkle Mine and other mineral deposits from inclusion in Denali National Park. Another 21 bills and 5 resolutions primarily of interest to the mining industry were introduced in the 1985 session. These bills and resolutions that do not duplicate those passed will be considered by the second session of the 14th legislature that convenes in January 1986.

The State awarded grants totaling $2.7 million through the Placer Mining Demonstration Grant project to qualifying placer miners that had presented approved projects. The grants fund industry innovations in placer techniques to reduce water use, improve waste disposal and fine-gold recovery, and improve the quality of placer effluents. These grant programs had their first field demonstrations during the 1985 season.

Mineral resource studies were conducted in various areas by Federal and State agencies. The U.S. Bureau of Mines continued studies in the Juneau mining district and "Gold Belt." Cooperative studies with the Division of Geological and Geophysical Surveys (DGGS) were in progress in the Skagway and Haines subdistricts north of Juneau and in the Crooked Creek alluvial diamond discovery area in the Circle mining district. The U.S. Bureau of Mines continued fieldwork and reporting on strategic mineral resources, including chromium, columbium, tantalum, and tin. The U.S. Geological Survey conducted a wide variety of studies in various parts of the State and continued the cooperative investigation of the geology and mineral resources of the Iditorod Quadrangle with DGGS. This quadrangle contains the Iditorod and

Innoko mining districts, southwest and west of McGrath. The City and Borough of Juneau was still working on its mining and land use ordinance at the end of 1985. Land use plans were being formulated for various State and Federal parks, preserves, and restricted-use areas.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Asbestos.—There was little activity at the asbestos deposits of Doyon Ltd., about 40 miles south and west of Eagle. Doyon continues to investigate possible acceptable methods for mining and processing the crude fiber and producing environmentally safe products.

Cement.—Anchorage Sand and Gravel Co. produced portland cement at its blending and grinding plant, using domestic clinker and gypsum shipped to Anchorage. In March 1985, the company completed a new 13,560-square-foot plant to manufacture concrete blocks. The steel-frame and tilt-up insulated concrete panel building houses cement and aggregate silos, block-making machinery, drying kilns, and robot transporter equipment. The processing is controlled by computers; three people operate the plant.

Gem Stones.—The value of gem stones reported in 1985 was $60,000, the same as reported in 1984. Jade was produced in the Jade Mountain area, near Shungnak, from private claims by Ivan Stewart and from Native lands by NANA. Stewart's jade is marketed through his shop in Anchorage. NANA's jade is taken to Kotzebue. Some of the better quality material is sold to manufacturing and trading companies that usually export it for cutting and polishing, then import semifinished or finished products for the jewelry trade. Jade Mountain Products Inc., a subsidiary of NANA, has a plant in Kotzebue that has sawing, trimming, and polishing equipment and manufactures jade tile. The tile plant operates seasonally so it does not interfere with the summer fishing season and some of the main subsistence activities. Soapstone was produced in the Talkeetna and Salcha River areas. The material suitable for carving is marketed to hobby shops, commercial outlets, and individuals. Epidote and some other crystals of museum and specimen quality were produced by the owners of patented mining claims on Green Monster Mountain, Prince of Wales Island. Brown coral, previously available in a variety of attractive settings, is apparently not currently on the market. It was formerly obtained off the Alaskan coast.

The U.S. Bureau of Mines and DGGS continued limited studies in the Crooked Creek area of the Circle mining district. Diamonds weighing 0.3 carat and 1.4 carats were recovered by miners at placer gold mines on Crooked Creek from sluice box concentrates during cleanup operations. The small diamond was recovered by miner Jim Regan in 1982 but not identified until 1984. The larger stone was found by Frank Warren at his mine in 1984. Possible sources of diamond occurrences in the area were investigated. Detailed mineralogical and rock identification studies are in progress to help determine the depositional history and bedrock sources of the stream gravels. Kimberlite-type indicator minerals are being sought in samples of concentrates from miners' sluice boxes, jig runs, sluicing tests, and grease-table runs.

Sand and Gravel (Construction).—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Estimated production of construction sand and gravel was 29.0 million short tons valued at $63.0 million, slightly less than the reported production in 1984. There was no reported production of industrial sand and gravel in Alaska. Production and consumption of sand and gravel in the urban areas decreased because of declines in building construction and State-funded capital projects. Production on the North Slope increased significantly in 1985 due to causeway, gravel island, road, and infrastructure construction associated with the development of some of the newer oilfields and other petroleum-related projects. State surveys indicated more than 700 employees were directly involved in producing about 16.7 million tons of sand and gravel on the North Slope, an increase of almost 35% over 1984 production.

AIC/Martin J./V. Inc., a subsidiary of Enserch Corp., completed at least four ma-

jor projects in 1985. The Endicott Causeway project extends about 6.5 miles offshore in water up to 12 feet deep. It will be used to develop the Endicott Oilfield. It includes the main production island and an associated drill station. This project required about 6.5 million cubic yards of gravel that was hauled from a materials site 11.5 miles inland. A fleet of 44 trucks hauled up to 80,000 cubic yards per day of frozen gravel that required drilling and blasting before loading. This project was for Sohio Alaska Petroleum Co. The ARCO-Kuparuk project included removal of 1 million cubic yards of overburden, with 2 million cubic yards of gravel mined and transported to various areas for construction of drillsites and roads. Sandpiper Island was built for Shell Western E&P Inc. in 49 feet of water, using 840,000 cubic yards of gravel. Northstar Island, built for Amarada Hess Corp., used 850,000 cubic yards of gravel. The innovative hexagonal shape of this island allowed the use of equally shaped concrete mats to protect against ice and wave erosion, instead of sandbags or trapezoidal concrete mats used on round islands.

The North Slope Borough owns and operates five floating hydraulic dredges with 12- to 16-inch suction heads. They are based at Atkasuk, Barrow, Kaktovik, Point Lay, and Wainwright. The dredged material is used to construct aircraft runways, roads, landfills, building sites, and other facilities. The State reports each dredge has mined between 150,000 and 300,000 tons of aggregate per season since 1982.

Small amounts of construction sand and gravel were used for road repairs and annual maintenance of the Seward Peninsula, in the Kotzebue area, and at numerous villages and mines. Survey information from the State indicate about 1.7 million tons of sand and gravel were produced in the Eastern Interior region, a slight increase over 1984 production. Private construction projects being built in anticipation of the arrival of a new U.S. Army Light Infantry Division at Fort Wainright, east of Fairbanks, and highway projects were the main consumers. Considerable amounts of sand and gravel were used by the Department of Transportation and Public Facilities in the eastern part of the region at the Delta Erosion Project, rerouting and rebuilding parts of the Alaska Highway between Delta and Tok, and on the Steese and Taylor Highways. The most expensive sand and gravel in Alaska is generally that used in the Southwestern region. An extensive riverbank erosion project to protect Bethel used aggregate that cost almost $46 per ton. Most of this material came from river lag deposits, some as far away as Aniak, 100 miles up the Kuskokwin River. Nearly 8 million tons of sand and gravel was produced in the south-central region. About one-half of this amount was mined in the Palmer-Wasilla area and hauled by train to Anchorage and vicinity. The Alaska Railroad Corp. used 80-car unit trains to haul gravel during the construction season, and delivered about 6 trains per day in 1985. There were numerous small producers in the region on the Kenai Peninsula, and near Cordova, Glenallen, Valdez, and other places. Road repair and construction projects in the Alaska Peninsula region were supplied by contractors mining sand and gravel on Kodiak Island and other local supply pits, as needed. The State reported about 616,600 tons of sand and gravel was produced in the Southeastern region in 1985. The largest volume pits were near the urban centers of Juneau and Ketchikan. Gravel was also produced at pits that served various road, fill, and construction jobsites near Craig, Haines, Sitka, Skagway, and towns and villages, logging camps, and forest roads.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed and broken stone production in 1985 was reported to be 1.9 million short tons valued at $8.5 million. Estimated production in 1984 was 2.5 million short tons valued at $10.8 million. No production of dimension stone was reported in 1985 or estimated in 1984. Surveys conducted by the State indicate stone production in 1985 was about 2.5 million tons valued at $12.1 million. A new port project at Nome opened a quarry for riprap and fill at Cape Nome, about 13 miles from the port. The $21.3 million project will provide a 2,500-foot causeway from the shore to water deep enough to allow supply ships to dock without having to unload cargo on shallow-draft small boats and barges for lightering to shore. The lightering is said to almost double the cost of moving ocean freight to Nome and other Seward Peninsula communities. About 435,000 tons of broken rock will probably be required for the jetty. About 130,000 tons of coarse rock was

delivered and the jetty built out to about 900 feet from shore between July 10th and late in December by the contractor, Kiewit-Pacific Co. Rocks of up to 25 tons were transported from the quarry. The project fell 2 months behind schedule because wet weather slowed hauling over the new road. The jetty is scheduled for completion by October 1987. The State reported that Yutan Construction Co. (Carrol-Vondra Partnership) mined about 400,000 tons of basalt at its Browns Hill Quarry near Fairbanks. The material was used as riprap, road surfacing, crushed fill for leach-fields, and ornamental stone. In the Southwestern region, the chief need for broken rock is for erosion control of the banks of the Kuskokwim River at Bethel, McGrath, and other towns and villages. All material sites are inland from the river and no roads are available to them. About 8,000 tons of granite was barged from Valdez to Bethel in 1985. Another barge carrying a $140,000 cargo of stone sank at sea enroute to Bethel during an October storm. A rock quarry is being developed at Goodnews Bay on Native village land by Calista Corp., and an access road has been built from the quarry to tidewater. The Alaska Railroad produces crushed and broken stone for railroad ballast and other uses. There are several quarries in the Anchorage area and on the Kenai Peninsula. In the Southeastern region, the U.S. Forest Service and its contractors are the largest producers and users of stone. There are several quarries in the Juneau and Ketchikan areas, and small operations near other towns and villages.

Table 4.—Alaska: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	15	45
Coarse aggregate, graded:		
Concrete aggregate, coarse	49	253
Bituminous aggregate, coarse	44	177
Railroad ballast	83	515
Fine aggregate (-3/8 inch): Stone sand and concrete	11	40
Combined coarse and fine aggregates:		
Graded road base or subbase	56	146
Unpaved road surfacing	1,233	5,588
Crusher run or fill or waste	68	260
Other construction[2]	111	493
Special: Other unspecified[3]	238	1,019
Total[4]	1,907	8,535

[1]Includes granite, limestone, shell traprock, and miscellaneous stone.
[2]Includes bituminous surface-treatment aggregate, filter stone, macadam, and stone sand (bituminous mix or seal).
[3]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[4]Data may not add to totals shown because of independent rounding.

Small amounts of various kinds of decorative stone are produced in the State to satisfy local markets. Some agricultural limestone was produced on the Kenai Peninsula.

METALS

Antimony.—Small lots of antimony ore were shipped from lode mines, according to the State. John Millhouse shipped sorted stibnite ore from his deposit in the Kantishna District. Miners shipped other small lots from near Fairbanks and from Sawtooth Mountain west of Livengood. According to the State, the total antimony content was said to be 65,000 pounds valued at $98,000. The State reported production of 135,000 pounds of antimony valued at $225,272 in 1984.

Copper and Lead.—No production of copper or lead ores was reported in 1985. Several deposits and properties formerly considered promising have been abandoned, and most of the unpatented deposits have been held by the minimum expenditures necessary for required assessment work. Kennecott held the Ruby Creek and Arctic Camp copper and copper-zinc deposits and other claim groups from 120 to 200 miles east of Kotzebue, in the Cosmos Hills and along the south flank of the Brooks Range. Kennecott reported completing six diamond drill holes and other types of work on its claims. Houston Oil and Minerals Exploration Co. (HOMEX), GCO Minerals Co., and WGM Inc. continue to hold interests in various claim groups in this extensive copper trend. Sunshine Mining Co. dropped about 800 claims it had held in this area. Nerco Minerals Co. and its subsidiary, Resource Associates of Alaska Inc. (RAA), continued exploration at their extensive

lead-zinc-copper-silver-gold claims in the Delta mineral belt of the Tok mining district, east Alaska Range. Nerco-RAA reported doing geologic mapping, trenching, and running geophysical and geochemical surveys. The Zackley-Zackley Extension copper-gold-silver skarn deposits were further explored by Nerco-RAA and Teton Exploration Drilling Inc. They used trenching, geophysics, geochemistry, and mapping at the property near the head of the McLaren River. Teton withdrew from the project at the end of the season. The Van Zelst Group, Glenview, IL, donated 18 patented and unpatented mining claims to the Federal Government. The claims covered about 250 acres in the McCarthy District, in the Wrangell-St. Elias National Park and Preserve. The airstrip and headquarters camp of Geneva Pacific Corp., on the south side of the Chitistone River canyon, was on these claims. Geneva Pacific donated 500 of the claims it had been exploring for Kennecott-type copper deposits to the Federal Government in 1983. The Illinois Creek claims in the Kaiyuh Mountains, south of Galena, were acquired by Cook Inlet Region Inc. from Anaconda. Prospects on Aleut Corp. land on the Alaska Peninsula were explored by Kennecott and Nerco-RAA. Prospects near Lake Illiamna, on Bristol Bay Native Corp. land, were also explored by Nerco-RAA.

In the Southeastern region, northwest of Haines, exploration drilling continued on the Boulderado, or Jarvis Glacier, prospect. In attempting to find the source of high-grade copper-zinc float boulders 3,730 feet of diamond drilling, geologic mapping, and geophysical surveying were used. The float boulders are found just downslope from a hanging icefield, but drilling both under and through the ice has not located their source. The joint venture holding the claim group consisted of Kennecott (operator), Southeastern Minerals Co., Marmot Mining Exploration Corp., and Alyu Mining Corp. Galactic Resources Ltd. and joint venturer Touchstone Resources Co. mapped and core-drilled their nickel-copper-cobalt claims on Yakobi Island, southwest of Pelican, and continued to hold the claim group at Mirror Harbor, nearby on Chichagof Island. The State reports Long Lac Minerals, Reno, NV, completed about 4,000 feet of core drilling, geochemical, and geophysical surveys, and other assessment work on about 260 claims. The properties are in the Lookout Mountain-Niblack Anchorage area and on the South Arm of Cholmondely Sound, Prince of Wales Island, and the Kaigani Prospect near the south end of Dall Island.

Gold.—Gold production reported to the U.S. Bureau of Mines in 1985 was 44,733 troy ounces valued at about $14.2 million. This is believed to be under 25% of the actual gold production. The best available production figure is about 190,000 ounces valued at $61.2 million, estimated by the State. Although gold production reported by the State was higher than in 1984, the value was less because of the lower average price of gold in 1985. The State used several sources of information in estimating gold production data published in "Alaska's Mineral Industry 1985." The sources were completed questionnaires with production estimates from 78 mechanized operations (up from 48 in 1984); company news releases and annual reports to stockholders; information from DGGS and Division of Mines personnel working in three of the seven regions in the State; estimates by precious metals refiners; and others. An estimated 188,500 ounces of gold and 27,400 ounces of silver were produced by 266 placer mines. The DGGS survey also indicated a total of 1,540 miners were employed in mechanized mines and another 190 participated in recreational mining statewide. Employees ranged from 1 to 103 and averaged 5 per mine. An independent survey of the placer industry in 1985 was made by L. A. Peterson and Associates of Fairbanks and published in "The Role of Placer Mining in the Alaska Economy, 1985." The 266 responses to Peterson's mailout of 498 delivered questionnaires indicate that 319 mechanized placer mines operated in 1985 and 2,226 people participated in the industry on at least a part-time basis, including recreational and assessment activities. Average prices of gold were about $325 per ounce in 1985, and $360 per ounce in 1984.

The State estimated that 18 operations in the Northern region produced about 14,400 ounces of gold and 2,000 ounces of silver from placer deposits in the Chandalar, Koyukuk-Nolan, and Shungnak areas. The Northern region is all north of latitude 67 degrees north. Alminco Inc. mined on the Eldorado Group in the Koyukuk-Nolan area. Timber Creek Mining Co. continued producing from Weise and Timber Creeks, near Klery Creek, in the Shungnak-Kobuk area. In the Bettles area, Paradise Valley Mining operated on Birch Creek, and Green Mining and Exploration mined its Discovery Group. The only reported underground drift mine was operated by Wild River

Ventures on Lake Creek in the Chandalar District. It hoisted over 5,000 tons of pay gravel and bedrock during the winter for washing in the summer when running water is available. The Dick Manns family (Paradise Valley Mining) explored placer and lode claims for precious metals, lead, and zinc; located several new claims; and did assessment work on 86 claims in the Wiseman Quadrangle. Green Mining churn-drilled and sunk shafts to prospect ground on Smalley Creek, near Bettles. Little Squaw Gold Mining Co. did not report any activity on its lode and placer claims in the Chandalar District in 1985. Silverado Mines Ltd. maintained its claims in the Nolan area.

Estimated production in the Western region was about 40,000 ounces of gold from 40 operations. About 80% of this production was from mines on the Seward Peninsula, with most of the balance from the Ruby and Tolstoi Districts. Alaska Gold Co. operated the No. 6 bucket-line dredge, near the Nome Airport. The No. 5 dredge, near Nome, and the Hogatza dredge west of Hughes were idle. The No. 6 dredge dug and treated just over 850,000 cubic yards of material in 160 days between late May and early November. Windfall Gold Mining Corp. mined leased Alaska Gold ground near Nome. It used hauling scrapers and loaders, sluicing about 600,000 cubic yards of gravel during the season. Power Resources Co. prepared for continued exploration and bulk sampling on offshore leases it acquired from ASARCO Incorporated. Environmental hearings were held and permitting procedures pursued. Inspiration Mining Co. acquired the leases and conducted additional exploration. It used a barge-mounted digging, recovery, and camp unit to do bulk sampling and experimental recovery work, and it produced some gold. Inspiration plans to acquire large-scale dredging equipment and start regular production operations in 1986. Small bucket-line dredges (1-1/2- to 3-cubic-foot buckets) were operated by the Engstrom, Peterson, and Tweet families on Henry and Quartz Creeks and by Pat Bliss in the Ungalik River area. Tachik Mining Co. mined the Cara Lee Bench close to Nome. Claims near Mount Distin on Anvil and Ruby Creeks were mined and tested by Macklin Placer Mines. In the Candle District, AU Mining Co. and Clara Beatrice Inc. mined and did exploratory drilling to enhance their reserves. Rhinehart Berg and Thor Wetlesen mined on Jump Creek and Bull Hill, and D. B. Parent produced gold on Bear Creek. In the Ruby mining district, Swift Creek Mining worked in the Basin Creek area, and at least five other operations were producing. In the Tolstoi mining district, Rosander Mining Co. continued mining on Colorado Creek, and Pete Snow worked on upper Colorado Creek. Alamin Mining Corp. mined Bear Creek, and Degnan Mining Co. worked its claims on Madison Creek. The partnership of Sherrer/Lacross reworked pre-World War I drift mine tailings and continued developing a drift mine on Boob Creek.

Greatland Exploration Ltd. drilled about 6,000 feet of test holes evaluating placers on several claims in the Anvil River area and did some trenching at Granite Mountain. Greatland retains the offshore permit applications for the Norton Sound project jointly conducted in 1984 with Coastal Exploration. Solomon Mines Inc. evaluated 52 leased placer claims on the Solomon River, east of Nome, by magnetometer surveys, drilling, and test pits. At the Big Hurrah lode mine north of Solomon, a joint venture of Cornwall Pacific Alaska Inc. and Night Hawk Resources Ltd. diamond drilled 6,500 feet of hole and dug 2,000 feet of trenches. Night Hawk reports it is diversifying into mineral exploration and will earn an interest in the joint venture by spending $1 millon for exploration and feasibility studies. Hawley Resource Group Inc. is the project consultant. Battle Mountain Gold Co. explored the Nixon Fork lode gold deposit north of McGrath with drilling, mapping, and geophysical surveys. It also evaluated several silver-tin prospects northwest of McGrath.

The Eastern Interior region produced an estimated 66,000 ounces of gold from about 135 placer mines. The production estimate for 1984 was 70,400 ounces of gold from 140 mines. This region adjoins the Western region about 20 miles west of Tanana and extends easterly to the Canadian border; both districts are bounded on the north by the 67° parallel and on the south by the 63° parallel. The State surveys again report that the Circle mining district is "Alaska's largest placer camp." The following descriptions are quoted from the State report: "Lower gold prices, exhaustion of easy-to-mine reserves, and water-quality regulations affected the 1985 production. The Circle mining district borders, or is part of, the Steese National Conservation Area, the

Yukon-Charley Rivers National Preserve, and the Birch Creek Wild and Scenic River System. Several of the 40 companies that operated in the Circle mining district are listed here: Eagle Rock/Burns operation on Bottom Dollar Creek, Underwood Mining on Porcupine Creek, The Mining Company on Faith Creek, Doxauco on Half Dollar Creek, Battest Mining on Birch Creek, Lester Mines on Butte Creek, the Echola operation on Wickersham Creek, Pavey Mining Co. on Nome Creek, Johnson Mining Co. and Hot Claims Co. on Ketchum Creek near Central, Stan Gelvin on Crooked Creek, Lakewood Mining on Mammoth Creek, and Polar Mining on Crooked and Mastodon Creeks. These companies (and others) contribute significantly to the economy of Circle City, Central, and Steese Highway areas." In the Forty Mile District, Aurum Philosophorum mined on Chicken Creek but reported a shortened season due to permitting problems. John Schilling mined in the Rampart District. Shimsky Mining worked on Eureka Creek near Manley, and Burgess Mining was developing a drift mine near Tofty on Sullivan Bench. In the Fairbanks District, Cook's Mining worked on Fairbanks Creek, Lucky Seven Mining Co. continued its operation on Fish Creek, and Smith Brothers Mining mined on Nugget Creek, a tributary to Smallwood Creek. Anderson Mining and Ken Bavard reworked old drift mine tailings on Tenderfoot Creek in the Richardson mining district. In the Kantishna mining district, within Denali National Park and Preserve, 17 operators mined throughout the season. It is improbable that the NPS will be able to satisfactorily respond to the requirements of the court order for the preparation of individual environmental analyses and a cumulative environmental impact statement in time to approve mining plans of mining operations before mobilization for the 1986 mining season. Eight mines operated in the Bonnifield mining district east of Healy. There were two mines on Colorado Creek, three on Moose Creek, one each reported on the Rex, St. George, and Tatlanika Creek drainages, and one on the Totatlanika River drainage. Three mines operated in the Livengood District, according to the State report. Mammoth Mines on Wilbur Creek developed water quality regulatory problems during the season. Nelson Mining Co. worked its Amy Creek property. Alaska Placer Development Inc. received a lease to work pay gravel stripped by Galaxy Minerals Inc., a previous leaser whose operation was terminated by a voluntary bankruptcy action. By terms of the agreement with the trustee, the property should revert to Livengood Placers Inc. by the end of 1985. Livengood Placers is about 80% owned by Callahan Mining Corp. The new mill at the Grant Mine, on Ester Dome, west of Fairbanks, operated from October 20th to mid-December 1985. The mine shut down when Aurex Inc., a joint venturer with Tricon Mining Inc. and Silverado, withdrew from the company. Silverado announced it is working on plans to reopen the mine in 1986. The Grant Mine produced the only lode gold reported in Alaska in 1985.

Many of the placer producers had exploration and development projects in progress to further evaluate their deposits and add to their reserves. There were other projects carried out by companies looking for economic placer and lode deposits. Amax Exploration Inc. mapped and sampled properties on Moose Creek in the Bonnifield District, and in other areas, searching for precious metals. Doyon has an ongoing program to evaluate mineral resources in the region as an aid in completing its final land selections provided by the Alaska Native Claims Settlement Act. Arctic Knight Mining Co. explored for placer deposits on St. George Creek, and Northern Lights Exploration Co. did assessment work on over 800 precious metals claims, both projects in the Bonnifield area. Greatland did additional work on its Little Eldorado Creek deep placer, studying the potential for establishing a drift mine. St. Joe American Corp. relinquished its lease on the Ryan Lode deposit on Ester Dome to Citigold Ltd. of Vancouver, British Columbia. The property now has an experimental 10,000-ton heap-leaching test in progress. Exploration Geo Consultants worked on Spruce Creek, Pedro Dome, evaluating antimony, bismuth, gold, and silver occurrences. Herning Exploration and Mining explored for gold and silver on Ottertail, Palmer, and Wolverine Creeks, off of the East Fork of the Chena River. In the Circle area, GHD Resources Partners Ltd. explored placers on Eagle Creek, and Gold Dust Mines operated its IHC recovery plant at its Gold Dust Creek Mine and contracted some placer exploration in the district to On-Line Exploration Services.

In the Southwestern region, about 17,000 ounces of gold and 2,190 ounces of byproduct silver were produced by about 32 mines, a 6% increase over that of 1984.

State surveys list quite a number of good small operations in this region. In the Innoko mining district, the Magnuson Mine on Ganes Creek operated, and three individuals reactivated, placers on Yankee Creek that had been idle since 1968. There was mining on Ester, Little, Ophir, and Spruce Creeks. The Norcross-Stoneberg Partnership continued mining on Anvil Creek. An 8-inch suction dredge recovered gold from the Innoko River near Ophir. In the Iditorod mining district, the Misco-Walsh Co. mined old dredge tailings and bedrock areas missed by the dredge on Otter Creek. After a year of development work, Flat Creek Placers (John and Richard Fullerton) stripped and mined on the Willow Bench. Alvin Aghoff's family operation mined on Prince Creek, and Ann Williams worked on Granite Creek. A residual placer overlying quartz veins on the Idaho Claim near the summit of Chicken Mountain was worked by Ken Dahl. Alaska Construction and Mining continued mining on Deadwood Creek. Granite Creek and Michigan Creek, tributaries on the George River, were worked by L. E. Wyrick and by Glenn Bass. The Lyman's Mine on the Donlin Bench at Snow Gulch continued active; this property is on a tributary of Crooked Creek and is leased from Calista. Calista, Doyon, and other Native land owners in the Iditorod-Flat and Innoko-Candle mining districts are interested in leasing mineral properties to mining operators, according to State reports. Tuluksak Dredging Ltd. operated its bucketline dredge for the 13th consecutive year near Nyac, about 60 miles east-northeast of Bethel. Northland Dredging Co.'s 6-cubic-foot dredge, just down the Tuluksak River, was still idle because of legal actions by various Native and other groups protesting the issue of the operating permit by BLM. In September, the Interior Board of Land Appeals (IBLA) affirmed a BLM decision to allow the operation. The IBLA stated that no environmetal impact statement is required because the BLM has identified areas of environmental concern and stipulated measures to minimize the impact of mining. Northland first submitted a plan of operations to BLM in 1983 after rebuilding the dredge and now hopes to mine in 1986. The Bowman Group of claims on Portage Creek north of Lake Clark was mined by Howard Bowman, using magnetometer surveys to outline placer mineral concentrations. Fortyseven Creek Mines mined ground it tested last year on Taylor Creek and Fortyseven Creek, 40 to 50 miles south of McGrath. Clarence Fry, of Homer, mapped, test-pitted, and prospected for placer and lode deposits in the Fortyseven Creek area.

The South-central region is in the area south of the 63° north parallel, east of the 153° west meridian to the Canadian border, south to the coast, and easterly along the Gulf of Alaska to about the 138° west meridian. Estimated gold production in this region was about 52,500 ounces from 38 mine operators. State reports say the Valdez Creek property of Denali Mines Ltd. was the largest gold producer in Alaska in 1984 and 1985. In 1985, about 31,000 ounces of placer gold, 852 fine, was recovered from 355,000 cubic yards sluiced, with an indicated recovery of over 90%. The stripping ratio was about 5:1, with about 1.7 million cubic yards stripped in 1985. Employment ranged from 53 to about 105, with the peak reached during exploratory and development drilling directed by the consultant WGM. The known channel was extended about 8,000 feet upstream by over 30,000 feet of drilling and by geophysical surveys. The company used five terraced settling ponds and recycles all of the water it can recover. Experimental plantings are being made to gain data useful for future tailings reclamation. The Valdez Creek Mine is north of the Denali Highway, about midway between Cantwell and Paxon. Camindex Mines Inc. of Toronto is listed as the majority owner in the Denali joint venture.

Alaska Mineral Resources Co. was probably the next to largest placer gold producer in this region with a reported cash flow of over $2.5 million. It mined on Slate and Ruby Creeks in the Chistochina mining district, about 25 miles northeast of Paxon. The property was formerly known as the Golden Eagle Mine when owned by Ranchers Exploration and Development Corp. Partners in this joint venture operation include Harrison Western Corp. and Northern Minerals Co. Alaska Mineral Resources modified the washing plant and conducted a $1.2 million sonic drilling program. An operator reporting production in the Cache Creek-Talkeetna District was Howard Williams on Chunilna and Johns Creeks. Alaska Plack and Plack and miner Mike McDaniels each worked placers along the Little Susitna River east of Willow. Hoffman Mining worked patented claims on Rex Creek in the Wrangell-St. Elias National Park and Preserve, south of McCarthy in the Nizina

District. Small-scale placer mining on the Kenai Peninsula was reported to the State by Jones and Co. near Moose Pass, Gaede and Lindman Dredging at Heaven's Gate and Canyon Creek, and Robert Titcheval on Busch Creek.

Lightfoot Mining Co. mined and milled small quantities of lode gold-silver ore about 7 miles east of the Denali Mine on Black Creek. Selected high-grade quartz-carbonate ore is processed in a 5-ton gravity mill.

Some work was reported at the Gold Cord lode mine near Hatcher Pass but no production. WGM ran an examination and exploration project at the Cliff lode gold mine west of Valdez, near the junction of Valdez Arm and Shoup Bay. Russ Miller and Jim Halloran had a crew digging test pits and collecting bulk placer samples on Valdez Creek. Aspen Exploration Corp. maintained their group of 50 AGR claims, also on Valdez Creek. A crew drove a crosscut at the Arch gold-silver lode prospect for Black Sands Mining Co. The Johnson River and Difficult Creek gold-copper-lead-zinc-silver prospects southwest of Tuxedni Bay were apparently idle during 1985. Cook Inlet owns the property and may have an operator in 1986. Anaconda had a large exploration crew working on these prospects in 1983 and 1984 and obtained promising results from the drilling and trenching projects. About 3,000 feet of holes were drilled at the Golden Zone gold-silver-copper lode mine near Cantwell by Hawley Resource and New Strategic Minerals Ltd. Hunt Oil Co. did drilling and other assessment work on about 320 base and precious metals claims in the Alaska Range south of Farewell.

Aspen has been exploring offshore in Cook Inlet for placer gold and other mineral commodities for several years. In 1979, Aspen applied for offshore mining permits on about 1 million acres. The application has since been scaled down to about 220,000 acres offshore between the Anchor and Ninilchik Rivers. This application was turned down by the Department of Natural Resources after it received protests from various fishermen, Natives, and other groups on environmental grounds. A complex series of appeals and court actions has resulted and mining has not started. Girdwood Mining Co. has acquired an old placer property on Crow Creek, north of Girdwood. The company bought an IHC jig-type gold recovery plant similar to the very successful unit at Gold Dust Mines in the Circle District. The plant was delivered to the port at Anchorage in mid-June but was not installed at the mine in 1985. Alaska Gold Mines Ltd. did some exploration and development work on its Cape Yakataga beach placers. Cusac Industries Ltd. holds a 30% interest in the property. Promising results were reported from exploration drilling at the Rambler lode gold mine by Wayne Bolt. The Rambler adjoins the Nabesna Mine, a former gold producer southeast of Slana at the north toe of the Wrangell Mountains and within the Wrangell-St. Elias National Park and Preserve.

No gold production was reported from the Alaska Peninsula region. Alaska Apollo Gold Mines Ltd. drilled 1,827 feet and did other exploratory work on its Apollo and Sitka Mines and the Shumagin Prospect on Unga Island. Lorena and Knox Christie worked on placer and lode deposits on Shuyak Island, just north of Kodiak Island. Kennecott explored gold prospects on five Aleutian Islands under lease to Nerco-RAA from Aleut.

In the Southeastern region, a few ounces of gold were produced in the Porcupine placer district northwest of Haines. There was some recreational suction dredge activity in the Juneau gold-belt area. Echo Bay Mines Ltd. obtained an option from Barrick Resources Corp. to explore the old Alaska Juneau Mine east of Juneau and the Treadwell group of mines on Douglas Island. Echo Bay retained WGM as consultants and continued the evaluation and exploratory work WGM had been doing for Barrick. Nerco-RAA conducted geochemical and geophysical surveys, geological mapping, and trenching at their HI Group of 262 claims, according to a State report. The HI Group is on the Mansfield Peninsula of Admiralty Island, mostly north of Hawk Inlet. HOMEX had an examination and exploration crew looking for precious metals properties in the region for most of the field season. Cumo Resources Ltd. announced it had acquired an option on 133 lode claims that included most of the old Eagle River Mine about 25 miles north of Juneau. Justice Mining Corp. conducted a short drilling and sampling project on the Leroy Claim of the old Mount Parker lode gold mine in Glacier Bay National Park. Placid Oil Co. did additional exploratory work at the Kensington-Comet property on Sherman Creek, north of Juneau.

The Chichagof Joint Venture continued surface and underground exploration at the Chichagof Mine at Klag Bay, on the west coast of Chichagof Island, about 45 miles north of Sitka. The mine produced about 660,000 ounces of lode gold and 200,000 ounces of silver from 596,000 tons of ore from 1918 to 1941. Underground work included about 2,000 feet of drifting and 2,500 feet of drilling to evaluate several target areas. Some surface drilling was completed. Metallurgical testing of the ore was started, permit applications were submitted, and environmental studies continued. About 450,000 tons of old mill tailings that average 0.11 ounce of gold per ton are believed to be accessible for reworking, in addition to the reserve of underground ore being developed. Enserch Exploration Inc. was reopening the haulage adit at the Hirst-Chichagof Mine to provide underground access for exploratory work. Hirst is north across Doolth Mountain from the Chichagof Mine. The Chichagof Joint Venture will acquire the mine. The present joint venturers are Exploration Ventures Co., Queenstake Resources Ltd., and Vector Mining Co.

WGM procured the LCM lode gold prospect, about 12 miles from Sitka, on Baranof Island, and optioned the Apex-El Nido Mines northeast of Pelican on Chichagof Island. These properties were surveyed, mapped, and sampled. Discovery Gold Explorations Ltd. obtained a lease option on the Dawson Mine, about 2 miles southwest of Hollis on Prince of Wales Island. Five short holes were drilled to intersect the Eva, Free Gold, and Humboldt veins. The company reports encouraging results were obtained and it will continue the exploration in 1986.

Table 5.—Alaska: Reported placer production of gold

Year	Mines producing	Material treated[1] (thousand cubic yards)	Gold recovered		
			Troy ounces	Value (thousands)	Average value per cubic yard
1981	21	3,257	26,432	$12,149	$3.730
1982	20	3,264	30,181	11,345	3.476
1983	20	3,194	39,470	16,735	5.240
1984[r]	14	2,013	19,433	7,009	3.482
1985[2]	16	1,781	44,733	14,210	7.979

[r]Revised.
[1]Excludes material treated primarily for the recovery of platinum and lode mine material milled.
[2]Includes small amounts of lode mine production to avoid disclosing company proprietary data.

Mercury.—No mercury production was reported to the U.S. Bureau of Mines. A State survey lists 2,094 pounds of mercury from the Mountain Top Mine southwest of Sleetmut. The property is being explored and developed by James R. Wylie.

Molybdenum.—The 1.5-billion-short-ton Quartz Hill molybdenum deposit will probably not be scheduled for equipping and production until the prices and markets for molybdenum and its products show substantial promise of long-term improvement. The property is on a care-and-standby basis with necessary data gathering, planning, servicing of unpatented claims, and other functions continuing. Water from the Quartz Hill and Bear Meadow adits is being treated prior to entering White and Beaver Creeks. Preparation and release of the final environmental impact statement has been delayed until 1986 for further studies and negotiations on location of the tailings disposal site. Officials of United States Borax and Chemical Co., the City of Ketchikan, and of the Gateway Borough have been meeting to determine and provide for socioeconomic impacts that will accompany the planned mining operation.

Platinum-Group Metals.—The Goodnews Bay platinum mine did not operate in 1985. Hanson Properties Inc. of Spokane, WA, is seeking a buyer for the property. Orbex Minerals Ltd. conducted some exploration activities on its Salt Chuck Mine copper-gold-platinum-group metals property at the west end of Kasaan Bay, Prince of Wales Island. Orbex has interested another Canadian company in the property and is preparing for an expanded exploration project in 1986. The Salt Chuck Mine is the only listed producer in Alaska of lode ores containing economic amounts of palladium, with some platinum. No platinum-group metal production was reported to the U.S. Bureau of Mines or reported by the State in 1985.

Silver.—The quantity and value of silver produced in Alaska in 1985 reported to the

U.S. Bureau of Mines was withheld from publication to protect confidentiality of company data. State surveys report 1985 production at about 28,500 ounces valued at $171,000. This was a good increase over the estimate of 20,000 ounces valued at $159,000 in 1984. The silver reported was all contained in placer gold as a natural alloy.

Intensive exploration continued at the Greens Creek silver-gold-zinc-lead mine on Admiralty Island, about 18 miles southwest of Juneau. This year about 1,300 feet of underground workings were driven. Ore reserves figures published by the State show over 4 million tons that contain an average of 10.3 ounces of silver per ton, 0.09 ounce of gold per ton, 6.4% zinc, and 2.1% lead. All access to the mine is by helicopter, but a road is under construction from the docksite on Hawk Inlet to the mill and haulage adit sites. About 1-3/4 miles of the 7-mile road was completed. Stone quarries and other material sites were investigated for completing the road to the mine, a tailings pond, staging and docking facilities, and a road from the dock area to Youngs Bay on the east side of the island. When the mine is operating, the crew will live in Juneau, commute daily to Youngs Bay by high-speed ferry and continue to the various worksites by bus. An emergency camp will be maintained at Hawk Inlet to house and feed a crew stranded by severe storms or transportation equipment breakdowns. Recent news releases indicate a proposed initial production rate of 300 tons of ore per day mined by open stope methods and concentrated by flotation into one or more shipping products. The production rate would be increased later to 600 tons per day. From 150 to 300 workers would be employed.

The Alaska National Interest Lands Conservation Act passed in 1980, embedded the Greens Creek mining project area in a nonwilderness portion of the Admiralty Island National Monument but imposed a stipulation that unpatented claims must be perfected and be validated by the U.S. Forest Service by December 2, 1985. Exploration proved that known mineral deposits extended outside of the eight core claims validated by the Forest Service. The Congress passed legislation in December 1985 that gave the operator until December 2, 1986, to explore the peripheral claims within three-quarters of a mile of the core claims. This act also provided that information obtained during the extension could not be used to validate peripheral claims. At the end of 1985, Congress was considering a proposal that in return for forfeiting various Native rights in the Monument the Sealaska Corp. would acquire the lands around the Greens Creek core claims. Sealaska is the regional corporation for the Natives of Southeastern Alaska. Anaconda's interest in the Greens Creek Joint Venture are for sale because Anaconda was dissolved by its parent company Atlantic Richfield on April 30, 1985.

Anaconda's rights to the Pat Group of silver-gold-copper-lead-zinc claims northwest of Chignik were acquired by Cook Inlet, a Native regional corporation. Previous shippers of silver ores generally maintained their mines and better claims but did not produce because of the low price of silver. The Silverstar Mine in the Wrangell Mountains and the Bishop Creek Mine south of Galena did assessment work only. Patino Inc. drilled two 100-foot holes on the Step Mountain silver-lead-zinc prospect north of Eagle.

Tin.—Alaska Placer Co. produced nearly 400,000 pounds of high-grade cassiterite concentrate from claims it leases from Lost River Mining on Cape Creek, according to a State report. Wayne Gibson mined placer deposits of cassiterite in the Tozimoran area north of Tanana. Greatland worked on tin prospects in the Kougarok areas and at Lost River, also on the Seward Peninsula. Annual assessment work on Lost River Alaska Corp.'s tin property was performed by Stevens Exploration Management Corp. Cook Inlet maintained its interest in the Kougarok tin-tantalum prospect Anaconda was exploring about 60 miles north of Nome.

Zinc.—Positive progress continued on the Red Dog zinc-lead-silver mining project about 90 miles north of Kotzebue. The State legislature enacted two bills authorizing AIDA to construct a barge-landing and staging-area port facility on the coast about 17 miles southeast of Kivalina, construct a road from the port to the Red Dog Mine and millsite, and to sell bonds to finance the above facilities. Cominco, the operator, will refund AIDA expenditures. NANA, the property owner, started procedures to have 3,298 square miles of land area containing the Red Dog and some other mineral deposits withdrawn from the North Slope Borough and added to NANA land to form a NANA-controlled borough. The proposed new borough would transfer taxing power and other functions from the Arctic Slope

Regional Corp. to NANA. This ensures opposition by Arctic Slope Borough.

Project activity in 1985 by Cominco included drilling to evaluate site conditions for mine, mill, road, and port facility sites; rotary drilling at the Main deposit to obtain bulk sample material for milling tests; and to locate and evaluate sources of road, foundation, and riprap material. Collection of environmental and climatic data continued and permitting efforts were maintained. Cominco selected the Ralph M. Parsons Co. to provide engineering, procurement, design, and construction of a 6,700-ton-per-day concentrator, mine support facilities, living accommodations, utilities, and transportation infrastructure including port shipping and receiving facilities. A bulletin released by Cominco lists published ore reserves of 85 million tons averaging 17.1% zinc, 5.0% lead, and 2.4 ounces of silver per ton. The open pit mine should last over 50 years. Project costs at the end of 1985 were estimated to be $40 million. Capital outlays for constructing the project are expected to be in the $400 million range. Construction could take 4 years with operation probably beginning in 1990 or 1991, depending on world economic conditions and the ability to complete all phases of the project as scheduled.

Noranda Exploration Inc., drilled 17,000 feet at the LIK deposit, 12 miles west of Red Dog, after signing an agreement with GCO to jointly explore the deposit. Reserves announced before the 1985 drill program were about 24 million tons averaging 9% zinc, 3.1% lead, and 2.5 ounces of silver per ton. Cominco has other zinc deposits in the Wulik River Basin on which it drilled over 3,500 feet and conducted other exploratory work.

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

Table 6.—Principal producers

Commodity and company	Address	Type of activity	Region
Cement:			
Anchorage Sand and Gravel Co	1813 East First Ave. Anchorage, AK 99501	Grind and blend.	Cook Inlet-Susitna.
Gold:			
Alaska Gold Co	Box 64 Nome, AK 99762	Placer-dredge	Seward Peninsula.
Alaska Mineral Resources Co	Box 60750 Fairbanks, AK 99708	____do ___	Copper River.
Denali Mines Ltd	6124 Winchester Anchorage, AK 99507	Placer ____	Yukon River.
Gold Dust Mines	Box 2141 Fairbanks, AK 99707	____do ___	Do.
McIntosh Co	Star Route 2, Box 22139 Fairbanks, AK 99701	____do ___	Do.
Tuluksak Dredging Ltd	Nyac, AK 99642	Placer-dredge	Kuskokwim River.
Windfall Gold Mining Corp	Box 1958 Nome, AK 99762	____do ___	Yukon River.
Sand and gravel (construction):			
Alaska Aggregate Corp	7800 Lake Otis Parkway Anchorage, AK 99507	Pit	Cook Inlet-Susitna.
AIC/Martin J./V. Inc	Box 61558 Fairbanks, AK 99706	Pit	Northern Alaska.
Anchorage Sand and Gravel Co	1813 East First Ave. Anchorage, AK 99501	Pit	Cook Inlet-Susitna.
Fairbanks Sand and Gravel Co	Box 686 Fairbanks, AK 99707	Pit	Yukon River.
Juneau Ready-Mix Inc	Box 270 Juneau, AK 99602	Pit	Southeastern Alaska.
U.S. Bureau of Land Management	Box 13, 701 C St. Anchorage, AK 99513	Pit	Various.
Stone:			
Alaska Railroad Corp	Box 107500 Anchorage, AK 99510	Pit	Do.
Aleutian Constructors	Box 4D Anchorage, AK 99509	Quarries	Cook Inlet-Susitna.
Associated Sand & Gravel Co. Inc	Box 3699 Juneau, AK 99803	____do ___	Southeastern Alaska.
Ketchikan Ready-Mix and Quarry Inc	Box 8100 Ketchikan, AK 99901	Quarry	Do.
U.S. Forest Service, Region 10	Box 1628 Juneau, AK 99802	Quarries	Various.
Yutan Construction Co	Box 1775 Fairbanks, AK 99707	Quarry	Yukon River.
Tin:			
Lost River Mining	Box 411 Nome, AK 99762	Placer ____	Seward Peninsula.

The Mineral Industry of Arizona

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

By Lorraine B. Burgin[1]

The value of Arizona nonfuel mineral production was $1.55 billion in 1985, up about 4% from that of 1984. Metals output comprised nearly 83% of the total value, a small increase from the $1.23 billion (revised) in 1984 to $1.29 billion in 1985. Copper was nearly three-fourths of the value of Arizona's nonfuel mineral production. Although output and value of copper increased, low prices continued to cause major restructuring moves by copper companies operating in Arizona. Prices of gold, molybdenum, and silver—metals recovered as byproducts of copper production—slumped, further curtailing growth in the State's nonfuel mineral industry. Factors affecting the value and output of metals included the worldwide oversupply of copper, the continued surplus of molybdenum, and the sluggish metal prices. Moreover, the strong dollar, though softened against the currencies of Japan and Europe the last half of 1985, continued to keep metal producers at a disadvantage relative to foreign competitors.

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

Mineral	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
Clays thousand short tons	138	$819	186	$1,503
Copper (recoverable content of ores, etc.) metric tons	746,453	1,100,182	796,556	1,175,995
Gem stones	NA	2,700	NA	2,700
Gold (recoverable content of ores, etc.) troy ounces	r54,897	r19,799	52,053	16,535
Gypsum thousand short tons	261	2,332	251	1,926
Lead (recoverable content of ores, etc.) metric tons	W	W	581	244
Lime thousand short tons	359	17,304	476	21,226
Molybdenum (content of concentrate) thousand pounds	24,013	76,112	24,125	63,389
Pumice thousand short tons	2	21	W	2
Sand and gravel (construction) do.	30,439	101,959	e37,000	e118,000
Silver (recoverable content of ores, etc.) thousand troy ounces	r4,247	r34,570	4,885	30,007
Stone:				
Crushed thousand short tons	e5,200	e27,300	5,929	23,111
Dimension do.	e(2)	e(2)	W	W
Combined value of cement, perlite, pyrites, salt (1984), sand and gravel (industrial), tin (1984), and values indicated by symbol W	XX	102,839	XX	95,447
Total	XX	r1,485,937	XX	1,550,085

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

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

[2]Less than 1/2 unit.

Table 2.—Nonfuel minerals produced in Arizona in 1984, by county[1]

County	Minerals produced in order of value
Apache	Sand and gravel, clays.
Cochise	Copper, lime, sand and gravel, silver, gold.
Coconino	Sand and gravel.
Gila	Copper, silver, sand and gravel, molybdenum, clays.
Graham	Sand and gravel, gold, silver, pumice, copper.
Greenlee	Copper, silver, gold, molybdenum, lead, tin.
La Paz	Silver, lead, gold.
Maricopa	Sand and gravel, salt, clays.
Mohave	Sand and gravel, gold, silver, lead, copper.
Navajo	Sand and gravel.
Pima	Copper, molybdenum, cement, sand and gravel, silver, gold, clays, lead.
Pinal	Copper, molybdenum, silver, gold, sand and gravel, gypsum, lime, perlite, lead, pyrites, clays.
Santa Cruz	Sand and gravel.
Yavapai	Cement, copper, sand and gravel, molybdenum, lime, clays, gypsum.
Yuma	Sand and gravel, lead, silver, gold, copper.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Nationally, the State rose from fifth to fourth place in 1985 in value of nonfuel mineral production: Arizona remained first in copper with 72% of the domestic production value; second in molybdenum with 18%; third in silver with 12%; and seventh in gold with 2%.

In the industrial minerals group, the leading commodities, in descending order of value, were construction sand and gravel, portland cement, crushed stone, lime, masonry cement, and industrial sand and gravel. Commodities increasing in value were clays, masonry cement, lime, and construction and industrial sand and gravel. Arizona continued to rank first nationally in gem stone production.

Trends and Developments.—As copper prices and demand remained depressed, petroleum companies, affected by falling oil prices, began to divest themselves of recently acquired copper operations. Several copper companies sought to improve their financial position by selling marginally economic operations, land, and equipment. New projects, including construction of solvent-extraction electrowinning (SX-EW) plants, were planned by some major producers to increase production and reduce costs. Also, in preliminary talks with labor representatives, all producers proposed pay-benefit reductions and other concessions for contracts ending in mid-1986.

The weakening of the Arizona mining industry from 1970 to 1985 was analyzed by the University of Arizona College of Business and Public Administration with the following conclusions. Employment in fuels and nonfuels mining dropped from a high of 26,900 in 1976 to about 12,000 in 1985 as shutdowns and layoffs impacted Arizona's copper industry; the State's principal mining employer had 21,900 workers in 1981, and by yearend 1985, just 9,000. Arizona mining industry wages and salaries increased from a total payroll of $441 million in 1976 to $728 million peak in 1981, reflecting rising copper production, the inflation pressures, and sharply increasing cost-of-living adjustments. However, by 1985, the total payroll plummeted to an estimated $390 million because of copper and other mineral industry layoffs.[2]

Environmental problems and changing regulations continued to require substantial financing, with several installations choosing to close rather than modernize old facilities. Smelter facilities, operating under temporary exemptions, were to be in full compliance with the Federal 1977 Clean Air Act.

Concern over copper smelter emissions and air pollution mounted, and again, attention was turned to copper operations near the Arizona-Mexico international border. Involved in the discussions were the Cía. Minera de Cananea S.A. smelter at Cananea, Sonora, 30 miles southwest of Douglas; the Mexicana de Cobre S.A. smelter at Nacozari, Sonora, 60 miles south of Douglas; and the Phelps Dodge Corp. smelter at Douglas, Cochise County. The Douglas smelter emitted about 330,000 short tons of sulfur dioxide per year; the Cananea smelter, 21,000 tons; and the Nacozari smelter, scheduled to come on-stream in early 1986, a projected 460,000 tons per year. On July 11, 1985, representatives of the Environmental Protection Agency (EPA) and the Mexican Ecology and Urban Development Agency signed a joint statement specifying that by January 1988, the Nacozari smelter would install an acid plant to reduce sulfur dioxide emissions and that the Douglas smelter would have pollution control equipment in place. In the interim, the Nacozari smelter would reduce emissions by limiting production during

Table 3.—Indicators of Arizona business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	2,970	3,072	3,187
Total civilian labor force	do.	1,386	1,441	1,477
Unemployment	percent	9.1	5.0	6.5
Employment (nonagricultural):				
Mining total[1]	thousands	14.3	13.1	12.0
Metal mining[2]	do.	12.2	11.3	9.9
Manufacturing total	do.	155.8	172.8	180.7
Primary metal industries	do.	6.5	7.0	7.8
Stone, clay, and glass products	do.	6.3	7.5	7.9
Chemicals and allied products[2]	do.	3.5	3.7	3.7
Petroleum and coal products[2]	do.	W	.1	.2
Construction	do.	78.6	97.0	110.4
Transportation and public utilities	do.	57.2	59.9	63.0
Wholesale and retail trade	do.	260.9	286.3	314.4
Finance, insurance, real estate	do.	65.7	72.1	80.6
Services	do.	242.2	273.2	298.0
Government and government enterprises	do.	203.1	207.5	218.4
Total	do.	1,077.8	1,181.9	1,277.5
Personal income:				
Total	millions	$32,865	$36,921	$40,775
Per capita		$11,039	$12,020	$12,795
Hours and earnings:				
Total average weekly hours, production workers		40.5	40.8	40.9
Mining (copper ores)		39.1	41.3	41.6
Total average hourly earnings, production workers		$9.0	$9.1	$9.5
Mining (copper ores)		$13.3	$13.4	$13.9
Earnings by industry:				
Farm income	millions	$365	$535	$423
Nonfarm	do.	$22,724	$25,840	$28,944
Mining total	do.	$528	$524	$491
Metal mining	do.	$407	$384	$357
Nonmetallic minerals except fuels	do.	$14	$15	$15
Coal mining	do.	$48	$49	$47
Oil and gas extraction	do.	$58	$76	$71
Manufacturing total	do.	$3,902	$4,496	$4,905
Primary metal industries	do.	$211	$228	$249
Stone, clay, and glass products	do.	$151	$184	$209
Chemicals and allied products	do.	$84	$90	$93
Petroleum and coal products	do.	$5	$5	$6
Construction	do.	$2,103	$2,595	$3,001
Transportation and public utilities	do.	$1,529	$1,625	$1,777
Wholesale and retail trade	do.	$3,853	$4,381	$4,943
Finance, insurance, real estate	do.	$1,433	$1,647	$2,054
Services	do.	$4,857	$4,727	$6,459
Government and government enterprises	do.	$4,350	$4,646	$5,099
Construction activity:				
Number of private and public residential units authorized[3]		63,964	79,259	71,820
Value of nonresidential construction[3]	millions	$917.0	$1,536.5	$1,831.0
Value of State road contract awards	do.	$291.0	$438.0	$499.0
Shipments of portland and masonry cement to and within the State	thousand short tons	1,645	2,001	2,318
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,511.7	$1,485.9	$1,550.1
Value per capita		$509	$484	$486

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

adverse weather conditions; the Cananea smelter would not triple production until an acid plant was installed; and the Douglas smelter would comply with the Clean Air Act as soon as possible, but no later than January 1, 1988.

An Environmental Defense Fund study claimed that the health of southeastern Arizona residents were threatened by sulfur dioxide emissions and linked copper smelters with acid rain falling between the Sierra Mountains in California and the Continental Divide in Colorado.

Relating to ground water pollution, the Arizona Water Quality Council found copper operations south of Tucson in violation of State ground water standards. Pumping from the mines' interceptor wells prevented some of the degraded water from reaching the Tucson Basin aquifer, sole water source for agricultural, domestic, and industrial uses. Tailings-pond contaminants reportedly increased hardness, sulfates, and other dissolved solids in local ground water.

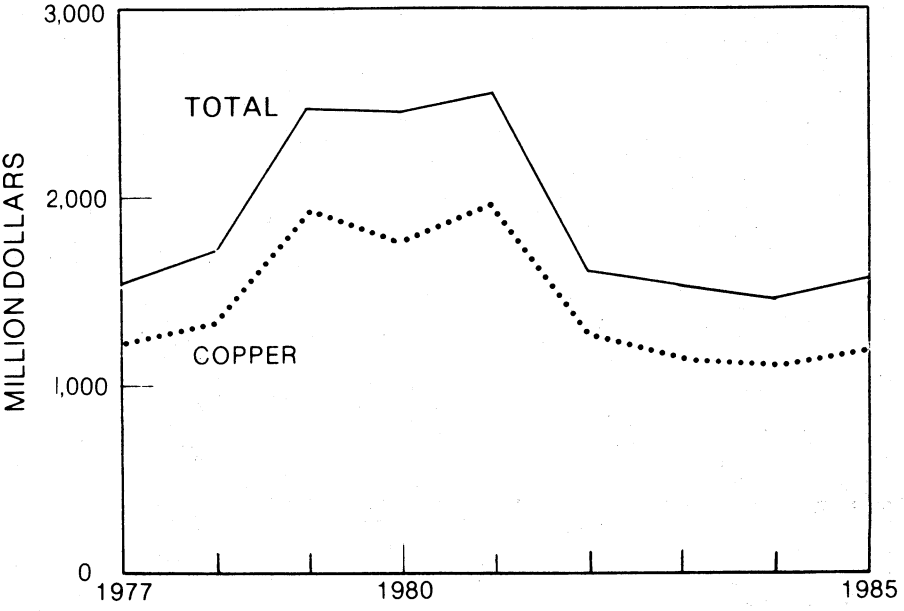

Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Arizona.

Exploration Activities.—Although exploration in the State declined with the slump in metal prices, improved leaching processes led to exploration for oxide deposits. For example, exploration drilling in the block-caved portion of San Manuel identified 60 million short tons of 0.47% oxide copper that could be mined by open pit. Additional drilling and tests for in situ mining were planned for the 200 million short tons of material under the area to be open pit mined.

In the search for gold, companies reopened old lode mines and examined mineralized areas suitable for heap leaching. Exploration in 1985 led to the Copperstone gold discovery on the north end of the Dome Mountains near Parker, La Paz County, where Cyprus Minerals Co. estimated reserves of 4 million short tons of 0.09 troy ounce of gold per ton.[3] Another purported find of the Lost Dutchman gold mine in the Superstition Mountains ended when a State grand jury indicted an Arizona rancher on charges of swindling $135,000 from investors.

In a 5-year agreement with the San Carlos Apache Indian Tribe, Billiton Exploration USA Inc. paid $2 million to explore the 1.8-million-acre reservation for metallic minerals.

Newmont Mining Corp. canceled its lease on a Vekol Hills-Papago Indian property south of Casa Grande claiming development of the 103-million-short-ton copper ore deposit would require a copper price of approximately $1.25 per pound.

Several exploration offices were closed, including the Phelps Dodge Small Mines Div., which was formed in 1981 to acquire and develop ore bodies of nonenergy minerals or metals that could be brought into production quickly. Other units of the company's exploration and development group were expected to assume the function. Kennecott planned to dispose of several shutdown mine and exploration properties and to refocus attention on those areas where exploration success had been demonstrated.

Legislation and Government Programs.—In 1985, the Governor signed Senate bill 1172, extending the term of the Arizona Department of Mines and Mineral Resources to 1996. The department promoted the State's mineral resources; assisted prospectors and operators of small mines; maintained an information bank, including a library of minerals and mining data in its Phoenix and Tucson offices, underground mine map repository files, and a mineral museum; surveyed potential economic mineral resources; and published mining information.

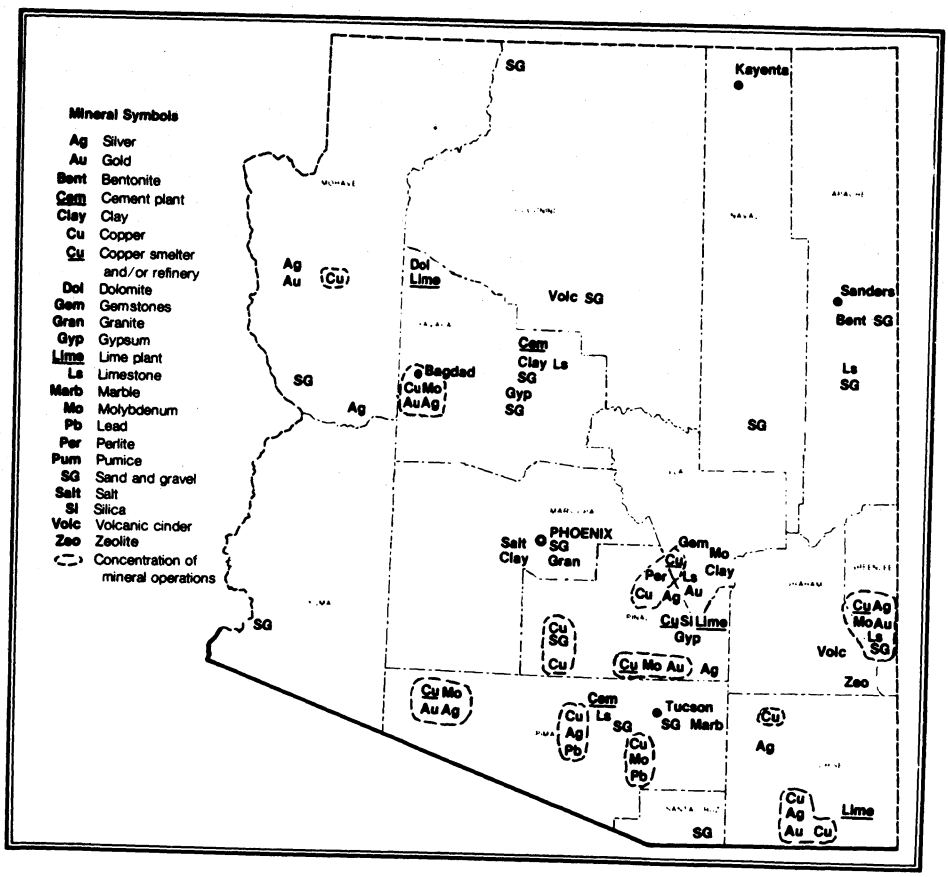

Figure 2.—Principal mineral producing localities in Arizona.

Pursuant to the State's water interests and directly affecting mining, the Governor signed two water bills: House bill 2396 revised the law on ground water pumping; and Senate bill 1249 established a fund for the Central Arizona Project (CAP) supplemental fund authorizing CAP to build and operate ground water recharge and recovery projects and to allow the CAP eminent domain rights.

Other bills were signed relating to the environment: House bill 2424 established the Governor's Commission on the Environment to make annual recommendations on ways to improve the environment; and Senate bill 1096 required an agency at the State level or lower to obtain local government approval with jurisdiction over the site before it can select a site for waste treatment or disposal.

In a landmark decision, the U.S. Supreme Court ruled in June that State governments cannot tax oil, gas, and other minerals extracted from Indian lands leased after 1938. The Indian Leasing Act of 1938 superseded a 1924 law permitting States to tax Indian tribes for oil and gas taken from the reservations. Some Arizona companies had continued paying State tax levies under protest. After the ruling, the Navajo Tribe started imposing taxes on large companies operating in the tristate reservation area.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Copper.—Arizona copper production increased in output and value about 7% in 1985 compared with that of 1984. A significant rise in copper output at the Morenci, Sierrita, Bagdad, Pinto Valley, Inspiration, Eisenhower, and Esperanza operations counteracted declines, shutdowns, and closings at others.

Copper was produced at 25 operations in the following counties, in descending order of output: Greenlee, Pinal, Pima, Gila, Yavapai, and Cochise. Of these, 11 were large-scale facilities treating more than 100,000 short tons of material. Eight former operations with large tonnages were phasing down, but continued copper recovery by precipitation or electrowinning processes. Four small base and precious metals companies recovered copper from old tailings or lode deposits, compared with nine in 1984. The quantities discussed in the following section are in short tons unless otherwise noted.

Amoco Minerals Co., a subsidiary of Amoco Corp., was spun off to a newly organized company, Cyprus Minerals, on July 1, 1985. Cyprus Metals Co., a division of Cyprus Minerals, operated the Cyprus Bagdad Copper Co., Cyprus Pima Mining Co. (owned 75.01% by Cyprus Minerals and 24.99% by Utah International Corp.), and Cyprus Johnson Copper Co.

The Cyprus Bagdad operation at Bagdad, Yavapai County, 120 miles northwest of Phoenix and 60 miles west of Prescott, included an open pit copper mine, a 55,000-ton-per-day sulfide ore concentrator, and an oxide ore heap-leaching system with an SX-EW plant producing electrowon copper cathode. Twenty percent of copper concentrates produced was under sales contracts to Mitsui Mining & Smelting Co. Ltd., Japan, through 1986. From 60% to 78% of the concentrates was to be sent for smelting and refining either to Inspiration or Magma Copper Co. through 1986; all refined metal returned to the company, and Bagdad cathode production was committed under sales agreements with U.S. metals fabricators under prices determined by commodity exchange quotations. Molybdenum concentrates toll roasted at several European and U.S. plants were marketed by Philipp Bros. Inc.

Following a 9-month shutdown in 1984, the Bagdad Mine was returned to full production in January 1985. Operating costs were reduced by 30% from 1983 levels. According to the Cyprus Minerals 1985 10K Annual Report to the Securities and Exchange Commission, the facility processed 19 million tons of sulfide ore yielding 167.3 million pounds of copper and 5 million pounds of byproduct molybdenum. The SX-EW plant also continued operating at near capacity during 1985. At yearend, Bagdad's proved reserves totaled 417 million tons averaging 0.44% copper. Because of projected low copper prices, the company wrote down its Bagdad investment of $385 million to an estimated net realizable value of $189 million.

The Cyprus Johnson operation, 20 miles east of Benson, Cochise County, consisted of an open pit mine (which was shut down in 1983), a heap leach, and an SX-EW plant. Leaching previously stockpiled ore and recovering copper at the SX-EW plant con-

tinued in 1985, producing 6.2 million pounds of copper.

Shut down since October 1982, the Cyprus Pima open pit copper mine and 32,500-ton-per-day copper concentrator, about 16 miles south of Tucson, Pima County, remained on a maintenance status. In late September, ASARCO Incorporated purchased the Pima Mine, ore body, land, and water rights for $12.5 million to be paid over the next 10 years. Pima's mothballed concentrator was not included in the transaction. The mine occupied one end of the open pit shared by Asarco's Mission, Eisenhower, and San Xavier Mines.

Anamax Mining Co. closed its Twin Buttes Mine in October 1985, laying off most of the company's 156 employees. Jointly owned by AMAX Inc. and Anaconda Minerals Co., Twin Buttes ceased copper mining in 1983 but continued operating a small copper oxide and SX-EW plant from existing oxide ore stockpiles. The operation, about 20 miles south of Tucson, had been for sale and much of the equipment had already been sold. At its peak in the mid-1970's, the Twin Buttes Mine employed about 2,100 people.

On December 31, 1984, the AMAX 10K Annual Report showed estimated ore reserves at Twin Buttes were 122 million tons of sulfide ore averaging 0.72% copper and 33 million tons of oxide ore with an average grade of 0.82% copper.

Asarco, in its 1985 annual report, reported that its Mission Complex, which includes the adjacent Mission, San Xavier, Eisenhower, and Pima (acquired in 1985), recovered 59,000 tons of copper and 1,073,000 troy ounces of silver. Compared with that of 1984, this was an increase of almost 4% and 2% for copper and silver, respectively. The Silver Bell concentrator was shut down in August 1984, and copper recovered from the precipitate plant in 1985 totaled 4,400 tons. Blister copper produced at the Hayden smelter reached 166,900 tons in 1985, compared with 80,000 tons in 1984 and 64,300 tons in 1983.

As of December 31, 1985, Asarco estimated reserves as follows: the Mission Complex, 286,426,000 tons of 0.62% copper and 0.13 ounce of silver per ton. Included are Pima reserves, acquired in 1985, of 38,879,000 tons containing 0.13 ounce of silver per ton and 0.61% copper.

In early 1985, a $500,000 revegetation project on the Sacaton property entered its final stage. Tailings ponds and waste dumps were covered to a depth of 1 to 1-1/2 feet with 288,000 tons of soil and planted with more than 3,600 plant species. About 10,000 feet of water pipe, 46,000 feet of drip lines, and more than 5,000 drip irrigation emitters were installed on the tailings pond to help nurture the new plants through the second growing season.[4]

After operating an Ore Purchasing Department in Tucson for 46 years, Asarco transferred this function to its New York City office in September. The Tucson office continued handling sulfuric acid sales generated at company smelters, Also, anticipating the unlikelihood of developing new copper mines, the company placed on the market more than 28,000 acres of ranchland and farmland bought for water rights and the protection of mining claims adjacent to certain of its undeveloped mineral deposits in southern Arizona. Asarco, however, retained the mineral rights.

Duval Corp., a subsidiary of Pennzoil Co., operated the Sierrita open pit copper-molybdenum mine and 85,000-ton-per-day concentrator 30 miles south of Tucson, Pima County. The adjacent Esperanza open pit copper-molybdenum mine and 15,000-ton-per-day concentrator remained shut down. The Mineral Park open pit molybdenum-copper mine and 15,000-ton-per-day concentrator 15 miles north of Kingman remained idle. Precipitate plants at Esperanza and Mineral Park produced 5,000 tons and 3.9 tons of cement copper, respectively.[5]

Although most of Duval's assets in Arizona continued to be for sale, the Sierrita facilities were operated throughout the year, and about 120 tons per day of copper contained in concentrate was produced. More than 660 hourly employees worked through 1984 and 1985 without renewing labor contracts that had expired September 30, 1983. On February 14, Duval workers voted 314 to 286 to decertify four unions. After hearing the unions' objections to the results of the elections, the National Labor Relations Board (NLRB) in Arizona upheld the vote. At yearend, the union appeal to the NLRB in Washington, DC, was still under consideration.

Inspiration Consolidated Copper Co., a subsidiary of Inspiration Resources Corp., properties included the Joe Bush-Thorton and Live Oak-Red Hill-Bluebird open pit mines and the two-stage dump leach operation in the Miami area, Gila County. Operations also included crushing facilities, a 20,000-ton-per-day concentrator, a smelter

with a rated annual capacity of 110,000 tons of copper in concentrate, a sulfuric acid plant, a solvent-extraction plant, an electrowinning and electrorefining tankhouse, and a continuous-cast rod-fabricating plant. Inspiration smelted copper-bearing materials and, to a lesser extent, provided refining and rod-fabricating services for other copper producers under toll contracts or by concentrate purchases. The company's Christmas open pit and underground mines and 5,500-ton-per-day concentrator 35 miles south of Miami, Gila County, and its Sanchez copper exploration project near Safford, Graham County, continued inactive.

Total copper produced from the Inspiration area mines increased from 75,490 tons in 1984 to 77,040 tons in 1985. Production at the copper rod plant increased to nearly 1 million pounds per day, and quality of the rods improved following the completion of a 2-year modernizing project. Also during the year, $3.2 million in capital expenditures was used to integrate the Bluebird Mine, acquired in 1984, into the adjacent mining and leaching operations. As of December 31, 1985, the company estimated 222 million tons proven reserves and 18 million tons probable reserves of 0.53% copper.

Despite cost-cutting measures and productivity improvements, continued weak copper prices resulted in the company incurring an operating loss of $8.7 million before unusual items in 1985, compared with an operating loss of $5 million in 1984.

During the year, Inspiration was cited for sulfur dioxide emissions resulting from routine smelter maintenance. The proceeding was settled on October 7 when the company and the Arizona Department of Health Services reached a consent agreement requiring Inspiration to curtail smelter operations when its acid plant was inoperative, to install continuous stack monitors by November, and to compile a report indicating any additional measures to reduce SO_2 emissions during an acid plant failure. Compliance with the judgment resulted in reduced smelter production.

By yearend, Inspiration employed at its base-metals operations approximately 1,230 persons, about 900 of whom were union members with contracts expiring on June 30, 1986.

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

Ray Mines Div. operated its mine and concentrator at close to capacity; however, its Hayden smelter remained shut down and concentrates were sold to Asarco for treatment at the Asarco Hayden smelter. After being idle since 1982, the silicate ore processing plant and SX-EW unit were reactivated in December for producing an additional 20,000 tons of copper per year.

According to the Standard Oil Co. 1985 10K Annual Report, Ray Mines Div. produced 92,498 net tons of copper in 1985, compared with 98,100 tons in 1984. Ores mined and treated increased to 12,612,000 net tons in 1985, compared with 11,756,000 tons in 1984; the average ore grade was 0.999% copper in 1985, compared with 1.109% in 1984.

Kennecott reported that its total metal mining losses increased from $160 million in 1984 to $165 million in 1985, principally because of expenses associated with the Utah Copper Div.'s complete suspension of operations. The company's Arizona and New Mexico operations essentially broke even at 1985 prices.

Newmont owned two subsidiaries in Arizona, Magma Copper and Pinto Valley Copper Corp. Magma Copper operated the San Manuel Div. at San Manuel, Pinal County, 43 miles northeast of Tucson, and the Superior Div. at Superior, Pinal County, 60 miles east of Phoenix.

Magma Copper's San Manuel Div. comprised an underground mine, a 64,000-ton-per-day concentrator, a smelter with a 200,000-ton-per-year capacity of copper anode, and a 125,000-ton-per-year continuous-cast rod plant. According to the 1985 Newmont annual report, the San Manuel Mine produced 17.4 million tons of ore averaging 0.638% sulfide copper in 1985, compared with 20.4 million tons in 1984. Copper production from concentrates declined to 108,642 tons, byproduct silver output dropped to 405,709 ounces, molybdenum sulfide to 2,836 tons, and gold to 21,131 ounces in 1985.

With pretax losses of $60.2 million, excluding special charges, at its Magma Copper and Pinto Valley Copper operations,

Newmont instituted major programs to reduce total costs. At San Manuel, reductions were sought by changes in underground mining methods, and by lowering labor charges, which accounted for just over 50% of copper production costs in 1985. Costs for producing copper at the underground mine were higher than the 1985 selling price for copper.

A $70 million project was started at San Manuel to produce copper by leaching oxide ore dumps mined by open pit methods with construction of the SX-EW plant and related leach dumps commencing in the spring. Upon completing the facility in mid-1986, about 25,000 tons per year of high-grade electrowon copper was expected to be recovered at one-half the cost of producing copper from sulfide ore at the underground mine. Minable ore reserves were estimated at 56.5 million tons. Commercial-scale testing of in situ leaching was planned for the larger part of the oxide ore body that was caved by mining the underlying sulfide ores. If tests prove successful, annual production from this part of the ore body was estimated at 25,000 tons of copper from reserves of 170 million tons. Since the ores would not be moved, costs were expected to be lower than those for dump leaching.

For the first time, the Arizona Department of Health Services cited the San Manuel smelter operation for violating emission standards three times during the year. Under the Clean Air Act, the company had been allowed to control smelter emissions by periodically curtailing production and had filed for permission to defer installing permanent equipment until January 1988. The cost of bringing the smelter into compliance was estimated to be $123 million, exclusive of financing, and the decision to modernize would come in 1986. In September, Newmont's Board of Directors authorized additional engineering studies, but stated that any modifications, such as construction of a flash smelter, would depend on a continuous feed of competitively priced concentrates.

Newmont reported San Manuel proven reserves at yearend were estimated at 297 million tons averaging 0.694% copper, 0.028% molybdenum sulfide, 0.029 ounce of silver, and 0.00158 ounce of gold, and at the deeper Kalamazoo ore body, reserves were estimated at 354.9 million tons of 0.715% copper with byproducts of the same grade as the San Manuel ore body.

The Superior Div.'s underground Magma Mine, idled in 1982 because of the high production costs, was permanently closed December 30, 1985. Since the mine was diverted to caretaker status on March 15, 1985, only 25 salaried and no hourly workers were employed. As of December 31, 1984, Magma had estimated ore reserves of 4.4 million tons of ore averaging 5.69% copper, 0.71 ounce of silver per ton, and 0.026 ounce of gold per ton.

Pinto Valley Copper operations included the Pinto Valley open pit mine, a 50,000-ton-per-day concentrator, a 33,000-pound-per-day SX-EW plant west of Miami; another SX-EW plant at Miami for treating leach solutions from the old Miami underground leach operation; the Copper Cities inactive open pit mine and leaching facilities; and the Miami East underground mine on standby status throughout the year. Concentrates were shipped to Magma Copper's San Manuel smelter and refinery for processing to finished copper.

Following resumption of operations in May 1984, the open pit mine and mill went to full production in 1985. According to the Newmont 1985 annual report, Pinto Valley Copper production totaled 19.6 million tons of ore averaging 0.45% copper, yielding 78,865 tons of copper, 311,180 ounces of silver, 5,524 ounces of gold, and 1,452 tons of molybdenum sulfide. At Pinto Valley and Miami, leaching and SX-EW facilities yielded 7,943 and 4,031 tons of copper, respectively.

In December, to reduce costs, Pinto Valley Copper operations were reorganized to integrate management with that of Magma Copper. Staff positions were reduced 25%, and departments were decreased from 11 to 8.

Magma Copper reported losses of $94.4 million before taxes, compared with $44.1 million in 1984, and Pinto Valley Copper posted losses of $6.1 million, compared with $9.1 million in 1984. Newmont's net income, exclusive of special charges, declined from $41 million in 1984 to $23.7 million in 1985. The reduced income was due to continued depressed copper prices, the decrease in gold prices, lower income from energy resources, and increased losses from ferroalloys.

Noranda Lakeshore Mines Inc., a subsidiary of Noranda Mines Ltd., Toronto, Canada, operated the Noranda Lakeshore Mine 28 miles southwest of Casa Grande, Pinal County, on the Papago Indian Reservation. In 1984, Noranda converted its under-

ground mine and vat-leach facility to an in situ leach of the mine and an SX-EW operation; copper output declined from the 7,701 tons produced in 1984 to 6,779 in 1985.

Phelps Dodge ranked first in copper production with nearly 30% of Arizona's total and about 22% of the newly mined copper output in the United States. The company owned and operated the Morenci-Metcalf open pit mine in Greenlee County, 169 miles northeast of Tucson; the New Cornelia open pit mine at Ajo, Pima County, 106 miles southwest of Phoenix; and the Copper Queen Branch leaching and precipitation operation at the permanently shutdown Lavender Pit and underground Copper Queen Mine at Bisbee, Cochise County. The Copper Basin copper deposit southwest of Prescott, Yavapai County, continued in the land acquisition stage.

After 3 consecutive years of losses, the company reported total earnings of $29.5 million in 1985, despite severely depressed copper prices. A rigorously observed program that reduced operating and overhead costs included increasing the cutoff grade of ore fed to the concentrators and segregating lower grade material for future treatment by SX-EW. Because it could not comply with State and Federal sulfur dioxide and particulate emission limitations, the company's Morenci smelter was shut down in January 1985. Its Ajo smelter was idled indefinitely in April 1985. Concentrates usually treated at the two smelters were shipped to the Phelps Dodge smelters at Douglas and Hidalgo, NM, with the excess sold for smelting by others both domestically and abroad. The New Cornelia Mine, shut down in August 1984, remained closed. Additional factors that produced the 1985 profit were productivity records set by company employees at Morenci and Tyrone, and at the Morenci Mine, a greater use of trucks instead of rail transportation.

In its 1985 annual report, the company estimated yearend ore reserves at its Morenci Mine to be 795 million tons of 0.75% copper; at its Western Copper property adjoining the Morenci Mine, 184 million tons of 0.64% copper; at its New Cornelia (Ajo) Mine, 209 million tons of 0.5% copper; at its Safford Mine, 262 million tons of 0.88% copper; and at Copper Basin, 175 million tons of copper-bearing material averaging 0.55% copper and 0.021% molybdenum.

The Phelps Dodge Morenci operation included the Morenci Mine (formerly the Morenci and Metcalf open pit mines); the 60,000-ton-per-day Morenci concentrator and 40,000-ton-per-day Metcalf concentrator; leaching and precipitation plants; and a 160,000-ton-per-year smelter. From 71,922,000 tons of ore and waste mined in 1984 and 62,049,000 tons mined in 1985, production at the Morenci Mine increased from 187,400 tons of recoverable copper in concentrates in 1984 to 232,100 tons in 1985, whereas, production of recoverable copper in precipitates declined from 29,300 tons in 1984 to 26,600 tons in 1985.

As part of its efforts to maintain a cost competitive position, the company announced plans to build a $90 million SX-EW facility at the Morenci Mine. Construction could be completed within 18 months after State and Federal permits were received. Initial annual production of 35,000 tons of copper, to be increased to 45,000 tons within 3 years, would partially replace production from the company's Tyrone, NM, ore body, which was expected to be mined out in the 1990's.

Heavy rainfall early in the year once more adversely affected water quality downstream from the Morenci Mine-Chase Creek Canyon waste dumps when the company's catchment and pumping facilities in Chase Creek could not handle floods in the area. In response to an administrative complaint filed in 1984 by the Water Quality Control Council of the Arizona Department of Health Services and a suit filed in May by the EPA, Phelps Dodge proposed constructing larger capacity storage and diversion facilities at a cost of $9 million. The company, however, was still negotiating a consent decree to settle the litigation with the agencies at yearend.

In November 1985, Phelps Dodge reached an agreement to sell, for $75 million, an undivided 15% interest in its Morenci Mine, concentrators, and related facilities to Sumitomo Metal Mining Arizona Inc., a jointly owned Delaware subsidiary of Sumitomo Metal Mining Co. Ltd. and Sumitomo Corp., both of Japan. The Morenci smelter was not included in the agreement. Phelps Dodge would remain the operator of the properties, and Sumitomo would receive its share of Morenci production. The Arizona company also prepared to sell another 15% interest in the properties.

The shutdown of the New Cornelia mining operation idled about 600 workers in 1984 and, with the closing of the Ajo smelter, another 235 employees were affected.

Phelps Dodge continued selling company-owned houses at Ajo.

At the Copper Queen Branch, the Campbell and Junction Mines' extensive underground workings (about 3,300 feet deep) were allowed to flood; contract miners had been mining small amounts of copper, gold, and silver ores for use as flux in the company's smelter. Phelps Dodge continued its small-scale copper leach and precipitation operation of the Bisbee dumps. Of 91 workers at the Bisbee operation, 25 remained to operate the leaching and precipitation facilities and perform security functions.[6]

Ores and concentrates were processed at the Douglas smelter throughout 1985; however, because the cost of installing environmental protection equipment could not be economically justified, the corporation planned to close the facility by yearend 1987. The Douglas smelter was operated under provisions of a 1977 amendment to the Federal Clean Air Act that granted smelters not complying with permanent sulfur dioxide emission regulations permission to obtain successive 5-year orders allowing continued operation until yearend 1987. Phelps Dodge submitted its application to operate its Douglas smelter under a second 5-year "Nonferrous Smelting Order" in May; however, by yearend, EPA had taken no action. Although the Arizona Department of Health Services issued an operating permit for the smelter in August, the company objected to the State agency's stipulation that required additional emission reductions and monitoring of air conditions in Bisbee, the Chiricahua National Monument, Douglas, and Elfrida. The new permit also ordered testing of smelter feed for toxic elements and the submission of pollution control plans within 39 days. For the first time, State agencies cited the Douglas plant for air quality violations in March, May, and August.

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
1981	1,040,813	$1,953,142	1,538,160	$2,886,440	67.7
1982	769,521	1,235,055	1,146,975	1,840,856	67.1
1983	678,216	1,144,285	1,038,098	1,751,476	65.3
1984	746,453	1,100,182	r1,102,613	r1,625,116	r67.7
1985	796,556	1,175,995	1,105,758	1,632,483	72.0

rRevised.

Table 5.—Arizona: 15 leading copper producing mines in 1985, in order of output

Rank in 1985	Rank in 1984	Mine	County	Operator	Source of copper
1	1	Morenci	Greenlee	Phelps Dodge Corp	Copper-molybdenum ore, concentrated and leached.
2	4	Sierrita	Pima	Duval Corp	Copper-molybdenum ore, concentrated.
3	2	San Manuel	Pinal	Magma Copper Co	Copper-molybdenum ore and retreated slag, concentrated.
4	3	Ray	do	Kennecott	Copper ore, concentrated and leached.
5	10	Bagdad	Yavapai	Cyprus Bagdad Copper Co	Copper-molybdenum ore, concentrated and leached.
6	6	Pinto Valley	Gila	Pinto Valley Copper Corp	Do.
7	5	Inspiration	do	Inspiration Consolidated Copper Co.	Do.
8	7	Eisenhower	Pima	ASARCO Incorporated	Copper ore, concentrated.
9	8	Twin Buttes	do	Anamax Mining Co	Copper ore, leached.
10	14	Lakeshore	Pinal	Noranda Lakeshore Mines Inc.	Do.
11	13	San Xavier	Pima	ASARCO Incorporated	Copper ore, concentrated.
12	15	Esperanza	do	Duval Corp	Copper ore, leached.
13	11	Silver Bell	do	ASARCO Incorporated	Do.
14		Miami	Gila	Pinto Valley Copper Corp	Do.
15	12	Mission	Pima	ASARCO Incorporated	Copper ore, concentrated.

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)	
	1984	1985	1984	1985	1984	1985	1984	1985
OPEN PIT								
Morenci	34,323	33,492	12,140	6,645	18,783	16,152	216,577	241,416
Sierrita	26,476	32,982	18,565	16,676	--	3,514	78,984	98,078
Ray	10,665	11,442	--	--	22,456	25,975	91,538	81,809
Bagdad	4,032	18,250	3,670	6,265	343	1,893	21,660	79,755
Pinto Valley	10,207	17,761	1,890	3,514	5,997	14,518	47,201	77,018
Inspiration	5,983	7,401	12,517	--	17,205	--	69,879	70,858
Eisenhower	6,090	7,115	9,218	12,317	--	--	33,646	43,687
Twin Buttes	--	--	--	--	--	--	22,788	8,992
San Xavier	2,113	1,266	4,168	1,750	--	--	8,598	5,525
Esperanza	--	4,130	--	--	2,057	--	4,235	4,657
Silver Bell	2,046	--	2,398	--	--	--	15,089	4,036
Miami	--	--	--	--	--	--	4,061	3,657
Mission	1,180	302	(2)	497	--	--	9,469	3,154
Johnson	NA	--	NA	--	NA	--	3,993	2,812
UNDERGROUND								
San Manuel	18,447	15,783	--	--	--	--	107,006	87,132
Lakeshore	--	--	--	--	--	--	6,987	6,148

NA Not available.
[1]Gross metal content.
[2]Included with waste material removed from Eisenhower Mine.

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

County	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1983, total	27	1	122,743,740	61,991	$26,284,184	4,491,532	$51,383,123
1984, total	24	--	125,687,818	r54,897	r19,799,044	r4,246,616	r34,570,257
1985:							
Cochise	2	--	W	W	W	W	W
Gila	2	--	W	5,459	1,734,100	287,293	1,764,611
Greenlee	1	--	W	W	W	W	W
Mohave	--	1	W	W	W	--	--
Pima	6	1	40,570,637	W	W	W	W
Pinal	5	--	W	W	W	1,155,759	7,098,903
Yavapai	1	--	W	--	--	W	W
Total	17	2	[3]127,209,540	[3]52,053	[3]16,535,105	[3]4,885,310	[3]30,006,552

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1983, total	678,216	$1,144,284,633	r234	r$111,786	--	--	r$1,222,063,726
1984, total	746,453	1,100,181,923	W	W	--	--	W
1985:							
Cochise	W	W	--	--	--	--	W
Gila	W	W	--	--	--	--	W
Greenlee	W	W	W	W	--	--	W
Mohave	--	--	--	--	--	--	W
Pima	164,004	242,126,933	W	W	--	--	W
Pinal	W	W	W	W	--	--	W
Yavapai	W	W	--	--	--	--	W
Total	[3]796,556	[3]1,175,995,140	[3]581	[3]244,313	--	--	[3]1,222,781,110

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

Table 8.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1985, 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	--	--
Silver	1	W	--	W	W	--	--
Total	2	W	W	W	W	--	--
Copper	14	126,874,640	46,056	4,382,734	[2]752,362	460	--
Other lode material:							
Gold-silver tailings	--	55,339	558	21,772	96	121	--
Silver tailings	--	W	W	W	--	--	--
Copper precipitates	2	63,633	--	--	43,088	--	--
Copper tailings	--	W	--	--	W	--	--
Total	2	W	W	W	W	121	--
Total lode	17	[3]127,209,540	W	[3]4,885,310	[3]796,556	581	--
Placer	2	--	W	--	--	--	--
Grand total	19	[3]127,209,540	[3]52,053	[3]4,885,310	[3]796,556	581	--

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 copper recovered from precipitates of ore leached.
[3]Includes items indicated by symbol W.

Table 9.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1985, 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:					
Acid leaching (vat, tank, heap)	--	--	[1]74,331	--	--
Smelting of concentrates[2]	46,056	4,382,491	678,937	451	--
Total	46,056	4,382,491	753,268	451	--
Direct smelting of:					
Ore	W	W	W	9	--
Precipitates	--	--	43,088	--	--
Tailings[3]	W	W	W	121	--
Total	W	[4]502,819	[4]43,288	130	--
Total lode material	W	[4]4,885,310	[4]796,556	581	--
Placer	W	--	--	--	--
Grand total	[4]52,053	[4]4,885,310	[4]796,556	581	--

W Withheld to avoid disclosing company proprietary data.
[1]Includes copper recovered by electrowinning process.
[2]Includes metal recovered from tailings.
[3]Excludes metal recovered from tailings by concentration.
[4]Includes items indicated by symbol W.

Gold.—Gold in the State continued to be recovered as a byproduct of copper production, principally from eight large-scale operations. Although output declined about 5%, its value of production fell more than 16% as the price of the metal dropped from an average of $360.66 per troy ounce in 1984 to $317.66 in 1985. In descending order of output, operations recovering gold included Morenci, San Manuel, Pinto Valley, A. J. Gilbert Inc. (Cochise County), Sierrita, Ray, Eisenhower, McFarland & Hullinger tailings dump (Pinal County), Diumich & Associates (Cochise County), San Xavier, and Mission. The number of small operations (under 100,000 short tons per year of material treated) reporting production declined from seven to three in 1985.

Lead.—Most of Arizona's lead production was a concentrate byproduct of copper ore beneficiation. Recoverable contained lead production more than doubled compared with that of 1984, as Morenci resumed lead recovery and the Eisenhower Mine significantly increased its lead concentrate output. In descending order of output, operations producing lead concentrates in 1985 included Morenci, the McFarland & Hullinger tailings dump, Ray, Eisenhower, the Gold Hill Mine of Little Hill Mines Inc. in Pinal County, San Xavier, and Mission.

Molybdenum.—Molybdenum continued to be recovered as a coproduct and/or byproduct of copper production at the Sierrita (the leading producer in the State), Bagdad, San Manuel, Pinto Valley, Morenci, and Inspiration operations. Contained molybdenum recovered from the ores increased nearly 34% in 1985; total shipments of concentrates, however, increased 0.5%, and value dropped about 17% as the average price of molybdic oxide (per pound of contained molybdenum) declined from about $3.53 in 1984 to $3.33 in 1985. Domestic shipments from four operating mines declined about 3%. Although just two operations exported molybdenum concentrates, compared with four in 1984, an increase of about 15% in exports was posted. Total inventories decreased from 2,737,373 pounds at the beginning of 1984 to 1,134,823 pounds at the beginning of 1985.

Rhenium.—The rhenium compound ammonium perrhenate was recovered by roasting molybdenum concentrates, a byproduct of copper production from porphyry copper ore. Duval's Sierrita Mine continued as the only domestic producer recovering the product in 1985. U.S. consumption increased 27% as the petroleum industry used the bimetallic platinum-rhenium catalyst to produce low-lead and lead-free high-octane gasoline.

Silver.—Arizona rose to third in the Nation in silver production. Recovered principally as a byproduct of copper production, silver output rose 15% because of increased output at several large-scale copper operations. Value of that production, however, fell about 13% as the average price of the metal continued its downward drift from $20.63 per troy ounce in 1980 to $8.14 in 1984 and $6.14 in 1985. Listed in descending order of output, the following operations recovered silver in Arizona: Sierrita, Eisenhower, Morenci, Bagdad, Ray, San Manuel, Reymert, Pinto Valley, A. J. Gilbert, San Xavier, Mission, Diumich & Associates, McFarland & Hullinger, Pima, and Gold Hill. Of the 11 small operations recovering silver in 1984, only 4 produced the metal in 1985.

Uranium-Vanadium.—Although no vanadium production was reported in the State in 1985, exploration continued for uranium contained in breccia pipes in the northern areas. Energy Fuels Nuclear Inc. officials held hearings in Flagstaff regarding a proposed mine 13 miles south of Tusayan and 15 miles south of the Colorado River in the Kaibab National Forest, Coconino County. Some residents were concerned about its proximity to the Grand Canyon and also about the possibility that contaminated water from the underground mine would drain into Cataract Canyon and then flow into the Colorado River.

INDUSTRIAL MINERALS

Cement.—Production of finished portland cement declined about 4%. Finished gray portland cement sales also dropped off more than 4%, and the value of sales declined more than 7%, partly because of a decline in the average price. After a respite of several years, one company resumed production of finished white portland cement. Masonry cement output rose about 4%, and sales increased about 6% in quantity and nearly 8% in value.

Arizona Portland Cement Co., a division of California Portland Cement Co. and the Phoenix Cement Co., a division of Gifford-Hill and Co., produced cement in the State. The Arizona Portland Cement plant at Rillito was a four-kiln, dry-process plant with 1.2 million metric tons per year of cement-grinding capacity and 1.1 million tons per year of clinker capacity. The Phoenix Cement plant at Clarkdale was a three-kiln, dry-heater-process plant with 630,000 tons per year of cement-grinding capacity and 550,000 tons per year clinker capacity. Both companies marketed a general-purpose and moderate-heat gray portland cement and masonry cement; Phoenix Cement also produced and sold a white portland cement and a pozzolan cement.

In descending order of tonnage, raw materials consumed included limestone, gypsum, clays, iron ore, fly ash, pyrite mill scale, and other substances. Natural gas consumed as fuel for kilns increased nearly 20%; electrical energy consumption rose 4%. A small amount of coal was also used.

Clays.—Arizona clay output increased

approximately 35%; however, the total value of its production rose about 84%. Common clay gained more than 31% in output and 47% in value, and bentonite rose 60% in output and 146% in value. In descending order of tonnage, common clay producers included Phoenix Brick Yard's Tolleson Pit in Maricopa County and Pantano Pit in Pima County; Phoenix Cement's pit in Yavapai County and Arizona Portland Cement's Pantano Pit in Pima County. Principal uses for common clay included face brick and portland cement. Nonswelling bentonite was mined at Harshaw/Filtrol Partnership's Cheto Pit, United Catalysts Inc.'s Cheto No. 1 Pit in Apache County, and Superior Companies' Arizona Gypsum Corp.'s Verde Pit in Yavapai County. The bentonite was used for filtering, clarifying, and decolorizing mineral and animal oils; for desiccants; and for animal feed. McKusick Mosaic Co. mined a swelling bentonite at its Weary Lode Mine, Gila County, for medical, pharmaceutical, and cosmetic purposes. The average unit value of all clays was $8.06 in 1985, compared with $5.95 in 1984.

Gem Stones.—Arizona continued to lead the Nation with 36% of gem stone output. Most important gem stones were turquoise, recovered at several copper mines, and peridot. Production was estimated to have remained the same as in 1984. A new lead-copper-antimony-chloride-sulfate mineral, discovered in 1968 at the Mammoth Mine, Tiger, Pinal County, was named mammothite. The Cerulean-blue monoclinic mineral, occurring as euhedral crystals imbedded in white anglesite and also associated with phosgenite, was compared with mammothite from Laurium, Attica, Greece.[7]

Gypsum.—Crude gypsum production declined nearly 4% in quantity and about 17% in value. Calcined gypsum production, however, increased about 4% in quantity and 6% in value. National Gypsum Co. quarried and crushed crude gypsum at Feldman, near Winkelman, Pinal County, and calcined gypsum for manufacturing wallboard at its Gold Bond Building Products Div. plant in Phoenix. Pinal Mammoth Gypsum Co. quarried gypsum for agricultural use at its Thunderbird Mine 6 miles north of Mammoth, Pinal County. Superior Companies quarried gypsum for use as a cement additive 4 miles southeast of Camp Verde, Yavapai County, and near Winkelman, Pinal County.

At yearend, a National Gypsum management group, Aanchor Holdings Inc., offered to acquire the company in the face of a hostile takeover bid by a Canadian investor and despite threats of asbestos-related litigation.

Lime.—Total lime production increased about 33% and about 23% in value as the copper industry began to recover. Genstar Lime Co., Yavapai County, was the leading producer of lime used for cement, followed by Can-Am Corp. near Douglas, Cochise County, and Magma Copper at San Manuel, Pinal County, both of which manufactured lime for the copper industry.

Perlite.—Crude perlite production increased slightly; however, the value dipped. Of six States mining perlite, Arizona, with minor output, ranked third after New Mexico and California.

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

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

Pumice.—Gila Valley Block Co. quarried pumice at its Pumice-Bluebird-Triangle operation 25 miles east of Safford, Graham County. Output and sales decreased in both quantity and value, with the material being used mainly for building and decorative block and lesser amounts for landscaping and insulation.

Pyrites.—Magma Copper, Superior Div., pyrite production from its Magma Mine fell sharply when the mine was permanently closed during the year.

Salt.—Southwest Salt Co. solution mined the Luke Salt deposit at Glendale, Maricopa County, and recovered the product in solar evaporation ponds. Salt was marketed for agriculture, industrial uses, and water softeners. The company was acquired by Morton-Thiokol Inc. during the year.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before

yearend.

Construction sand and gravel production was estimated to have gained about 22% in output and about 16% in value in 1985. As suburban development encroached on construction sand and gravel deposits, nearby residents complained of dust and noise pollution; in addition, some mining operations were faced with charges that rivers and streams were being rechanneled. For example, a court order halted the Valley Concrete and Materials Inc. Verde River operations for 7 months until riverbank stabilization procedures were under way. The State also filed suit for alleged damage to the Dead Horse Ranch State Park downstream from the sand and gravel excavation site. Residents of Pine, Gila County, were concerned with persistent dust problems caused by truck traffic in the area of the Payson Concrete and Materials Inc. operations.

Industrial.—Industrial sand and gravel producers included Arizona Silica Sand Co., Apache County, and Little Hill Mines Inc., Pinal County. Arizona Silica sold the product for hydraulic fracturing in the petroleum industry, blasting, and filtration, and Little Hill sold the commodity for metallurgical flux. Industrial sand and gravel operations produced less than 100,000 short tons. Output and value gained about 13% and 15%, respectively, as the average price per ton rose from $17.18 in 1984 to $17.53 in 1985.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Total output of stone increased, although the value of production declined as the average value of crushed stone fell from $5.06 per ton in 1983 to $3.90 in 1985. Yavapai County led in crushed stone production, followed by Pima, Mohave, Maricopa, Coconino, Pinal, Apache, Navajo, Cochise, and Graham.

Crushed.—Twenty-four private companies and four State and Federal entities mined crushed stone at a total of 40 quarries. About 40% of the material was transported by truck, the rest by rail, waterway, and other means.

Limestone and dolomite comprised 63% of crushed stone output. Listed in declining order of tonnage, limestone was produced in Yavapai, Pima, Cochise, Apache, and Gila Counties. Limestone for cement was quarried by Phoenix Cement in Yavapai County and by Arizona Portland Cement in Pima County. Lime used in copper operations was manufactured from limestone by Genstar Lime in Yavapai County, Paul Lime Div. of Can-Am in Cochise County, and McFarland & Hullinger in Pinal County. Superior Companies in Apache County crushed limestone for treating sulfur dioxide in stack gases. Paul Lime also crushed lime for use as a flux, for use in sugar refining, for treating stack gases, and for use as terrazzo and exposed aggregate. Granite Construction Co. quarried limestone in Pima County. Robert E. McKee Inc. continued to mine and crush dolomite for use as railroad ballast.

Granite, comprising about 22% of crushed stone production, was quarried by the U.S. Forest Service in Gila County; by A&A Materials Inc. in Pinal County; and by Arizona Granite, Madison Granite Supplies, Red Mountain Mining Inc., Choctaw Materials Inc., and Sunrise Granite Co. in Maricopa County for use as terrazzo and exposed aggregate, and for fine aggregate and fill.

Volcanic cinder and scoria, totaling about 11% of crushed stone output, was mined by the Forest Service and the Apache County Highway Department in Apache County; by Superlite Builders Supply division of U.S. Industries Inc. (the leading producer in the State), Coconino County Highway Department, Flagstaff Cinder Sales Inc., Olsen Bros., and the Arizona Highway Department in Coconino County; by Gila Valley Block in Graham County; and by Perkins Cinders Inc. in Navajo County. The product was used for aggregate, terrazzo and exposed aggregate, and road construction.

In other crushed stone applications, marble was quarried by Andrada Marble Co. and Catalina Marble Co. in Pima County for such uses as fine aggregate, poultry grit, roofing granules, and terrazzo and exposed aggregate. Magma Copper mined a sandstone in Pinal County for use as flux, and Magic Mountain Mining Co. mined sandstone in Yavapai County.

Table 10.—Arizona: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	53	451
Coarse aggregate, graded:		
Concrete aggregate, coarse	1	6
Railroad ballast	W	4,256
Fine aggregate (-3/8 inch):		
Stone sand, concrete	39	301
Stone sand, bituminous mix or seal	43	W
Screening, undesignated	4	12
Combined coarse and fine aggregates:		
Graded road base or subbase	447	W
Unpaved road surfacing	205	667
Crusher run or fill or waste	161	2
Other construction[2]	598	1,955
Agricultural: Other agricultural	W	215
Special:		
Roofing granules	W	13
Other miscellaneous[3]	4,039	13,547
Other unspecified[4]	341	1,688
Total[5]	5,929	23,111

W Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."
[1]Includes dolomite, granite, limestone, marble, sandstone, volcanic cinder and scoria, and miscellaneous stone.
[2]Includes stone used in terrazzo and exposed aggregate, and stone used for other construction and maintenance purposes.
[3]Includes stone used in cement and lime manufacture, other fillers or extenders, lightweight aggregate, paper manufacture, porcelain, waste material, sulfur oxide removal, and data indicated by symbol W.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Dimension.—Hazel Bowman quarried a small amount of sandstone in Coconino County for use as flagging.

Sulfuric Acid.—Arizona ranked first in output of sulfuric acid recovered as a byproduct in copper smelters. The State's copper industry supplied almost 34% of the Nation's byproduct sulfuric acid. Although the domestic supply remained essentially the same, declining just 0.5% in output, Arizona production fell nearly 8% in quantity and 20% in value as two smelters were idled. Sulfuric acid production in the State was 1,106,509 short tons valued at $11,526. The marketing of sulfuric acid and the position of the industry as related to southwest copper production was discussed in the literature.[8]

Vermiculite (Exfoliated).—W. R. Grace & Co. produced exfoliated vermiculite at its plant in Phoenix from crude vermiculite shipped into the State. The product was marketed for use principally in fireproofing, concrete aggregates, and block insulation, followed by horticulture applications, loose-fill applications, and plaster aggregates. Output and sales increased; however, value of the product declined.

Zeolites.—In 1985, East West Minerals Inc. acquired Anaconda's zeolite properties near Bowie, Graham County. The company's estimated reserves in Arizona, California, Nevada, and Oregon totaled 1.2 billion tons.[9]

[1]State Mineral Officer, Bureau of Mines, Denver, CO.
[2]De Gennaro, N. Arizona Mining: Decline of an Industry. Ariz. Econ., Dec. 1985, p. 4.
[3]Niemuth, N. J. Exploration, 1985: Arizona. Min. Eng., v. 38, No. 5, May 1986, pp. 323-324.
[4]Russell, W. Asarco Is Well Along With Sacaton Mine Reclamation Project. Arizona Pay Dirt, No. 547, Jan. 1985, p. 28A.
[5]Beard, R. R. The Primary Copper Industry of Arizona in 1985. Arizona Department Mines and Miner. Resour., Spec. Rep. No. 10, Oct. 1986, p. 20.
[6]Epler, B. Phelps Dodge Pulls the Pumps—Famous Bisbee Mines are Flooding. Arizona Pay Dirt, No. 552, June 1985, pp. 1, 4A-6A.
———. Sucker for Fine Old Machinery Takes a Last Look at Bisbee's Junction Pump Station. Arizona Pay Dirt, No. 553, July 1985, pp. 8B-12B.
———. Bisbee 220 Junction Corrections, Flooding Progress Report. Arizona Pay Dirt, No. 554, Aug. 1985, p. 13B.
[7]Peacor, D. R., P. J. Dunn, G. Schnorrer-Kohler, and R. A. Bideauz. Mammothite: A New Mineral From Tiger, Arizona and Laurium, Greece. Mineralogical Rec., v. 16, No. 2, Mar.-Apr. 1985, pp. 117-120.
[8]Engineering and Mining Journal. Marketing Cogenerated Smelter Acid. V. 187, No. 5, May 1985, pp. 31-33.
[9]Eyde, T. H. Zeolites. Min. Eng., v. 38, No. 5, May 1986, p. 369.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Arizona Portland Cement Co., a division of California Portland Cement Co., a subsidiary of CalMat Co.	Box 338 Rillito, AZ 85246	Quarry and dry-process, 4-rotary-kiln plant.	Pima.
Phoenix Cement Co.,[1] a division of Gifford-Hill and Co.	2505 West Beryl Box 35395 Phoenix, AZ 85069	Quarry and dry-process, 3-rotary-kiln plant.	Yavapai.
Cinder (volcanic):			
Flagstaff Cinder Sales Inc	Old Highway 66 Box 2796 Flagstaff, AZ 86003	Quarry	Coconino.
Superlite Builders Supply, a subsidiary of U.S. Industries Inc.	4150 West Turney Box 23163 Phoenix, AZ 85063	Open pit mine and crushing plant.	Do.
Clays:			
Harshaw/Filtrol Partnership, of Kaiser Aluminum & Chemical Corp. and Chevron Corp.	Box 155 Sanders, AZ 86512	Open pit mine	Apache.
McKusick Mosaic	Route 1, Box 35-D Globe, AZ 85501	Surface mine	Gila.
Phoenix Brick Yard	1814 South 7th Ave. Phoenix, AZ 85007	Open pit mine	Maricopa.
United Catalyst Inc	Box 32370 Louisville, KY 40232	Surface strip mine	Apache.
Copper:			
Anamax Mining Co., Twin Buttes Mine	Box 127 Sahuarita, AZ 85629	Open pit and underground mines and mill.	Cochise.
ASARCO Incorporated:			
Hayden Unit	Box 98 Hayden, AZ 85235	Smelter and acid plant	Gila.
Mission Complex[2 3 4]	Box 111 Sahuarita, AZ 85629	Open pit mines and mill	Pima.
Silver Bell Unit	Silver Bell, AZ 85270	Open pit mine, mill, leach dumps, precipitation plant.	Do.
Cyprus Metals Co., a division of Cyprus Minerals Co., (formerly Amoco Minerals Co.):			
Cyprus Bagdad Copper Co.[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.
Duval Corp., a subsidiary of Pennzoil Co.:			
Sierrita Mine[2 4 5]	Box 125 Sahuarita, AZ 85629	Open pit mines, mill, leach dumps, precipitation plant.	Pima.
Inspiration Consolidated Copper Co.[5]	Box 4444 Claypool, AZ 85532	Open pit mines, mill, dump leaching, solvent extraction plant, electrowinning-electrorefining tankhouse, custom smelter, sulfuric acid plant, continuous-cast-rod fabrication plant.	Gila.
Kennecott, a subsidiary of Standard Oil Co. of Ohio, Ray Mines Div.[2 3 4]	Box 9 Hayden, AZ 85235	Open pit mine, leach dumps, precipitation, vat-leaching, solvent extraction-electrowinning plants, smelter.	Gila and Pinal.
Magma Copper Co., a subsidiary of Newmont Mining Corp., San Manuel Div.[2 4 5 6]	Box M San Manuel, AZ 85631	Underground mine, mill, smelter, refinery, continuous-rod casting plant.	Pinal.
Noranda Lakeshore Mines Inc., a subsidiary of Noranda Mines Ltd.	Box C-6 Casa Grande, AZ 85222	In situ mine and solvent extraction-electrowinning plant.	Do.
Phelps Dodge Corp.:			
Copper Queen Branch	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[2 3 4 5]	Morenci, AZ 85540	Open pit mines, mills, tailings leach plant, leach dumps, precipitation plant, smelter.	Greenlee.
New Cornelia Branch	Drawer 9 Ajo, AZ 85321	Open pit mine, mill, and smelter.	Pima.
Pinto Valley Copper Corp., a subsidiary of Newmont Mining Corp.[2 4 5]	Box 100 Miami, AZ 85539	Open pit mine, mill, leach dumps, in-place leaching, precipitation plants, solvent extraction-electrowinning plants.	Gila.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
National Gypsum Co.:			
Gold Bond Building Products Div.	Box 20863 Phoenix, AZ 85036	Plant	Maricopa.
Winkelman Gypsum Pit	Star Route, Box 3990 Winkelman, AZ 85292	Open pit mine and crushing plant.	Pinal.
Pinal Mammoth Gypsum Co	Box 1208 Coolidge, AZ 85228	Open pit mine	Do.
Superior Companies[1 7]	2402 South 19th Ave. Phoenix, AZ 85005	Quarries and plant	Apache, Pinal, Yavapai.
Lime:			
Can-Am Corp., Paul Lime Div[7]	Drawer T Douglas, AZ 85607	Quarry and 3 lime kilns	Cochise.
Genstar Lime Co., a division of Genstar Corp.[7]	Box 197 Peach Springs, AZ 86434	Quarries and plant	Yavapai.
Perlite:			
Harborlite Inc	Box 960 Superior, AZ 85273	Open pit mine and plant	Pinal.
Sil-Flo Inc	Box 127 Superior, AZ 85273	do	Do.
Pumice:			
Gila Valley Block Co	Box 465 Safford, AZ 85546	Open pit mine	Graham.
Salt:			
Southwest Salt Co., a subsidiary of Morton-Thiokol Inc.	Box 1237 Litchfield Park, AZ 85340	Solar evaporation of brine from wells.	Maricopa.
Sand and gravel:			
CalMat Co. of Arizona, a subsidiary of California Portland Cement Co., a subsidiary of CalMat Co.	Box 52012 Phoenix, AZ 85036	Open pit mines and plants	Do.
Granite Construction Co	4115 East Illinois Box 27557 Tucson, AZ 85726	Pits	Apache, Pima, Pinal.
Tanner Co., United Metro Div	3640 South 19th Ave. Box 20128 Phoenix, AZ 85036	Open pit mines and plants	Coconino, Maricopa, Pima, Pinal, Yavapai, Yuma.
Union Rock and Materials Corp	2800 South Central Ave. Box 8007 Phoenix, AZ 85066	do	Maricopa and Pima.
Stone:			
Andrada Marble Co	4901 East Drexel Rd. Tucson, AZ 85706	Quarry	Pima.
Arizona Granite	7401 West Villa Rita Dr. Peoria AZ 85345	do	Maricopa.
Madison Granite Supplies	7050 Grand Ave. Glendale, AZ 85301	Quarry and plant	Do.
Red Mountain Mining Inc	4250 North Bush Hwy. Mesa, AZ 85205	do	Do.
Dolomite:			
Robert E. McKee Inc	Box 107 Peach Springs, AZ 86434	Quarry and crushing plant	Mohave.
Vermiculite (exfoliated):			
W. R. Grace & Co., Construction Products Div.	4220 West Glenrosa Phoenix, AZ 85019	Plant	Maricopa.

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

The Mineral Industry of Arkansas

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

By James R. Boyle[1] and William V. Bush[2]

The value of Arkansas nonfuel mineral production in 1985 was $256.7 million, a decrease of nearly $16 million from that of 1984. Output of most nonfuel minerals decreased, reflecting the sluggish economy of the State. Leading industrial mineral commodities in terms of value were bromine, cement, crushed stone, and sand and gravel. The State was a major producer nationally of abrasives, bauxite, and bromine. Crushed stone and sand and gravel, basically construction minerals, contributed significantly to the State's economy, serving both local and regional markets.

Arkansas ranked first nationally in output of bauxite, bromine, and special silica stone for abrasive products (oilstones and whetstones); was second in crushed sandstone; and third in kaolin. Despite its national importance with regard to several minerals, the State ranked 29th in the Nation in value of nonfuel minerals produced and 24th in value of industrial minerals. Arkansas produced 1.4% of the Nation's industrial minerals, valuewise.

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

Mineral		1984		1985	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	1,019	$7,838	1,052	$10,769
Gem stones		NA	200	NA	200
Sand and gravel:					
Construction	thousand short tons	8,334	23,786	e8,500	e24,400
Industrial	do.	459	6,207	412	5,414
Stone:					
Crushed	do.	e15,200	e59,800	14,815	60,874
Dimension	do.	--	--	5	305
Combined value of abrasives, bauxite, bromine, cement, gypsum, lime, talc, tripoli (1984), and vanadium		XX	174,797	XX	154,735
Total		XX	272,628	XX	256,697

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

Table 2.—Nonfuel minerals produced in Arkansas in 1984, by county[1]

County	Minerals produced in order of value
Ashley	Sand and gravel.
Bradley	Do.
Calhoun	Do.
Carroll	Do.
Clark	Sand and gravel, clays.
Clay	Sand and gravel.
Columbia	Bromine.
Craighead	Sand and gravel, clays.
Crawford	Sand and gravel.
Crittenden	Clays.
Cross	Sand and gravel.
Faulkner	Do.
Franklin	Do.
Fulton	Do.
Garland	Abrasives, sand and gravel.
Grant	Sand and gravel.
Greene	Do.
Hempstead	Sand and gravel, clays.
Hot Spring	Clays, sand and gravel, abrasives.
Howard	Cement, gypsum.
Independence	Sand and gravel, lime.
Izard	Do.
Jefferson	Do.
Johnson	Sand and gravel, clays.
Lafayette	Sand and gravel.
Lincoln	Do.
Little River	Cement, sand and gravel.
Marion	Sand and gravel.
Miller	Sand and gravel, clays.
Montgomery	Do.
Nevada	Sand and gravel.
Ouachita	Sand and gravel, clays.
Pike	Gypsum, sand and gravel.
Poinsett	Sand and gravel.
Polk	Do.
Pope	Do.
Pulaski	Clays, sand and gravel.
St. Francis	Sand and gravel.
Saline	Bauxite, lime, sand and gravel, talc.
Sebastian	Sand and gravel, clays.
Sevier	Sand and gravel.
Stone	Do.
Union	Bromine.
Yell	Sand and gravel.
Undistributed[2]	Stone (crushed), vanadium, gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Arkansas business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	2,325	2,346	2,359
Total civilian labor force	do	1,028	1,041	1,051
Unemployment	percent	10.1	8.9	8.7
Employment (nonagricultural):				
Mining total[1]	thousands	5.3	5.6	5.4
Metal mining[2]	do	.2	.2	W
Nonmetallic minerals except fuels[2]	do	1.2	1.2	1.3
Coal mining[2]	do	(3)	(3)	W
Oil and gas extraction	do	4.0	4.1	3.8
Manufacturing total	do	200.3	213.0	210.2
Primary metal industries	do	6.6	7.9	7.7
Stone, clay, and glass products	do	4.7	4.9	4.8
Chemicals and allied products	do	6.3	6.0	5.9
Petroleum and coal products	do	1.4	1.2	1.1
Construction	do	30.0	33.7	36.1
Transportation and public utilities	do	42.7	45.4	47.4
Wholesale and retail trade	do	163.0	172.9	181.8
Finance, insurance, real estate	do	34.1	35.6	36.6
Services	do	128.6	134.5	139.3
Government and government enterprises	do	137.3	139.5	143.3
Total	do	741.3	780.2	800.1
Personal income:				
Total	millions	$21,230	$23,388	$24,707
Per capita		$9,132	$9,971	$10,476

See footnotes at end of table.

Table 3.—Indicators of Arkansas business activity —Continued

		1983[r]	1984	1985[p]
Hours and earnings:				
Total average weekly hours, production workers		40.1	40.5	40.2
Total average hourly earnings, production workers		$7.0	$7.3	$7.6
Earnings by industry:				
Farm income	millions	$664	$1,137	$1,076
Nonfarm	do	$13,902	$15,308	$16,269
Mining total	do	$158	$169	$167
Metal mining	do	$5	$6	$9
Nonmetallic minerals except fuels	do	$24	$27	$29
Coal mining	do	$1	$2	$1
Oil and gas extraction	do	$127	$134	$128
Manufacturing total	do	$3,705	$4,101	$4,179
Primary metal industries	do	$163	$210	$206
Stone, clay, and glass products	do	$95	$104	$106
Chemicals and allied products	do	$184	$175	$170
Petroleum and coal products	do	$48	$41	$39
Construction	do	$859	$999	$1,055
Transportation and public utilities	do	$1,227	$1,366	$1,462
Wholesale and retail trade	do	$2,402	$2,613	$2,768
Finance, insurance, real estate	do	$690	$739	$848
Services	do	$2,460	$2,707	$2,948
Government and government enterprises	do	$2,294	$2,510	$2,736
Construction activity:				
Number of private and public residential units authorized[4]		10,070	9,802	9,935
Value of nonresidential construction[4]	millions	$282.5	$399.4	$415.8
Value of State road contract awards	do	$115.4	$169.6	$160.0
Shipments of portland and masonry cement to and within the State	thousand short tons	696	761	818
Nonfuel mineral production value:				
Total crude mineral value	millions	$246.4	$272.6	$256.7
Value per capita		$106	$116	$109

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]Less than 50 employees.
[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

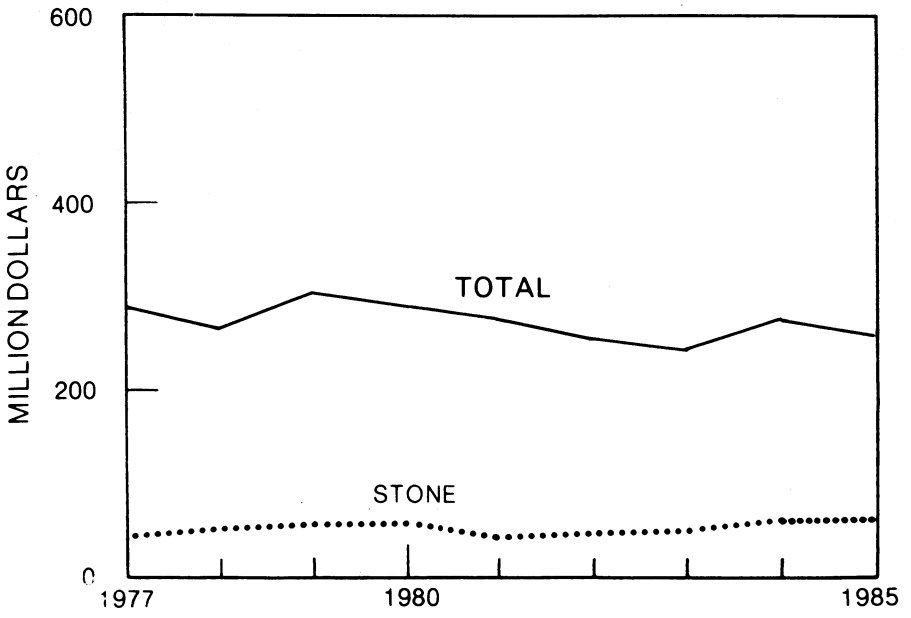

Figure 1.—Value of stone and total value of nonfuel mineral production in Arkansas.

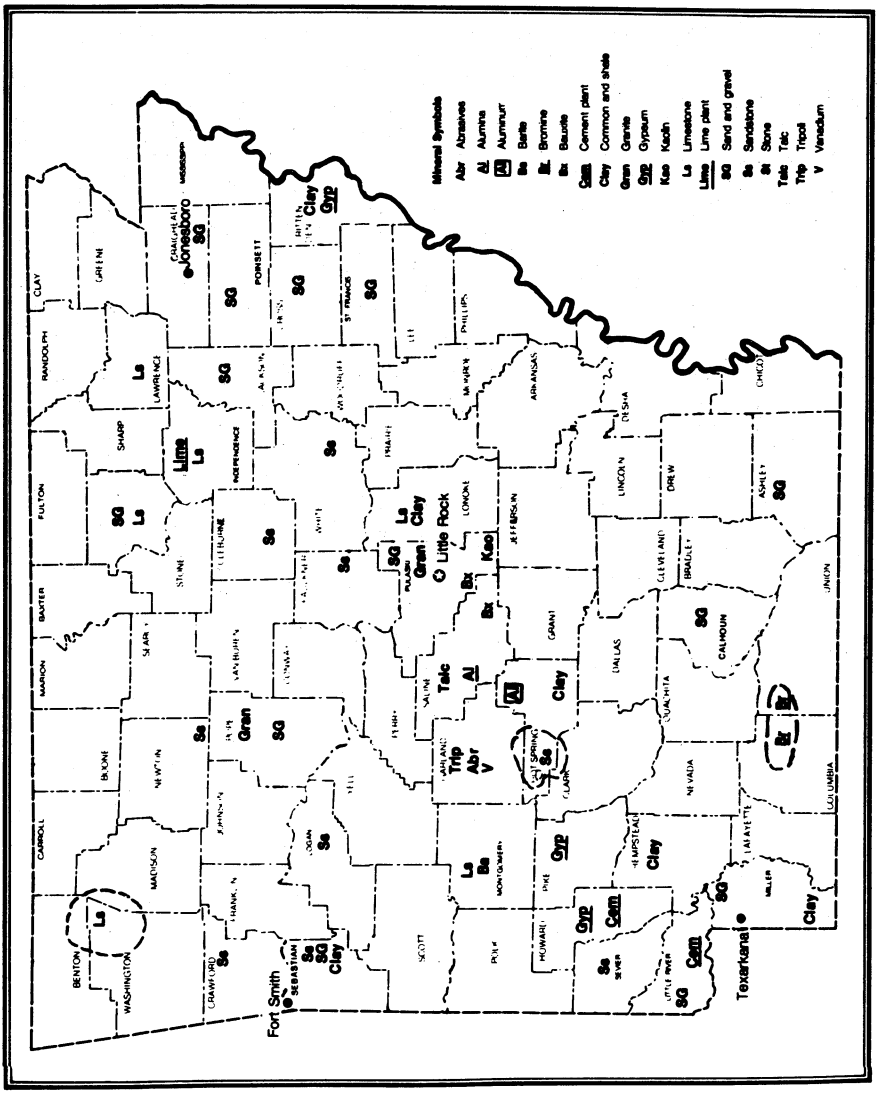

Figure 2.—Principal mineral producing localities in Arkansas.

Trends and Developments.—The Arkansas economy was sluggish during the year as evidenced by employment in mineral-related sectors. Compared with 1984 levels, construction employment increased slightly, but that of mining, primary metals, stone, clay, and glass remained constant or decreased. Additionally, national markets for bauxite and bromine products declined. Arkansas Chemicals Inc. announced closure of its El Dorado bromine operation late in the year. Increased imports and decreased usage of bromine in gasoline resulted in reduced market demands. The Aluminum Co. of America (Alcoa) operated its bauxite operation at reduced levels during the year. Reynolds Metals Co. shut down its Arkadelphia and Jones Mill reduction plants, and Umetco Minerals Corp. closed its vanadium operation at Hot Springs late in the year. In contrast, Alumax Mill Products Div., AMAX Inc., began construction of an aluminum rolling mill and melt shop at Texarkana. Mac Steel Div. of Quanex Corp. dedicated a new specialty bar plant at Fort Smith.

Employment.—The unemployment rate dropped from 8.9% in 1984 to 8.7% in 1985. Mining employment declined by 200 workers. The number of unemployed in Arkansas dropped from 93,000 in 1984 to 91,000 in 1985.

Legislation and Government Programs.—The Arkansas Legislature meets biennially and was in session in 1985. The legislature enacted Act 447, Mining and Processing Exemption, which exempts open pit and underground mining and processing of ore from pits at least 50 feet deep from State and local sales and use taxes on natural gas, liquefied petroleum gas, and electricity. The Joint Performance Review Committee of the Arkansas Assembly voted to make a study on mineral taxation. The committee will review laws and procedures relating to the ad valorem assessment and taxation of mineral interests that have been severed from the surface interest in lands, which are owned by a person or entity other than the owner of the surface interest. The committee is required to report its findings and recommendations, including proposed legislation, to the 1987 session of the general assembly.

The Arkansas Department of Revenue received $21.4 million in severance taxes in 1985, down from $23.8 million in 1984. Severance taxes were received from oil ($20 million), natural gas ($428,000), brine ($424,000), sand and gravel ($310,000), coal ($1,900), and miscellaneous minerals ($184,000).

The Arkansas Department of Labor, in its annual report, stated that 168 nonfuel mines operated in the State and produced a total of 21.3 million short tons of minerals. Additionally, seven coal mines in Franklin, Johnson, and Sebastian Counties produced nearly 50,000 short tons of coal.

The University of Arkansas Agricultural Experiment Station continued research on reclaiming strip mined lands in the bauxite region of central Arkansas. The studies evaluated the use of sewage sludge, fertilizer, brown lime, agricultural lime, and fly ash for pH control. Fertilizer and sewage sludge are equally effective as a source of nitrogen while fly ash and agricultural lime were superior to brown lime for long-term pH control.

The Arkansas Geological Commission (AGC) continued its programs focusing on the prudent development and use of the mineral, water, and energy resources of the State. Outside geologic interest centered on base metals, diamond, lignite, oil and gas, and silver exploration. Primary drilling activity has been in the frontal Ouachita Mountains with limited drilling in the southern Ouachitas. About 33,000 feet of core samples from the Milchem barite operations in Montgomery County were donated to the AGC repository. The AGC completed its third phase of the Midcontinent Strategic/Critical Minerals Program of the U.S. Geological Survey (USGS). The phase included a tectonic map, an isopach and lithofacies map of Mississippian Limestone, and an east-west cross section of Mississippian Limestone of an area in Arkansas north of 36° latitude. Efforts continued on the development of data on the lignite resources of the State. A report, "Arkansas Lignite Investigation," was published with other lignite-related reports planned. The AGC, in cooperation with the USGS and the Oklahoma Geological Survey, entered the second year of a multiyear program to evaluate the economic potential of the Ouachita Mountains with emphasis on geological and geophysical mapping. AGC continued its advisory role in reviewing mining and reclamation plans and landfill permits.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Of the total 1985 value of nonfuel minerals in the State, the major portion was attributed to industrial minerals.

Abrasives (Natural).—During 1985, four companies mined novaculite for oilstone and whetstone products; mine production and value decreased from that of 1984. Arkansas ranked first nationally in output of special silica stone abrasives. Finished stone production accounted for 78% of both the total value and the total quantity of special stone products sold or used by domestic producers. Novaculite, a dense, hard, fine-grained metamorphosed chert of virtually pure silica, was mined in Garland County by Norton Co. Oilstones Inc., Hiram A. Smith Whetstone Co. Inc., and Dan's Whetstone Cutting Co. Inc., and in Hot Spring County by Arkansas Whetstone Co. Inc. At all operations, output was relatively low with waste material ranging up to 95% of material mined. Limited applications were available for the waste material, but other markets were being sought. Several firms only finished small quantities mined by other companies in the State. These companies included Arkansas Oilstone Co., Hall's Arkansas Oilstones Inc., Pioneer Whetstone Co., and Washita Mountain Whetstone Co. Buffalo Stone Corp. shipped deburring media from Garland County that was used to smooth rough edges of cast metal.

Bromine.—Arkansas remained the largest domestic bromine producer and accounted for about one-third of the world's output in 1985. Production and value decreased about 15% from that of 1984. Bromine occurs in brines in Columbia and Union Counties in the south-central part of Arkansas. The bromine industry is capital-intensive, with an investment of over $300 million; Arkansas reportedly had 85% of the Nation's capacity to produce bromine chemicals. Two companies, Dow Chemical U.S.A. and Ethyl Corp., operated in Columbia County, while two others, Arkansas Chemicals and Great Lakes Chemical Corp., operated in Union County. The industry operated at less than 50% of capacity during 1985 because of competition from imports and limited markets. Current plans to reduce lead in gasoline in the United States and Europe will result in a decrease of both domestic and export markets, resulting in an oversupply of elemental bromine. Because of limited markets, the industry planned expansions into other areas such as flame retardants, drilling fluids, and well-completion fluids. The industry continued to face mounting environmental concerns about deep well injections of both hazardous and nonhazardous waste materials.

Rated capacity of the bromine producing plants in Arkansas was reported to be 277,500 short tons of elemental bromine.

The United States and Israel were negotiating a free trade pact, which by 1995 would lift all tariffs on Israeli imports. The domestic bromine industry had objected because of unfair cost advantages through Israeli Government assistance. Domestic bromine companies predict that if a free trade area is established, imports of Israeli bromine products would increase from $9.7 million in 1983 to $40 million by 1990.

Late in the year, Arkansas Chemicals, El Dorado, announced the closure of parts of its bromine operation for an indefinite period. Officials said reduced domestic markets and imports determined the decision to shut down. Great Lakes Chemical and PPG Industries Inc. each own 50% of the operation. The company indicated the plant would be down several months with the possibility of reopening early in 1986.

Cement.—Portland cement shipments and value decreased from that of 1984; masonry shipments and unit values also decreased. Two companies, Ideal Cement Co., a subsidiary of Ideal Basic Industries Inc., and Arkansas Cement Corp., a subsidiary of Arkla Inc., produced both kinds of cement at plants in Saratoga and Foreman, respectively. Both plants, with a total of five kilns, used the wet process. Major end uses for portland cement were ready-mixed concrete, concrete products, building materials, and highway construction. Raw materials used included chalk, gypsum, iron ore, limestone, and sand. The Alcoa plant at Bauxite was one of three plants nationally that produced aluminous cement, a nonportland hydraulic cement.

Late in the year, Arkansas Cement was sold to Ash Grove Cement Co., Overland Park, KS, for $38 million. The sale included Arkansas Cement's plant at Foreman and five distribution terminals: two in Arkansas, two in Louisiana, and one in Oklahoma.

Clays.—The Arkansas clay industry pro-

duced common clay and kaolin with total output increasing over that of 1984. Production and value of common clay decreased from that of 1984, while production and value of kaolin increased substantially. Common clay was mined by 7 companies at 14 pits in 10 counties; leading counties were Crittenden, Hot Spring, and Montgomery. Major uses were in brick and lightweight aggregate. Kaolin was mined by two companies at three pits in Pulaski County, with Arkansas ranking third nationally in output. Output included unprocessed and calcined kaolin.

Gem Stones.—Park authorities at the Crater of Diamonds Park in Pike County reported that nearly 57,000 visitors had recovered 699 diamonds compared with 1,339 diamonds in 1984. Total weight amounted to 148.54 carats; the largest diamond recovered was 1.94 carats. Of the diamonds recovered, 24 were over 1 carat.

During the year, renewed interest developed over commercial mining of the diamonds. The last request considered was rejected in 1981. Harvey-Boulle Mining Group of Dallas, TX, incorporated in the State as Arkansas Diamond Development Co. of Murfreesboro and reportedly leased 3,000 acres of land surrounding the State park. The company advocated a $2 million exploratory phase of core drilling to determine the amount of diamonds available. The State formed a committee to review proposals for mining. No action was taken during 1985.

Other stones recovered in the State included agate, amethyst, jasper, quartz, and other semiprecious gems.

Graphite (Synthetic).—Output and value of synthetic graphite decreased about 12% and 34%, respectively, from that of 1984. Arkansas ranked sixth nationally in the production of synthetic graphite. The electrodes produced were used in electric arc furnaces to melt scrap for production of steel. Great Lakes Carbon Corp. manufactured graphite at its plant in Ozark. Superior Graphite Co. produced electrodes at its Russellville plant, which was obtained from The Dow Chemical Co. in 1984.

Gypsum.—Production and value decreased from those of 1984. Crude gypsum was produced by Weyerhaeuser Co. in Howard County and Harrison Gypsum Co. Inc. in Pike County. Weyerhaeuser's Briar Mine and plant was 1 of the top 10 producing units in the Nation in 1984. Calcined gypsum was produced by Temple Eastex Inc., Crittenden County, and Weyerhaeuser, Howard County. Production and value increased.

Lime.—Output and value of quicklime decreased while that of hydrated lime increased compared with 1984 levels. Output of total lime remained at a relatively low level. Quicklime and hydrated lime were produced by Arkansas Lime Co., Independence County. About one-half of the quicklime produced is sold to Alcoa, which continued to operate at reduced levels of capacity.

Nitrogen.—Agrico Chemical Co., Blytheville, produced anhydrous ammonia during 1985. The facility had a rated capacity of 407,000 short tons.

Perlite (Expanded).—Strong-Lite Products Corp. expanded perlite shipped in from out of State at its plant in Pine Bluff. Output and value decreased; unit values increased slightly. Expanded perlite was used in concrete aggregates and horticultural applications.

Quartz.—Various grades of natural quartz were surface mined and processed by Coleman Crystal Inc. and by Geomex Mine Services Inc. Coleman was the major domestic producer of lascas for electronics. Primary output of Geomex was exported to the Federal Republic of Germany. Lascas is the silicon dioxide feedstock material used for cultured quartz production and for certain fused quartz end uses.

Sand and Gravel.—Arkansas produced both construction and industrial sand and gravel in 1985. Total sand and gravel output was estimated to have increased slightly over that of 1984, with construction sand and gravel output increasing while industrial output decreased. Unit value remained relatively stable.

Construction.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel was the fourth leading commodity among the nonfuel minerals produced in Arkansas. The estimated increase in 1985 was basically due to a surge in construction activities, which started late in 1984 and maintained its momentum through 1985. Most operations were relatively small with no individual pit producing over 1 million short tons. In 1984, there were 68 operations in 38

counties; leading counties were Little River, Ouachita, and Pulaski.

Industrial.—Six companies produced industrial sand and gravel from six counties during 1985; output and value decreased. Producers were Arkansas White Rock Inc., Arkhola Sand & Gravel Co., Gifford-Hill & Co. Inc., Ideal Cement, Silica Products Co. Inc., and Turner Trucking Co. Major uses for industrial sand and gravel were foundry molds, glassmaking, and blasting abrasives, with most shipped by railroad. No one operation produced more than 500,000 tons.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave only estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Output of crushed stone decreased for the fourth time in the last 5 years. Material mined included limestone, granite (syenite), sandstone, slate, novaculite, and dolomite. Arkansas was second in the Nation in output of crushed sandstone and was one of the top three States in crushed slate production.

Crushed stone was produced by 36 companies at 45 quarries in 28 counties; leading counties were Pulaski, Lawrence, and Little River. Three quarries each produced in excess of 1 million short tons in 1985. The top 10 companies produced 80% of the crushed stone output. Shipments were mainly by truck with the material being used for cement manufacture, ballast, and aggregate. With output down, most operations were intermittent or at reduced workweeks during the year.

Table 4.—Arkansas: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	802	3,276
Filter stone	3	9
Coarse aggregate, graded:		
Concrete aggregate, coarse	821	3,747
Bituminous aggregate, coarse	460	2,309
Bituminous surface-treatment aggregate	182	1,172
Railroad ballast	1,478	6,846
Fine aggregate (-3/8 inch): Screening, undesignated	333	1,291
Combined coarse and fine aggregates:		
Graded road base or subbase	2,678	10,892
Crusher run or fill or waste	114	404
Other construction[2]	1,805	7,404
Agricultural: Agricultural limestone	57	275
Special:		
Other miscellaneous[3]	2,055	6,758
Other unspecified[4]	4,029	16,491
Total	[5]14,815	60,874

[1]Includes limestone, dolomite, granite, sandstone, and slate.
[2]Includes stone used for unpaved road surfacing, stone sand (bituminous mix or seal), and stone used for other construction and maintenance purposes.
[3]Includes stone used for agricultural marl and other soil conditioners, poultry grit and mineral food, cement manufacture, flux stone, other fillers or extenders, chemicals, roofing granules, waste materials, and lime manufacture.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data do not add to total shown because of independent rounding.

Dimension.—Dimension stone output increased since there was no production reported in 1984; output was well below the 1983 production level. Dimension stone was quarried by three companies in Independence and Logan Counties.

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

Talc.—The Milwhite Co. Inc. mined talc near Benton from its Congo Pit and processed the ore at its Bryant mill. Production and value increased significantly as demand for roofing materials and as an industrial filler increased; unit values increased.

Tripoli.—Malvern Minerals Co. Inc., Garland County, remained the State's only processor of tripoli using material from inventory. Output was used primarily as a

filler with some used as an abrasive.

Vermiculite (Exfoliated).—Strong-Lite, Pine Bluff, and W. R. Grace & Co., North Little Rock, exfoliated crude vermiculite from out of State with output decreasing; unit values increased. Exfoliated vermiculite was used for texturing paints and in aggregate, insulation, agriculture, and fireproofing.

METALS

Although not a significant industry in the State, primary metal production was expanding and contributing to the well-being of the State. The metals industry depended mainly on out-of-State raw materials with limited output from sources in Arkansas. Developments in the iron and steel sector were being offset by reduction of activities in the aluminum industry.

Aluminum.—Arkansas was 1 of 17 States with primary aluminum production facilities. Production and value decreased as the industry was impacted by high operating costs and low prices for aluminum. Reynolds operated its Jones Mill facility at 40% of capacity (50,000 short tons) and its Arkadelphia facilities at full capacity (68,000 short tons) through most of the year. In August, Reynolds was notified by Arkansas Power & Light Co. of increased power costs, which would amount to an additional $20 million per year. In September, Reynolds notified Arkansas Power & Light that it would terminate its power contract as of January 1, 1987; Reynolds was the largest single customer for electricity. In mid-October, Reynolds started shutdown of its primary aluminum facilities in Arkansas. The reason cited was that operating costs exceeded aluminum prices. Late in the year, Reynolds announced that the closures were permanent and took a $313.5 million write-down in the third quarter. The cable plant at Malvern and the continuous rolling mill at Hot Springs remained in operation. During the year, Reynolds received aluminum ingots from Canadian Reynolds Metals Co. Ltd., Baie Comeau, Quebec.

Alumax Mill Products Div. of AMAX was constructing a $100 million rolling mill and melting operation at Texarkana. The facility was expected to go on-stream early in 1986.

Bauxite.—Arkansas continued to be the leading State in output of bauxite, even as output decreased slightly; unit prices increased. With the exception of 1984, output has decreased steadily since 1977. Production was from two operations in Saline County, Alcoa and American Cyanamid Co. Porocel Corp., Little Rock, produced activated bauxite from purchased ore. Alcoa, which mined bauxite for its alumina refining plant at Bauxite, operated at relatively low levels of capacity during the year. A bill signed by the Governor to exempt mining and refining operations from sales tax on gas and electricity would reportedly save Alcoa about $1.5 million per year. Late in the year, Alcoa announced curtailment of its alumina refining operations, which would also affect bauxite mining operations. Alcoa continued to operate its specialty alumina products plant utilizing alumina from its Point Comfort, TX, alumina plant. Alcoa had six main chemical production centers for producing hydrated, hydral, activated, calcined, tabular alumina, and calcium aluminate cements. Hydrates were used to produce aluminate and alum for use in water treatment plants. Hydral, an ultrafine alumina hydrate, was used as a whitening filler. Activated aluminas were used as dehydration agents and catalysts. Calcined aluminas were used in ceramics, refractories, and abrasives. Tabular alumina was used as a feedstock for producing sparkplugs and other ceramics. Calcium aluminate cements were hydraulic binders for refractories.

Norton Co. and Alcoa's partnership in production of proppants (Norton-Alcoa Proppant Co.) resulted in the startup in July of a $50 million expansion of Norton's facilities at Fort Smith. Output was increased from 100 to 300 million pounds per year. Alcoa trucked calcined bauxite from its operations at Bauxite. The proppants were used in hydraulic fracturing to stimulate flow rate of oil and gas from wells.

American Cyanamid processed and partially calcined bauxite for the production of aluminum sulfate, which was used in the paper industry and for water treatment.

Iron and Steel.—Quanex started operations at its $125 million specialty alloy bar plant at Fort Smith. It was reportedly the largest rotary continuous casting plant in the Nation, with a capacity of 280,000 short tons per year. Quanex produced seam-free carbon and alloy steel bars for the forging industry.

Omega Tube and Circuit Corp. started operations at its $10 million welded tube plant in Little Rock. The 36,000-metric-ton-per-year plant will manufacture conduits for electric cable and wire. Omega is a

subsidiary of Western Tube and Conduit Corp., which is owned by Sumitomo Metal Industries Ltd. of Japan.

Commerical Metals Co. planned to install a steel rail rerolling mill at Magnolia. The mill would supply steel T-posts at the rate of 60,000 tons per year. Industrial bonds totaling $5 million were issued by Columbia County to finance the project.

The Arkansas Directory of Manufacturers listed six gray iron foundries, three steel foundries, and eight secondary smelters in operation in the State.

Vanadium.—Umetco Minerals, a subsidiary of Union Carbide Corp., was Arkansas' sole vanadium producer. The plant operated through most of the year but closed in December. High inventories were cited as reasons for closure. The mill can produce about 7,500 short tons per year of vanadium pentoxide, which was converted to ferrovanadium at the company's plant at Niagara Falls, NY. The mill at Hot Springs was scheduled to reopen in September 1986 after process modifications are completed. The modifications would allow the plant to use a wider range of raw materials. Arkansas was the leading State for output of vanadium.

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

[2]Geologist, Arkansas Geological Commission, Little Rock, AR.

Table 5.—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.
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.
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 Ash Grove Cement Co.[1]	Box 25900 Overland Park, KS 66225	Plant	Little River.
Ideal Cement Co., a subsidiary of Ideal Basic Industries Inc.[1]	Box 8789 Denver, CO 80201	----do	Howard.
Clays:			
Acme Brick Co., a division of Justin Industries Inc.	Box 425 Fort Worth, TX 76101	Pits and plants	Hot Spring and Sebastian.
Arkansas Lightweight Aggregate Corp	El Dorado, AR 71730	Pit and plant	Crittenden.
Eureka Brick & Tile Co	Box 379 Clarksville, AR 72830	Mine	Johnson.
A. P. Green Refractories Co., a subsidiary of United States Gypsum Co.	Box 6057 Little Rock, AR 72216	Pit and plant	Pulaski.
Gypsum:			
Harrison Gypsum Co. Inc	Box 336 Lindsay, OK 73052	Mine	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.[1]	Box 2356 Batesville, AR 72501	Quarry and plant	Independence.
Perlite (expanded):			
Strong-Lite Products Corp	Box 8029 Pine Bluff, AR 71611	Plant	Jefferson.
Sand and gravel:			
Construction (1984):			
Jeffrey Sand Co	Box 998 Fort Smith, AR 72901	Pits	Faulkner, Pulaski, Sebastian.
St. Francis Materials Co., a division of Ben M. Hogan Co. Inc.	Box 999 Forrest City, AR 72335	Pits and plants	Calhoun, Craighead, Poinsett, St. Francis.

See footnotes at end of table.

Table 5.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Industrial:			
Gifford-Hill & Co. Inc.[2]	Box 6615 Shreveport, LA 71106	Pits	Miller.
Silica Products Co. Inc	Box 29 Guion, AR 72540	Pit	Izard.
Stone:			
Granite:			
Freshour Construction Co. Inc	Drawer AF Cabot, AR 72023	Quarry	Pulaski.
McGeorge Contracting Co. Inc	Box 7008 Pine Bluff, AR 71611	Quarries	Do.
Minnesota Mining & Manufacturing Co.	3M Center, 223-4N-05 St. Paul, MN 55144	Quarry	Do.
Limestone:			
McClinton-Anchor Co., a subsidiary of Ashland Oil Inc.	Box 756 Fayetteville, AR 72701	Quarries	Benton, Madison, Washington.
Midwest Lime Co	Box 2608 Batesville, AR 72501	Quarry	Independence.
Sandstone:			
Arkhola Sand & Gravel Co.,[1] a subsidiary of Ashland Oil Inc.	Box 1627 Fort Smith, AR 72901	Quarries	Crawford and Sebastian.
H M B Construction Co	Box 5606 Texarkana, TX 75501	Quarry	Sevier.
Ben M. Hogan Co. Inc.[1]	Box 2860 Little Rock, AR 72203	Quarries	White.
M & M Rock Co. Inc	Box 1190 Conway, AR 72032	____do	Faulkner, Perry, White.
Slate:			
Bird & Son Inc	Drawer 151 Glenwood, AR 71943	Quarry	Montgomery.
Sulfur (recovered):			
Ethyl Corp., Arkansas Div	Box 729 Magnolia, AR 71753	Sulfur recovered in bromine extraction.	Columbia.
Phillips Petroleum Co	724 Adams Bldg. Bartlesville, OK 74004	Sulfur recovered as a byproduct of petroleum refining.	Lafayette.
Talc:			
The Milwhite Co. Inc	Box 15038 Houston, TX 77020	Mine and plant	Saline.
Vanadium:			
Union Carbide Corp., Metals Div	Route 6, Box 943 Hot Springs, AR 71901	Mine and mill	Garland.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Pulaski.
Strong-Lite Products Corp	Box 8029 Pine Bluff, AR 71611	____do	Jefferson.

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

The Mineral Industry of California

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

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

California remained the leading State in the Nation in the production of nonfuel minerals. Value for 1985 rose to nearly $2.1 billion, or about a 5% increase from that reported in 1984. The increase in value was attributed to continued growth in the construction industry and a generally improving economy in the State. Most industrial mineral operations were functioning near capacity throughout most of the year.

California ranked first nationally in the production of asbestos, diatomite, rare-earth concentrates, construction sand and gravel, sodium compounds, and tungsten, and was the sole producer of boron minerals. It ranked second in the production of natural calcium chloride, portland cement, calcined gypsum, magnesium compounds, and sodium carbonate.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Boron minerals thousand short tons	1,367	$456,687	1,269	$404,775
Cement (portland) do.	8,715	520,026	9,462	601,506
Clays[2] do.	2,100	23,868	2,203	26,600
Gem stones	NA	500	NA	550
Gold (recoverable content of ores, etc.) troy ounces	85,858	30,965	165,101	52,446
Gypsum thousand short tons	1,382	12,443	1,332	12,201
Lime do.	406	26,827	367	24,733
Pumice do.	80	1,600	78	1,491
Sand and gravel:				
Construction do.	102,420	360,427	e112,800	e430,000
Industrial do.	2,281	39,176	2,255	37,434
Silver (recoverable content of ores, etc.) thousand troy ounces	W	W	115	709
Stone:				
Crushed thousand short tons	e38,600	e158,000	41,199	174,395
Dimension do.	e22	e2,990	23	2,449
Talc do.	74	1,642	100	2,493
Combined value of asbestos, calcium chloride, cement (masonry), clays (fire clay), copper, diatomite, feldspar, iron ore, lead (1984), magnesium compounds, molybdenum, peat, perlite, potassium salts, rare-earth metal concentrates, salt, sodium carbonate, sodium sulfate, tungsten ore and concentrate, wollastonite (1984), and value indicated by symbol W	XX	r360,085	XX	323,014
Total	XX	r1,995,236	XX	2,094,796

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

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

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

Table 2.—Nonfuel minerals produced in California in 1984, by county[1]

County	Minerals produced in order of value
Alameda	Sand and gravel, salt, clays.
Amador	Sand and gravel, clays.
Butte	Sand and gravel.
Calaveras	Asbestos, sand and gravel, talc, cement.
Colusa	Sand and gravel.
Contra Costa	Sand and gravel, lime, clays.
Del Norte	Sand and gravel, gold.
Fresno	Sand and gravel, gold, clays, silver.
Glenn	Sand and gravel, lime.
Humboldt	Sand and gravel.
Imperial	Gypsum, gold, lime, sand and gravel, silver.
Inyo	Boron minerals, tungsten, sand and gravel, talc, perlite, clays, molybdenum, pumice, copper, gold, silver.
Kern	Boron minerals, cement, clays, sand and gravel, gypsum, gold, silver, copper, tungsten, lead.
Kings	Gypsum.
Lake	Sand and gravel.
Lassen	Sand and gravel, diatomite.
Los Angeles	Sand and gravel, lime, clays, tungsten.
Madera	Tungsten, sand and gravel, pumice.
Marin	Sand and gravel, clays.
Mariposa	Sand and gravel.
Mendocino	Do.
Merced	Do.
Modoc	Peat, sand and gravel.
Mono	Pumice, clays, gold, silver, talc, sand and gravel.
Monterey	Magnesium compounds, lime, sand and gravel.
Napa	Salt, sand and gravel.
Nevada	Sand and gravel, clays.
Orange	Sand and gravel, feldspar, clays.
Placer	Sand and gravel, clays.
Plumas	Sand and gravel.
Riverside	Cement, sand and gravel, iron ore, clays, wollastonite, gypsum.
Sacramento	Sand and gravel, clays.
San Benito	Asbestos, sand and gravel, clays.
San Bernardino	Cement, sodium carbonate, boron minerals, rare-earth minerals, sodium sulfate, sand and gravel, potassium salts, calcium chloride, clays, salt, lime, iron ore, feldspar, talc, gypsum.
San Diego	Sand and gravel, feldspar, salt, magnesium compounds, gypsum.
San Joaquin	Sand and gravel, lime, gold, silver.
San Luis Obispo	Sand and gravel, gypsum.
San Mateo	Magnesium compounds, salt.
Santa Barbara	Diatomite, sand and gravel, lime.
Santa Clara	Cement, sand and gravel.
Santa Cruz	Cement, sand and gravel, clays, peat.
Shasta	Cement, sand and gravel, clays, copper.
Sierra	Gold.
Siskiyou	Gold, silver, pumice, sand and gravel.
Solano	Sand and gravel.
Sonoma	Do.
Stanislaus	Sand and gravel, gold, clays, silver.
Sutter	Sand and gravel, clays.
Tehama	Sand and gravel.
Trinity	Do.
Tulare	Do.
Tuolumne	Lime.
Ventura	Sand and gravel, clays, gypsum.
Yolo	Sand and gravel, lime.
Yuba	Gold, sand and gravel, clays, silver.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of California business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	25,311	25,795	26,365
Total civilian labor force	do.	12,269	12,619	12,937
Unemployment	percent	9.7	7.8	7.2
Employment (nonagricultural):				
Mining total[1]	thousands	48.1	50.0	50.6
Metal mining	do.	1.7	1.6	1.7
Nonmetallic minerals except fuels	do.	6.3	6.7	7.1
Oil and gas extraction[2]	do.	40.2	41.7	40.0
Manufacturing total	do.	1,949.3	2,065.5	2,089.5
Primary metal industries	do.	43.5	42.6	41.6
Stone, clay, and glass products	do.	48.7	51.6	51.0
Chemicals and allied products	do.	63.8	64.1	63.8
Petroleum and coal products	do.	31.0	30.0	29.1
Construction	do.	369.3	445.2	482.3
Transportation and public utilities	do.	536.9	554.6	564.9
Wholesale and retail trade	do.	2,332.2	2,507.4	2,615.4
Finance, insurance, real estate	do.	661.7	694.2	730.5
Services	do.	2,345.1	2,509.5	2,637.6
Government and government enterprises	do.	1,724.3	1,747.4	1,794.5
Total[3]	do.	9,965.8	10,573.8	10,965.3
Personal income:				
Total	millions	$353,949	$390,909	$423,566
Per capita		$13,984	$15,155	$16,065
Hours and earnings:				
Total average weekly hours, production workers		40.0	40.3	40.2
Mining (nonmetallic minerals, except fuels)		40.7	43.0	42.0
Total average hourly earnings, production workers		$9.5	$9.8	$10.1
Mining (nonmetallic minerals, except fuels)		$13.8	$14.4	$15.1
Earnings by industry:				
Farm income	millions	$5,044	$5,610	$5,554
Nonfarm	do.	$252,353	$280,904	$307,207
Mining total	do.	$2,246	$2,527	$2,482
Metal mining	do.	$67	$50	$66
Nonmetallic minerals except fuels	do.	$216	$251	$277
Oil and gas extraction	do.	$1,960	$2,220	$2,133
Manufacturing total	do.	$52,937	$58,308	$62,570
Primary metal industries	do.	$1,336	$1,383	$1,376
Stone, clay, and glass products	do.	$1,295	$1,452	$1,480
Chemicals and allied products	do.	$1,825	$1,955	$2,084
Petroleum and coal products	do.	$1,597	$1,554	$1,682
Construction	do.	$15,256	$18,437	$20,244
Transportation and public utilities	do.	$17,803	$19,071	$20,334
Wholesale and retail trade	do.	$42,300	$46,839	$51,066
Finance, insurance, real estate	do.	$16,654	$18,285	$21,230
Services	do.	$61,641	$70,773	$78,141
Government and government enterprises	do.	$41,271	$44,347	$48,676
Construction activity:				
Number of private and public residential units authorized[4]		172,721	225,501	271,396
Value of nonresidential construction[4]	millions	$8,821.5	$10,961.4	$12,183.8
Value of State road contract awards	do.	$260.0	$555.0	$965.0
Shipments of portland and masonry cement to and within the State	thousand short tons	7,035	9,316	10,130
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,783.6	$1,995.2	$2,094.8
Value per capita		$70	$77	$79

[p]Preliminary. [r]Revised.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

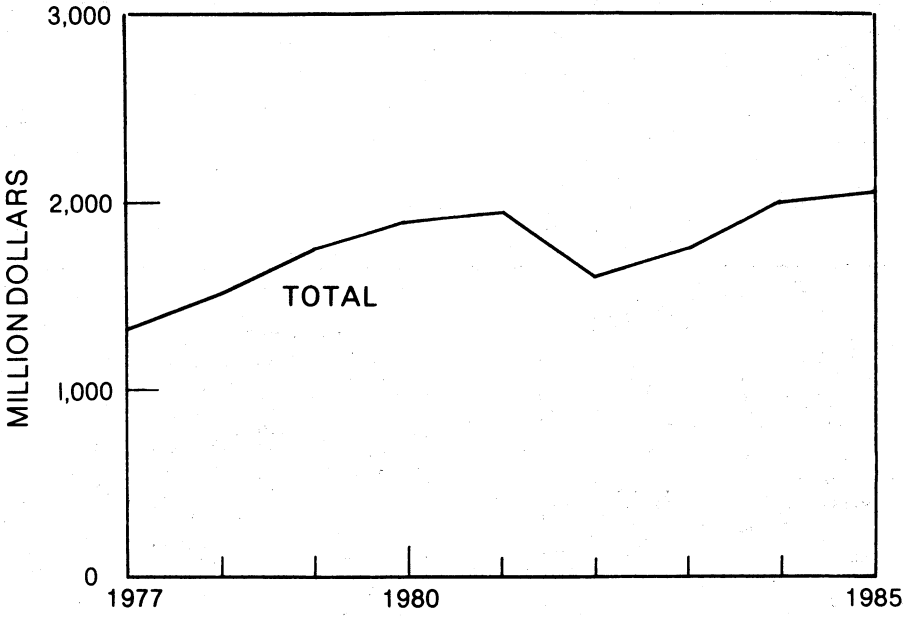

Figure 1.—Total value of nonfuel mineral production in California.

Trends and Developments.—Industrial minerals accounted for the bulk of California's nonfuel mineral production, comprising more than 95% of the State's mineral production value. In 1985, 31 mineral commodities, including 7 metallic minerals, were produced in California. A rising trend continued in mineral production and value from a 1982 low, reflecting the continuing expansion of the State's economy. Exploration for and development of precious metals deposits continued throughout the year. California became the third leading gold producing State in the Nation, with new production from Homestake Mining Co.'s McLaughlin gold project in Napa County commencing early in the year.

Legislation and Government Programs.—The California State Mining and Geology Board exercised its broad policy responsibilities under the Surface Mining and Reclamation Act of 1975. The board initiated the designation of aggregate resources in seven metropolitan areas in the State. Regulations for the western San Diego County Production-Consumption Region were approved and incorporated into State law. Four nonurban classification reports (Sutter Creek, Folsom, Auburn, and Halleran Springs 15-minute quadrangles) were reviewed and transmitted to affected lead agencies. In addition, two petitions for mineral land classification were accepted. The board adopted policy resolutions for more effective implementation of the Surface Mining and Reclamation Act, interim criteria for mineral resource management policies, and for the reclamation program. Pursuant to the provisions of the Alquist-Priolo Special Zone Act, 43 maps of new and revised special study zones were reviewed and issued.

The California Department of Conservation's Division of Mines and Geology continued work on mineral land classification studies. Nonurban studies were conducted in the foothills portion of the Sierra Nevada and in the California Desert Conservation Area. Mineral land classification reports were released for three areas where mineral resources of statewide or regional significance have been identified. The released quadrangles were the Mid Hills area, the Ivanpah-Crescent Peak-Searchlight area, and the Lanfair Valley-Homer Mountain-Davis Dam area. Mineral land classification

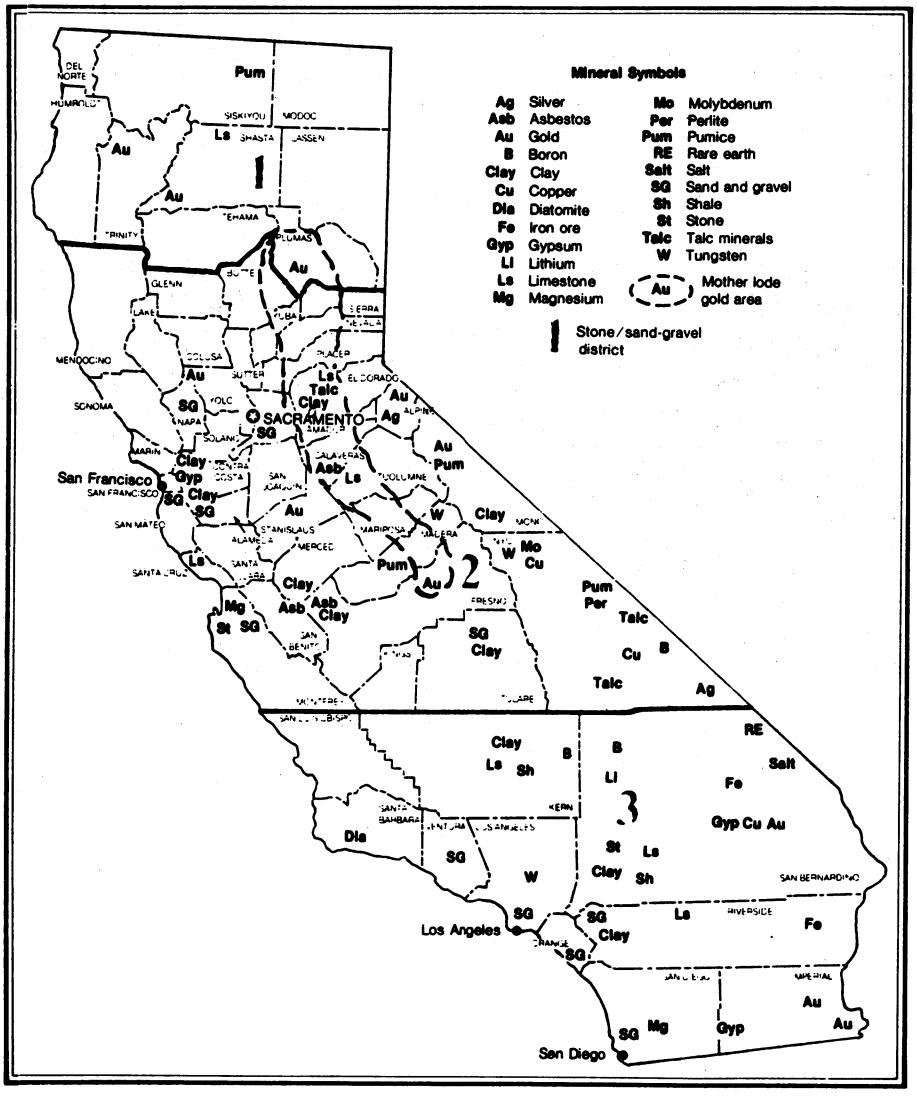

Figure 2.—Principal mineral producing localities in California.

studies (urban) were completed for the Fresno area.

In 1985, 5 mineral commodity reports were published, and 21 reviews of possible public land withdrawals from mineral entry were prepared. A report on the geophysical investigations of geothermal resources in the Santa Rosa-Sonoma area was published in the November issue of California Geology.

The California office of the Federal Bureau of Land Management (BLM) announced that 102,000 proofs of labor for locatable mining claims were filed in 1985. The BLM also reported 10,891 new claims were recorded in California. Miners filed 167 plans of operation with the BLM during 1985, compared with 162 plans in 1984.

The California mining industry helped the BLM to formally identify three areas of critical mineral potential (ACMP) in the State, totaling 3,759 acres. The ACMP's are in Inyo, Riverside, and San Bernardino Counties and contain potentially significant gold, silver, and lead deposits.

Since the program began in 1978, the U.S. Geological Survey (USGS) and the U.S. Bureau of Mines have published joint mineral survey reports on 1.6 million acres of the 6.8 million acres of BLM wilderness study areas in the State. In 1985, BLM released 18 of these mineral surveys for public comment. The studies involved 20 separate wilderness study areas, covering more than 1 million acres in Humboldt, Imperial, Inyo, Mendocino, Riverside, and San Bernardino Counties. Work continued during 1985 on the remaining surveys.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Asbestos.—California was the Nation's leading producer of asbestos. Production, which was reported from two mines, the Calidria Corp.'s Santa Rita Mine in San Benito County and the Calaveras Asbestos Ltd.'s Copperopolis Mine in Calaveras County, increased from that reported in 1984, but value was slightly less.

In July, Union Carbide Corp. sold its wholly owned subsidiary, Calidria, to a group of private investors (KCAC Inc.).

Boron Minerals.—Sales of boron minerals declined 7.2% from the 1984 figure, to 1,269,388 short tons.

California was the only domestic source of boron minerals, principally in the form of sodium borate. United States Borax & Chemical Corp., a subsidiary of RTZ Corp. of London, England, operated a mine and processing plant in Kern County that continued to supply the major portion of the State's domestic production. Kerr-McGee Chemical Corp. operated its Trona and Westend plants in San Bernardino County to produce a variety of borate products. American Borate Co. also reported production from its colemanite and ulexite-probertite mine in Death Valley.

Calcium Chloride.—Natural calcium chloride production was reported from three operations in San Bernardino County. Leslie Salt Co., a subsidiary of Cargill Inc., reported production from its Amboy plant; National Chloride Co. of America from its Bristol Lake plant; and Hill Bros. Chemical Co. from its Cadiz plant. Leslie Salt was the State's largest producer. Overall, production and value in 1985 were comparable to that reported in 1984.

Cement.—Nearly all of the reported cement production in the State was finished portland cement; a small amount of masonry cement was also produced. California ranked second among the Nation's portland cement producers, recording an 8% increase in production from that of 1984. Of the 11 plants reporting production in the State, 8 were in southern California. Kaiser Cement Corp. sold its cement distribution facility in Eureka.

The San Andreas cement plant of Genstar Cement & Lime Co. remained closed throughout 1985.

Work continued on CalMat Co.'s cogeneration project at its Colton plant. The project is expected to cost $40 million and make the plant self-sufficient for electrical power.

CalMat, Kaiser Cement, and Southwestern Portland Cement Co. were the largest producers of finished portland cement. CalMat, at its Colton plant in San Bernardino County, and Lone Star Industries Inc., at its Davenport plant in Santa Clara County, also reported small amounts of masonry cement production.

Table 4.—California: Portland cement salient statistics

(Short tons unless otherwise specified)

	Northern California		Southern California		California total	
	1984	1985	1984	1985	1984	1985
Number of active plants	3	3	8	8	11	11
Production	2,518,081	2,517,845	6,204,049	6,860,166	8,722,130	9,378,011
Shipments from mills:						
Quantity	2,507,005	2,594,475	6,208,306	6,867,778	8,715,311	9,462,253
Value	$149,566,255	$158,655,509	$370,459,887	$442,850,427	$520,026,142	$601,505,936
Stocks at mills, Dec. 31	234,521	119,133	306,942	300,582	541,463	419,715

Clays.—Production of 2.2 million short tons of clay and shale, valued at more than $26.6 million, was reported in 1985 from 32 companies in 21 counties throughout the State. Common clay and shale comprised the bulk of the clays produced, with smaller amounts of bentonite, ball clay, fire clay, and kaolin.

The principal uses for clays produced were in construction materials, pet waste absorbents, sewer pipe, and paint. Major producers of common clay and shale included Allied Chemical Co. in Amador County; Port Costa Materials Inc. in Contra Costa County; Excel Minerals Co. and General Portland Cement Inc. in Kern County; Lincoln Clay Products Co. in Placer County; Pacific Clay Products Co. in Riverside County; Lone Star Industries in Santa Cruz County; and Lightweight Processing Co. in Ventura County. The leading bentonite producer in California was Lowes Inc. of Kern County. Standard Industrial Minerals Co. was the leading producer of kaolin from mines in Inyo and Mono Counties. Fire clay was produced in Amador County and ball clay in Stanislaus County.

Diatomite.—California continued as the leading diatomite producer in the Nation; production remained nearly the same as in 1984. The major producer was Manville Products Corp. from its operation near Lompoc in Santa Barbara County. Grefco Inc. began construction of additional facilities at its Burney, Shasta County, diatomite operation. The massive deposit, known as the Pit River or Shasta deposit, contains high-quality diatomite suitable for filtration.

Feldspar.—California ranked fourth nationally in production of feldspar; quantity produced and value both declined slightly from the 1984 figures. The production of feldspar-silica mixtures was reported from Calspar Inc.'s San Bernardino County plant, and from Crystal Silica Co.'s Oceanside plant in San Diego County and California Silica Products Co.'s Mission Viejo plant in Orange County.

Gypsum.—California ranked fifth in the Nation in the production of crude gypsum during 1985 and second in the production of calcined gypsum.

Crude gypsum output was reported from eight mines in Imperial, Kern, Kings, Riverside, San Bernardino, San Luis Obispo, and Ventura Counties. Calcined gypsum was produced in six plants in Alameda, Contra Costa, Imperial, and Los Angeles Counties. Byproduct gypsum was produced in Contra Costa, Fresno, and San Joaquin Counties.

Lime.—California ranked 13th among the 36 States and Puerto Rico reporting lime production in 1985. Output declined less than 1% to 367,000 short tons. Genstar Cement & Lime was the largest producer from its plants in Contra Costa and Los Angeles Counties. Holly Sugar Co., with three plants in Glenn, Imperial, and San Joaquin Counties, and Kerr-McGee, with its Westend plant in San Bernardino County, were also important producers.

Magnesium Compounds.—Production of magnesium compounds from seawater declined nearly 15% from that of 1984, although value dropped slightly less than 9% because of increasing prices.

National Refractories and Materials Corp., organized by former Kaiser employees to assume Kaiser's divested refractories operations, produced magnesia and magnesium hydroxide from hydrated dolomitic lime and seawater in Monterey County. Dolomite from the Natividad quarry, 5 miles northeast of Salinas, was calcined to remove CO_2 and shipped to the Moss Landing plant for processing with seawater for magnesia recovery.

Merck & Co. Inc. produced magnesium hydroxide, magnesium carbonate, and magnesium oxide at its San Mateo County plant.

Peat.—Peat production was essentially the same in 1985 as that reported in 1984.

Radel Inc. in Modoc County and Hyponex Corp. in Santa Cruz County were the only producers.

Perlite.—California ranked second in the United States in the production of processed perlite and third in the production of expanded perlite. Perlite was mined at Redco Inc.'s Fish Springs Mine in Inyo County. Expanded perlite was produced at seven plants in Los Angeles, San Bernardino, and San Diego Counties. American Perlite Co.'s plant in Los Angeles County was the State's largest producer of expanded perlite.

Potassium Salts.—Kerr-McGee produced muriate of potash (60% K_2O) and sulfate of potash (50% K_2O) from plants in San Bernardino County. Production and value declined slightly from that of 1984.

Pumice.—California was the third largest pumice producing State in 1985. Value declined about 7% to $1,491,000, although the 78,000 short tons produced was only 2.5% less than that of 1984. Siskiyou County was the leading producer of the five counties reporting pumice output. Production was also reported from Inyo, Madera, Modoc, and Mono Counties. Principal uses were in abrasives, concrete aggregate, building and decorative blocks, and landscaping.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

An estimated production of 113 million short tons in 1985 continued California's ranking as the leading construction sand and gravel producing State.

Industrial.—California ranked fourth among the States in the quantity of industrial sand and gravel produced in 1985, but was second to Illinois in value, which exceeded $37 million. Production of 2,255,000 short tons was 26,000 tons less than that produced in 1984.

Three companies, Owens-Illinois Inc. in Amador County, Ottawa Silica Co. in San Diego County, and Unimin Corp. in Contra Costa County, produced nearly 70% of the total industrial sand and gravel in California. Additional production was reported in Monterey, Orange, Riverside, Santa Cruz, and Ventura Counties.

Sodium Compounds.—California was the Nation's largest sodium sulfate producer in 1985 and was second in the production of sodium carbonate. All sodium sulfate production was from Kerr-McGee's Westend plant, where natural brines were pumped from Searles Lake. Sodium carbonate production was reported from Kerr-McGee's Argus and Westend plants in San Bernardino County.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—California ranked eighth among the producing States for crushed and broken stone in 1985. Production of 41,199,000 short tons was 16% higher than the reported 1983 output. In 1985, output of crushed stone was reported from 189 quarries in 45 counties. Principal uses were in cement manufacture, construction materials, road base, aggregates, riprap, and jetty stone. In 1985, the U.S. Bureau of Mines began compiling crushed stone production statistics by districts for some States.

Table 5.—California: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	1,577	8,747
Filter stone	279	1,347
Other coarse aggregate[2]	1,380	9,870
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,412	4,420
Bituminous aggregate, coarse	1,611	8,002
Bituminous surface-treatment aggregate	229	843
Railroad ballast	77	266
Fine aggregate (-3/8 inch):		
Stone sand, concrete	70	2,222
Stone sand, bituminous mix or seal	158	323
Other fine aggregate	309	855

See footnotes at end of table.

Table 5.—California: Crushed stone[1] sold or used by producers in 1985, by use —Continued

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Combined coarse and fine aggregates:		
Graded road base or subbase	6,363	18,632
Unpaved road surfacing	772	2,119
Terrazzo and exposed aggregate	2,129	16,708
Crusher run or fill or waste	2,712	7,939
Other construction	630	3,165
Agricultural:		
Agricultural limestone	9	36
Agricultural marl/soil conditioners	20	W
Poultry grit and mineral food	57	715
Chemical and metallurgical:		
Cement manufacture	13,348	41,654
Lime manufacture	446	6,045
Dead-burned dolomite manufacture	67	716
Special:		
Roofing granules	26	670
Other miscellaneous[3]	1,555	18,403
Other unspecified[4]	5,964	20,696
Total[5]	41,199	174,395

W Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."
[1]Includes dolomite, granite, limestone, quartzite, sandstone, shell, slate, traprock, volcanic cinder and scoria, and miscellaneous stone.
[2]Includes macadam and coarse aggregate, large.
[3]Includes chemical, flux stone, asphalt fillers or extenders, whiting or whiting substitute, other fillers or extenders, glass manufacture, lightweight aggregate, porcelain, sugar refining, sulfur oxide removal, waste material, and other unspecified uses.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Table 6.—California: Crushed stone sold or used by producers in 1985, by district and use

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	(1)	(1)	2,159	13,358	(1)	(1)
Coarse aggregate, graded	(1)	(1)	2,467	8,991	(1)	(1)
Fine aggregate (-3/8 inch)	--	--	(1)	(1)	(1)	(1)
Combined coarse and fine aggregates	592	1,685	10,505	40,885	1,380	4,936
Other construction	77	261	215	1,534	2,310	13,808
Agricultural limestone	--	--	72	691	(2)	(2)
Cement manufacture	(3)	(3)	(2)	(2)	10,325	32,347
Lime manufacture	--	--	446	6,045	--	--
Dead-burned dolomite manufacture	--	--	67	716	--	--
Flux stone	--	--	(2)	(2)	--	--
Chemical stone	--	--	(2)	(2)	--	--
Glass manufacture	--	--	--	--	(2)	(2)
Sulfur oxide removal	--	--	(2)	(2)	--	--
Asphalt fillers or extenders	--	--	(2)	(2)	(2)	(2)
Whiting or whiting substitute	--	--	--	--	(2)	(2)
Other fillers or extenders	--	--	--	--	(2)	(2)
Lightweight aggregate	--	--	(2)	(2)	(2)	(2)
Roofing granules	--	--	(2)	(2)	(2)	(2)
Sugar refining	--	--	(2)	(2)	--	--
Other miscellaneous	(3)	(3)	3,054	12,713	840	13,196
Other unspecified[4]	--	--	4,987	16,710	978	3,986
Total	1,394	4,479	23,972	101,643	15,833	68,273

[1]Withheld to avoid disclosing company proprietary data; included with "Other construction."
[2]Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."
[3]Withheld to avoid disclosing company proprietary data; included in "Total."
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.

Dimension.—Dimension stone was produced in 13 counties. Production of 23,181 short tons from 14 quarries was valued at nearly $2.5 million.

Sulfur (Recovered).—Byproduct sulfur was recovered at 16 oil refineries—4 in Contra Costa County, 9 in Los Angeles County, and 1 each in Kern, Santa Barbara, and Solano Counties. California's 1985 production of 576,000 metric tons ranked third among the States for recovered elemental sulfur. Both production and value increased from that of 1984. Chevron U.S.A. Inc.'s refinery in El Segundo, Los Angeles County,

was the largest producer.

Talc and Pyrophyllite.—California ranked fifth among the 10 producing States reporting talc and pyrophyllite production in 1985. Crude talc ore came primarily from 10 operations in Inyo and San Bernardino Counties, with some production reported from 1 mine in Calaveras County. Processed talc production was reported from six operations in Calaveras, Inyo, Los Angeles, Sacramento, and San Bernardino Counties. Pyrophyllite was produced and processed from two mines in Mono County and one mill in Inyo County.

Talc and pyrophyllite increased 35% in quantity and 52% in value from that of 1984.

Vermiculite (Exfoliated).—California ranked first among the 28 States that reported exfoliated vermiculite production in 1985. W. R. Grace & Co. was the sole producer from plants in Alameda and Orange Counties. Most of the vermiculite output was used in fireproofing, with smaller amounts used in concrete and plaster aggregates and in horticulture.

METALS

Copper.—The only copper production reported in the State during 1985 was byproduct copper from tungsten ore processing at Umetco Minerals Corp.'s Pine Creek tungsten mill, Inyo County.

Gold.—California became the third largest gold producing State in the Nation in 1985; reported production nearly doubled from that of 1984 to 165,101 troy ounces valued at more than $52 million. The increase resulted from the opening of Homestake's McLaughlin Mine in Napa County, where the first gold was poured early in March. The McLaughlin Mine, formally dedicated in September, is expected to yield approximately 200,000 ounces of gold per year over the next 25 years.

State gold production in 1985 was reported from eight lode mines and six placer operations, including one dredge. Byproduct gold was recovered from three sand and gravel operations. The Picacho Mine in Imperial County and the Gray Eagle Mine in Siskiyou County were major lode producers.

Placer production of nearly 4,000 ounces of gold, valued at $1,260,000, was reported from 5 mines and 16 plants in Del Norte, Fresno, San Joaquin, Sierra, Siskiyou, and Stanislaus Counties. A significant gold recovery was made by Placer Service Corp.'s Yuba 21 bucket-line dredge, operating near Hammonton in Yuba County. According to company reports, production increased nearly 50% over that of 1984. Placer gold mining by individuals with small suction dredges was a popular recreational pursuit on many California rivers.

Construction began on Gold Fields Mining Corp.'s Mesquite gold mine project 35 miles east of Brawley in Imperial County. Brush Creek Mining & Development Corp. continued development of the Brush Creek Mine in Sierra County and reportedly mined 1,415 tons of ore during 1985. The heap leach test program continued at Glamis Gold Ltd.'s Yellow Aster property in Kern County. Calgom Mining, Greenville, CA, announced its Goldstripe open pit gold mine and heap leach project reached full commercial operation near Canyon Dam in Plumas County.

Exploration for gold was carried on throughout the State. Brush Creek Mining opened the 290-foot level of the Brush Creek Mine and did some surface drilling. Tundra Gold Mines Ltd. explored by core drilling at the Ballard, California, Plymouth, and Seton claims in Amador County. International Minerals Services Ltd. of Sacramento contracted to perform site preparation, shaft rehabilitation, dewatering, and ore reserve analysis in the old workings of the Calaveras Central Mine in Calaveras County. NERCO Minerals Co., a subsidiary of Pacific Power & Light Co. of Portland, OR, signed an agreement with Mother Lode Gold Mines Consolidated (MLGM) to do exploratory drilling at the latter's Mountain King-Royal Mine in Calaveras County. Northcal Resources explored its Gold Cliff property near Angel's Camp in Calaveras County.

Cous Creek Copper Mines Ltd. began preliminary exploration at its Shoshone Mines unit in Inyo County. Houston Oil and Minerals Exploration Co. (HOMEX), a subsidiary of Tenneco Co., and Queenstake Resources Inc. of Vancouver, British Columbia, Canada, explored Queenstake's Argus gold project in Inyo County. Cactus Gold Mines Co. explored a property in the Mojave Desert about 85 miles north of Los Angeles in Kern County. Drilling was conducted at the Pine Tree-Josephine gold deposit in Mariposa County by Golden Bell Resources Inc. of Vancouver, British Columbia, Canada. Drilling was done by Baltic Consolidated Gold Mines Corp. in Nevada

County, 10 miles southeast of Allegheny.

Inca Resources completed hydrological work, engineering, and feasibility studies at its Rich Gulch property in Plumas County. Sunshine Mining Co. continued exploration at its Bellevue gold property, an underground placer gold mine in Plumas and Sierra Counties. Amselco Exploration Inc. explored at the Colosseum Gold Mine project in San Bernardino County. Amselco Minerals Inc., a subsidiary of British Petroleum Corp. Ltd., started a major exploration program on Beaver Resources' Kramer Hills property in San Bernardino County. A bulk sampling program began at Adriatic Resources' Crystal Falls-Chicago Mine in Shasta County. Helena Silver Mines Inc. explored the Central Mine property near Yreka in Siskiyou County.

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

Iron and Steel.—United States Steel Corp. and Pohang Iron and Steel Co. of the Republic of Korea established a joint venture to operate and modernize the plant at Pittsburg, CA. The joint venture plans to market sheet and tin products throughout the Western United States.

Mercury.—No mercury was mined in California during 1985, but nearly 3,000 flasks were sold from stocks in Napa, San Luis Obispo, and Sonoma Counties.

Molybdenum.—All of California's 1985 molybdenum production was byproduct from tungsten recovery at Umetco's Pine Creek Mine in Inyo County.

Nickel.—Activity at California Nickel Corp.'s Gasquet Mountain nickel-cobalt property in Del Norte County was limited to assessment work and technical data collection for environmental studies.

Rare-Earth Metal Concentrate.—Rare-earth production in California in 1985 dropped to its lowest level in 9 years owing to decreased demand. All California production was from the Mountain Pass bastnasite mine of Molycorp Inc., a wholly owned subsidiary of Unocal Corp. Major end uses were in petroleum cracking catalysts, metallurgical applications, glass and ceramics, and permanent magnets.

According to Unocal's annual report, Molycorp's sales of rare earths declined in 1985, primarily because of a decreased demand for rare-earth-containing fluid cracking catalysts used in leaded fuel production. New regulations by the Environmental Protection Agency, which sharply reduced the amount of lead that can be added to boost octane levels in gasoline, were cited as the cause of the reduced rare-earth demand.

Silver.—California ranked ninth among the States in the amount of silver produced during 1985, with a reported 115,478 troy ounces valued at $709,000. Production increased from that of 1984, but there was a moderate decline in value reflecting lower market prices for the metal. Lode silver production was obtained from five mines in Imperial, Mono, Napa, Siskiyou, and San Bernardino Counties. The Noranda Grey Eagle Mine in Siskiyou County was the State's largest producer, reporting 82,785 troy ounces valued at $508,482. Recovery of 308 ounces of silver was reported from gold placer operations in San Joaquin and Stanislaus Counties.

Tungsten Ore and Concentrate.—California ranked first among the two States reporting tungsten production, despite a 24% reduction in quantity and a 38% reduction in value from that of 1984.

Tungsten ore was mined in Inyo, Los Angeles, and Madera Counties. Umetco remained the leading producer of crude ore and concentrates from its Pine Creek Mine in Inyo County. The mine and ammonium paratungstate plant were closed, or operated at a reduced capacity during most of the year. The State's second largest producer, Teledyne Tungsten, produced tungsten concentrate from its Strawberry Mine and mill near North Fork in Madera County during most of the year, except when closed owing to winter weather conditions. Restrictions on access limited Curtis Tungsten Co.'s Andrew Mine production in Los Angeles County.

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[1]State Mineral Officer, Bureau of Mines, Reno, NV.
[2]State geologist, California Department of Conservation, Division of Mines and Geology, Sacramento, CA.
[3]Geologist, California Department of Conservation, Division of Mines and Geology, Sacramento, CA.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Calaveras Asbestos Ltd	Box 127 Copperopolis, CA 95228	Surface mine and plant.	Calaveras.
Calidria Corp	Box K King City, CA 93930	____do_____	San Benito.
Boron minerals:			
Kerr-McGee Chemical Corp.[1]	Kerr-McGee Center Oklahoma City, OK 73125	Evaporators and plant.	San Bernardino.
United States Borax & Chemical Corp.	Box 75128 Sanford Station Los Angeles, CA 90010	Surface mine and plant.	Kern.
Calcium chloride:			
Leslie Salt Co.,[2] a subsidiary of Cargill Inc.	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] (Cal-Mat Co.)	3200 San Fernando Rd. Los Angeles, CA 90065	Plants	Various.
Kaiser Cement Corp	300 Lakeside Dr. Oakland, CA 94612	____do_____	Do.
Southwestern Portland Cement Co.[4]	Box 937 Victorville, CA 92392	Plant	San Bernardino.
Clays:			
Excel Minerals Co	Box 878 111 South La Patera Lane Goleta, CA 93116	Pits	Kern.
Gifford-Hill & Co. Inc., Phoenix Cement Co.[5]	Box 47127 Dallas, TX 75241	____do_____	Various.
Lightweight Processing Co	715 North Central Ave. Suite 321 Glendale, CA 91203	____do_____	Ventura.
Lincoln Clay Products Co	Box 367 Lincoln, CA 95648	Pit	Placer.
Lone Star Industries Inc.[5]	2800 Campus Dr. San Mateo, CA 94403	Pit	Santa Cruz.
Port Costa Materials Inc	Box 5 Port Costa, CA 94569	Pit	Contra Costa.
Diatomite:			
Manville Products Corp	2500 Miguelito Rd. Lompoc, CA 93436	Surface mine and plant.	Santa Barbara.
Feldspar:			
California Silica Products Co.[6]	Box 248 31302 Ortega Highway San Juan Capistrano, CA 92693	____do_____	Orange.
Crystal Silica Co	3231 Oceanside Dr. Oceanside, CA 92054	Mine and plant	San Diego.
Gold:			
Chemgold Inc.[7]	Box 2015 Yuma, AZ 85364	Mine	Imperial.
Noranda Exploration Inc.[7]	Box 788 Happy Camp, CA 96039	____do_____	Siskiyou.
Lime:			
Kaiser Aluminum & Chemical Corp.[8]	Box 1938 Salinas, CA 93901	Surface mine and plant.	Monterey.
Perlite:			
American Perlite Co	11831 Vose St. North Hollywood, CA 91605	Surface mine and mill.	Los Angeles.
Pumice:			
American Pumice Products Inc	17992 Mitchell, South Irvine, CA 92714	____do_____	Inyo.
Tionesta Aggregates Co	13290 Hodge Dr. Reno, NV 89511	Surface mine	Siskiyou.
Rare earths:			
Molycorp Inc	Union Oil Center 461 South Boylston St. Los Angeles, CA 91017	____do_____	San Bernardino.
Sand and gravel (construction):			
CalMat Co	3200 San Fernando Rd. Los Angeles, CA 90065	Pits	Various.
Koppers Co. Inc., Kaiser Sand & Gravel Co.	Box 640 Santa Monica, CA 93456	____do_____	Do.
Livingston-Graham	16080 East Arrow Highway Irwindale, CA 91706	____do_____	Do.
Owl Rock Products Co	Box 330 Arcadia, CA 91006	____do_____	Do.
Pleasanton Gravel Co	Box 850 Pleasanton, CA 94566	Pit	Alameda.
A. Teichert & Sons Inc., Teichert Aggregates.	Box 15002 Sacramento, CA 95851	Pits	Various.
Talc and pyrophyllite:			
Pfizer Inc.[9]	Drawer AD Victorville, CA 92394	Surface mine and plant.	Inyo.
Western Source Inc	Box 280 San Andreas, CA 95249	Surface mine and mill.	Calaveras.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Tungsten ore and concentrate:			
Teledyne Tungsten	4709 North El Capitan Ave. Suite 109 Fresno, CA 93711	Underground mine and plant.	Madera.
Umetco Minerals Corp., a subsidiary of Union Carbide Corp.[10]	Route 2 Bishop, CA 93514	____do ____	Inyo.
Vermiculite (exfoliated):			
W. R. Grace & Co	1114 Avenue of the Americas New York, NY 10036	Plants ____	Alameda and Orange.

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

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]

The value of nonfuel minerals produced in Colorado in 1985 was about 6% less than in 1984, resuming the downtrend begun in 1981 and interrupted in 1984. The value of production of nearly all nonfuel mineral commodities mined in the State was lower than in 1984. Metal mineral declines included almost 100% for vanadium, 81% for silver, 58% for lead, 45% for zinc, and 36% for gold. Only molybdenum, the State's most important nonfuel mineral commodity, increased in output over 1984 levels; the value of molybdenum output increased 25%. Molybdenum ran counter to the trend in price change as well, with higher prices in 1985, whereas prices of all other metals were lower. Although improved over that of 1984 and 1983, molybdenum production remained at only 50% of the peak 1981 level.

The State's industrial minerals also reflected lower production, except for lime and peat, which were higher, and sand and gravel, which changed little from that of 1984. A large percentage increase in dimension stone production reflected increased popularity of stone in architectural design.

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

Mineral	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
Clays thousand short tons	308	$2,111	303	$1,743
Gem stones	NA	80	NA	80
Gold (recoverable content of ores, etc.) troy ounces	60,010	21,643	43,301	13,755
Gypsum thousand short tons	291	W	233	1,800
Sand and gravel:				
Construction do.	28,024	87,324	e27,500	e88,000
Industrial do.	149	2,213	W	W
Silver (recoverable content of ores, etc.) thousand troy ounces	2,200	17,909	549	3,370
Stone:				
Crushed thousand short tons	e7,200	e26,200	7,037	25,930
Dimension do.	e1	e87	2	204
Combined value of cement, copper, iron ore, lead, lime, molybdenum, peat, perlite, pyrites, salt (1984), tin, tungsten ore and concentrate, vanadium (1984), zinc, and values indicated by symbol W	XX	r278,609	XX	273,296
Total	XX	r436,176	XX	408,178

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.—Nonfuel minerals produced in Colorado in 1984, by county[1]

County	Minerals produced in order of value
Adams	Sand and gravel.
Alamosa	Do.
Arapahoe	Do.
Boulder	Cement, sand and gravel, clays, peat, gold, silver.
Chaffee	Sand and gravel, lime, peat.
Clear Creek	Molybdenum, sand and gravel, gold, silver, lead, copper.
Conejos	Sand and gravel.
Costilla	Do.
Crowley	Do.
Custer	Perlite, sand and gravel.
Delta	Sand and gravel.
Dolores	Do.
Douglas	Sand and gravel, clays.
Eagle	Sand and gravel, silver, gold, copper, lead.
Elbert	Sand and gravel, clays.
El Paso	Do.
Fremont	Cement, gypsum, sand and gravel, clays.
Garfield	Sand and gravel.
Grand	Do.
Gunnison	Do.
Hinsdale	Gold, silver, copper, lead.
Huerfano	Sand and gravel.
Jackson	Do.
Jefferson	Sand and gravel, clays.
Kit Carson	Sand and gravel.
Lake	Molybdenum, zinc, gold, silver, lead, tungsten, sand and gravel, tin, pyrites, copper.
La Plata	Sand and gravel.
Larimer	Cement, sand and gravel, gypsum, lime.
Las Animas	Sand and gravel.
Logan	Sand and gravel, lime.
Mesa	Vanadium, sand and gravel.
Mineral	Silver, lead, copper.
Moffat	Sand and gravel.
Montezuma	Do.
Montrose	Vanadium, sand and gravel, salt.
Morgan	Lime, sand and gravel.
Otero	Sand and gravel.
Ouray	Sand and gravel, silver, lead, gold, copper.
Park	Sand and gravel, peat, silver, gold, lead, copper.
Phillips	Sand and gravel.
Pitkin	Sand and gravel, iron ore.
Prowers	Sand and gravel.
Pueblo	Sand and gravel, clays.
Rio Blanco	Sand and gravel.
Rio Grande	Do.
Routt	Do.
Saguache	Gold, silver.
San Juan	Gold, zinc, silver, lead, copper.
San Miguel	Vanadium, sand and gravel.
Sedgwick	Lime, sand and gravel.
Summit	Sand and gravel.
Teller	Gold, peat, sand and gravel, silver.
Weld	Lime, sand and gravel.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Colorado business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	3,149	3,190	3,231
Total civilian labor force	do.	1,668	1,714	1,720
Unemployment	percent	6.6	5.6	5.9
Employment (nonagricultural):				
Mining total[1]	thousands	36.1	35.9	32.9
Metal mining	do.	5.5	5.5	4.1
Nonmetallic minerals except fuels[2]	do.	.8	.9	1.0
Coal mining[2]	do.	3.9	3.9	3.8
Oil and gas extraction	do.	26.0	25.7	24.0
Manufacturing total	do.	180.7	195.3	193.3
Primary metal industries[2]	do.	3.7	3.7	3.4
Stone, clay, and glass products	do.	9.1	10.0	9.8
Chemicals and allied products	do.	7.7	8.2	8.5
Construction	do.	83.0	89.9	85.6
Transportation and public utilities	do.	83.7	87.2	89.1
Wholesale and retail trade	do.	326.2	345.9	353.5
Finance, insurance, real estate	do.	87.0	94.7	97.7
Services	do.	289.7	309.2	321.2
Government and government enterprises	do.	240.7	244.4	249.2
Total[3]		1,327.2	1,402.3	1,422.4
Personal income:				
Total	millions	$41,634	$45,125	$47,859
Per capita		$13,223	$14,147	$14,812
Hours and earnings:				
Total average weekly hours, production workers		39.9	40.9	40.2
Total average hourly earnings, production workers		$9.0	$9.2	$9.5
Earnings by industry:				
Farm income	millions	$534	$565	$680
Nonfarm	do.	$30,878	$33,717	$35,731
Mining total	do.	$1,596	$1,652	$1,565
Metal mining	do.	$209	$216	$175
Nonmetallic minerals except fuels	do.	$25	$26	$30
Coal mining	do.	$208	$251	$260
Oil and gas extraction	do.	$1,154	$1,158	$1,099
Manufacturing total	do.	$4,696	$5,231	$5,495
Primary metal industries	do.	$126	$136	$120
Stone, clay, and glass products	do.	$256	$293	$297
Chemicals and allied products	do.	$243	$276	$299
Petroleum and coal products	do.	$38	$40	$39
Construction	do.	$2,659	$2,929	$2,894
Transportation and public utilities	do.	$2,682	$2,816	$2,977
Wholesale and retail trade	do.	$5,220	$5,702	$5,977
Finance, insurance, real estate	do.	$2,039	$2,264	$2,563
Services	do.	$6,359	$7,145	$7,858
Government and government enterprises	do.	$5,448	$5,800	$6,211
Construction activity:				
Number of private and public residential units authorized[4]		51,426	44,369	32,824
Value of nonresidential construction[4]	millions	$1,245.3	$1,775.5	$1,409.1
Value of State road contract awards	do.	$137.0	$305.0	$337.8
Shipments of portland and masonry cement to and within the State	thousand short tons	1,504	1,704	1,597
Nonfuel mineral production value:				
Total crude mineral value	millions	$337.7	$436.2	$408.2
Value per capita		$107	$137	$126

[p]Preliminary. [r]Revised.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

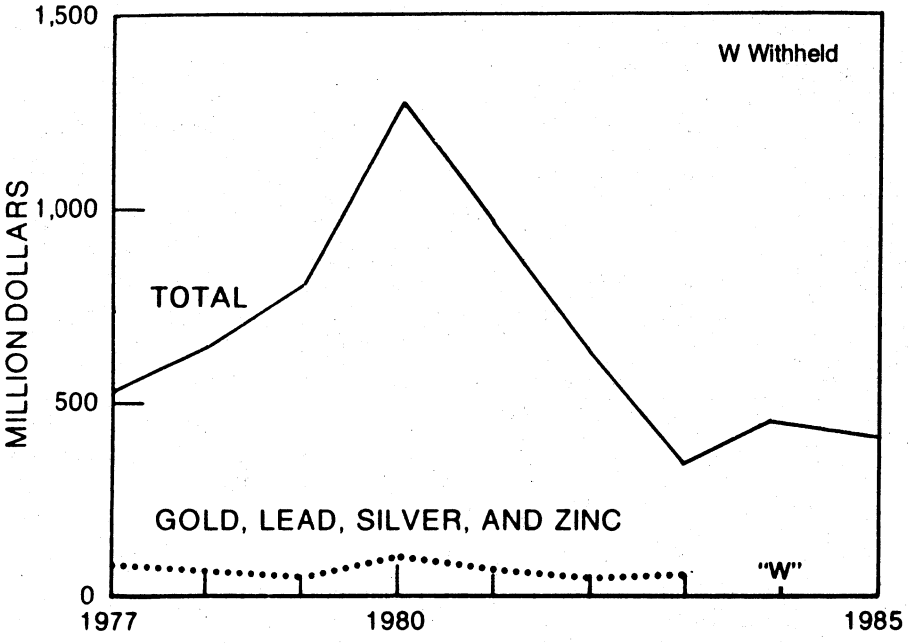

Figure 1.—Value of mine production of gold, lead, silver, and zinc and total value of nonfuel mineral production in Colorado.

The State ranked 19th among all States in nonfuel production, compared with 20th in 1984 and 7th in 1981. Twenty-three nonfuel minerals were produced in the State, 12 industrial minerals and 11 metals. Metals contributed 52% of total value; industrial minerals, 48%. Sand and gravel accounted for nearly one-half the industrial minerals produced, and with cement, accounted for well over 90%; molybdenum produced about 80% of the metals value.

Employment in metal mining fell to an estimated 4,100 people from 5,500 in 1984. Total employment in mining declined from 35,900 in 1984 to 32,900 in 1985.

Trends and Developments.—Colorado again ranked first in the Nation in molybdenum output as the market and price for that metal appeared to stabilize, albeit at a relatively low level. Tungsten output, a molybdenum coproduct at the Climax Mine, increased considerably as production at that mine stabilized. Gold and silver production and their coproducts from Colorado's complex ores, copper, lead, and zinc, all declined 30% to 80% as the major mines remained closed throughout the year. The Bulldog Mountain, Sherman, Sunnyside, and Victor Mines were closed all or some part of 1985. Of Colorado's larger metal mines, only ASARCO Incorporated's Leadville Unit, the Black Cloud Mine at Leadville, remained open throughout the year; it was the largest producer of gold, lead, silver, and zinc in the State for 1985. For the first year in many years, no vanadium was recovered in Colorado. In the past, the State has been ranked first or second in production of this alloying metal based on its occurrence as a coproduct in many uranium ores in the State. The Schwartzwalder Mine, the only major uranium source in 1985, yielded no ores containing vanadium.

A continuing bright spot in the State's mineral industry was the interest in gold and silver. Several new mines and prospects were under development, notably Galactic Resources Ltd.'s Summitville Mine and Homestake Mining Co.'s Equity Prospect.

Aside from molybdenum, Colorado did not rank high as a metals producer, compared with other States. It ranked 11th of 14 States producing gold, 8th of 17 in silver, 3d of 10 in lead, 5th of 8 in zinc, and 2d of 2 in tungsten.

The mining industry in Colorado generally continued in the slump begun in 1981. Last year's upturn proved to be a short-

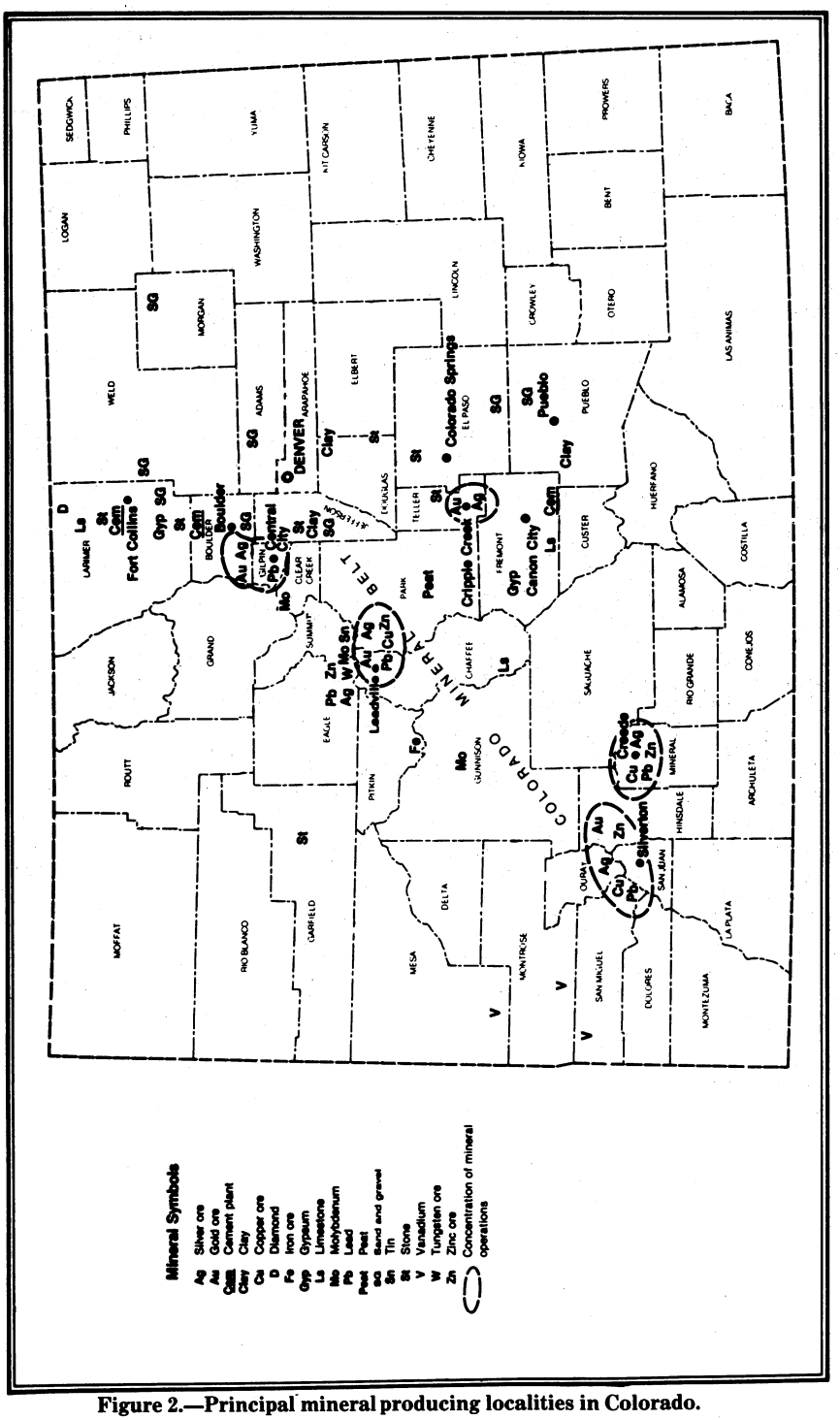

Figure 2.—Principal mineral producing localities in Colorado.

lived aberration; nonetheless, the industry remained more stable than in the preceding several years, and interest in developing gold and silver was promising.

Exploration Activities.—Although continuing low metal prices kept all but one of the State's major precious metals-base metals mines closed at least part of the year, interest in and exploration for gold and silver remained high. Colorado ranked fourth in nonferrous metals (mostly gold) exploration, behind Nevada, Arizona, and California. The major expansion effort continued to be by smaller firms; several large firms reduced exploration efforts. Several Canadian firms remained prominent. Most exploration was in areas that had a previous history of precious metals production.

Two notable exploration projects during the year were Homestake's Equity project near Creede and Galactic Resources' Summitville project south of Del Norte. Homestake has been exploring underground at the old Equity Mine property for several years, on the same vein system that runs through its closed Bulldog Mountain Mine 8 miles southeast at Creede. Although the company has not commented about discoveries, rumors suggest a major silver strike. Galactic Resources built on years of exploration work by The Anaconda Minerals Co. and others to start developing an open pit, heap leaching operation at Summitville.

Most gold and silver exploration occurred in the Colorado Mineral Belt. (See figure 2.) Activity was concentrated in the San Juan Mountains near Silverton at the southern end of the belt, at Creede and Leadville in the Clear Creek County area around Idaho Springs, in Boulder County at the northern end of the Colorado Mineral Belt, and at Cripple Creek-Victor in central Colorado.

Exploration projects near Silverton included those of Gerber Minerals Corp. at the Gold King Mine; P&G Mining Co., in partnership with International North American Resources Inc. (a Canadian company), on Sultan Mountain; the Brooklyn Mining Co. at the Brooklyn Mine; and Silverton Mining Co. at the Mighty Monarch. Cornucopia Resources of Canada, a sister company to Galactic Resources, was working on nearby Red Mountain.

One participant characterized Creede as "the most exciting gold and silver camp in the United States today"; exploration, in addition to the Homestake Equity project, included drilling programs by Pioneer Nuclear Inc.-Minerals Engineering Co. (ME-CO), and Crown Resources Corp.-Sutton Resources Inc. Todilto Exploration and Development Corp. prospected the Amethyst vein on Mammouth Mountain east of Creede. Also active in southwestern Colorado were Chevron Resources Co. at Spring Creek, Sierra Resources Inc. and Exxon Corp. at and around the Bessie G Mine in La Plata County, and Rapholz Silver Inc. at the Carbonero Mine near Ophir.

Companies active in exploration and development for gold and silver around Leadville were Leadville Mining and Milling Corp. at the Hopemore Shaft on Breece Hill, Leadville Silver and Gold Co., The Apache Corp., Great West Gold and Silver Inc. at the Consolidated Virginia and Dinero Mines, and American Gold Resources at the Granite Tunnel. Asarco's Leadville Unit worked to extend the gold reserves of the Black Cloud Mine, where in 1985 gold surpassed lead, silver, and zinc as the most valuable product. Across the mountains from Leadville, Chiwawa Mines was investigating its Mount Bross property; Cobb Resources Corp. found two more major gold ore veins in the London Mine near Alma; and the Blue River Mining and Milling Co. explored the Blue River Tunnel near Breckenridge.

In the old Cripple Creek-Victor District, Texasgulf Minerals and Metals Inc. resumed managing the Cripple Creek and Victor Gold Mining Co. from Hecla Mining Co. and reviewed options for further exploring the Ajax, Cresson, and other of the extensive properties held in the area with Golden Cycle Gold Corp. Minerex Minerals prospected and drilled on Mineral Hill. Yellow Gold of Cripple Creek Inc. sought to lease or buy additional mining properties in the Moffat Tunnel area; and Nerco Minerals Co., Newport Minerals Co., and Hull Mining Co. continued developing their gold leaching operations.

Among the numerous companies working in the Clear Creek-Idaho Springs area, Franklin Consolidated Mining Co. reported discovering a large gold-silver ore shoot in the Franklin Mine, and Hibernia Resources continued its Little Mattie project.

In Boulder County, the Gold Hill Limited Venture Partnership of Cosmos Resources Inc. and the Steen family completed preproduction work at the Cash Mine. Hendricks Mining Co. completed exploration and development at the Cross Mine. Wassuk Gold Co. continued work at the Bueno.

In addition to the interest in gold and

silver, several companies leaving metal mining because of low prices indicated interest in a variety of industrial minerals in the State, mainly sand and gravel.

Legislation and Government Programs.—In 1985, the Colorado Legislature enacted only three bills directly related to nonfuel mining: House bill 1204, which put all unmined minerals under the same category for property taxes and provided for assessment on the basis of surface use only; Senate bill 94, which controlled cyanide use in mine operations; and Senate bill 109, which provided for hazardous materials cleanup.

A U.S. District Court judge in Denver ruled on November 26 that designation of land as wilderness in Colorado carried with it an implied Federal reserve water right. In response to a January 1984 suit by the Sierra Club, the ruling generated fear among State water users that it would adversely affect established water rights. In a countermove, two members of the State congressional delegation wrote into all new wilderness bills a denial of implied water rights; this move delayed approval of new wilderness legislation until the question is resolved.

The Environmental Protection Agency's cleanup list for Colorado under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund) was expanded to include the Rocky Mountain Arsenal and the Rocky Flats nuclear weapons plant, both in the Denver area.

Colorado received $42.6 million as its share of public land rents and royalties, $4.4 million less than in 1984, reflecting reduced mineral activity on Federal lands. According to the Colorado Geological Survey (CGS), Colorado received $96.6 million in "direct revenue" during the 1983-84 fiscal year (the most recent figures available) from the State severance tax and other charges. In addition, local governments received an estimated $94.2 million from ad valorem taxes levied on mineral properties.

The U.S. Bureau of Mines had a total of $1.08 million in contracts in Colorado, mostly for mine safety and related developments.

The Jefferson County Board of Commissioners established a broadly based advisory board to help develop guidelines for evaluating proposals for new sand and gravel and stone operations. Jefferson County had not approved a new aggregate extraction site for 5 years.

Working under a reduced direct appropriation from the State legislature, the CGS received enough additional funding from other State and Federal agencies and institutions to conduct a full engineering and environmental-geology program and mineral fuels and mineral resources studies. CGS advised State and local government agencies on geologic problems; inventoried and analyzed the State's mineral resources; determined areas of geologic hazard to reduce their impact on the citizens and the economy of the State; collected geologic information; and published reports on its findings in 6 formal reports, 19 open-file reports, and numerous technical memoranda and informal reports.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Cadmium.—Asarco recovered cadmium from flue dust, dross, and byproduct materials from out-of-State smelters at its Globe refinery in Denver. This output was not included in the State mineral production total because origin of the processed materials could not be determined. In a lawsuit filed in 1983, a Denver Federal judge ruled in October 1985 that the Globe plant was responsible for ground and water pollution in the Globeville area around the plant. State health authorities had complained of arsenic, cadmium, lead, thallium, and zinc pollution. Damages, cleanup, and a plan to prevent further pollution were not decided.

Copper.—Copper was produced in Colorado only as a byproduct of other metal production. It occurred in complex ores along with gold, lead, silver, and zinc, but comprised only about 1% of the value of those ores. Eight mines in Colorado reported copper production, but 90% of the total came from Asarco's Leadville Unit, Black Cloud Mine, and Standard Metals Corp.'s Sunnyside Mine. Copper production fell about 64% from the 1984 level.

Gold.—Gold produced in Colorado fell nearly 28% from the 1984 level to 43,301 troy ounces. Output value fell 36% to $13.76 million because of lower prices. Only one of the State's major gold producing mines remained open throughout the year, Asarco's Leadville Unit, the Black Cloud Mine, at Leadville. Although primarily a lead-zinc

mine, the Black Cloud's 1985 gold production value was significant. The State's largest gold mine, the Sunnyside Mine at Silverton, closed in March and remained closed the rest of the year.

Ten mines in Colorado reported producing gold in 1985. The Black Cloud and Crystal Hill Mines were the two largest producers, followed by the Victor and the Sunnyside Mines. Colorado was 11th of 14 States producing gold, with just 5% of national output. The average gold price during the year was $317.66 per troy ounce.

Construction of a large open pit mine at Summitville by Galactic Resources of Vancouver, British Columbia, Canada, was the most dramatic development of the year. Galactic Resources purchased the property in south-central Colorado from Anaconda Minerals in 1984. Under a $21 million contract to construct an open pit, heap leach operation, Bechtel Civil & Minerals Inc. directed about 300 construction workers throughout the year. Galactic Resources planned to produce about 120,000 troy ounces of gold and 50,000 troy ounces of silver per year at a production cost below $200 per ounce of gold. No production took place in 1985 but was scheduled to begin about March 1986. The heap leach pad covered 35 acres and was designed to process 17,000 short tons of ore per day, with planned expansion to 105 acres. At 11,000-foot elevation, a 9-month leaching season was projected. Proven ore reserves were estimated at 18 million tons.

The future of Standard Metals' Sunnyside Mine at Silverton, San Juan County, the State's major gold producer in recent years, was in question throughout the year because of Standard Metals' filing for chapter 11 protection under the bankruptcy laws in March 1984. The Sunnyside was profitable, and Standard Metals looked for a merger or sale of the mine. In January, because of low prices and cash-flow problems, Standard Metals reduced operations at the Sunnyside, closing it in March. With this closure, the unemployment rate in San Juan County rose to over 30%, compared with the State average of 5.9%. In August, an agreement was reached with Echo Bay Inc., a subsidiary of Echo Bay Mines Ltd. of Edmonton, Ontario, Canada. Standard Metals was to receive $20 million in cash and retain a 30% net-profit royalty interest. The bankruptcy court approved the sale in November. Echo Bay, which reorganized the operation as Sunnyside Gold Corp., planned to spend about $6 million in refurbishing the mine. Sunnyside had produced an average of 35,000 troy ounces of gold and 330,000 troy ounces of silver in each of the past 3 years. Echo Bay set a production goal for the mine of about 750 tons per day to be reached by mid-1986.

Also in the Silverton area, Gerber Minerals, a subsidiary of Gerber Energy International Inc., budgeted about $650,000 in exploration and development at the Gold King Mine, adjacent to the Sunnyside, and on extensions of the same vein system. Limited production was planned by 1986. P&G and International North American Resources formed a partnership to develop the Sultan Mountain Mine with first production scheduled for 1986. P&G also acquired the old Pride of the West mill in Howardsville. Federal Resources Corp. resumed operations at the Camp Bird Mine near Ouray.

At Cripple Creek, Nerco Minerals, in a joint venture with Silver State Mining Corp., kept the Victor Mine closed because of design and construction problems. Some gold and silver was produced later in the year during testing of new facilities. Cripple Creek and Victor Gold Mining, a joint venture between Texasgulf Minerals and Metals and Golden Cycle Gold, continued exploring portions of the extensive old properties it controlled in the area; the company began heap leaching 3 million tons of old mine dump material from the Cresson Mine on leach pads constructed below the Carlton mill. Hull Mining and Newport Minerals also conducted heap leach operations in the area at the Ruby Pad and the Cameron heap leach site.

In Boulder County, the Gold Hill Limited Venture Partnership of Cosmos Resources of Vancouver, British Columbia, Canada, and the Steen family, completed construction of a 50-ton-per-day mill and preproduction work at the Cash Mine; production began late in the year. Hendricks Mining completed additional exploration and development work at the Cross Mine above Nederland.

At nearby Idaho Springs, Franklin Consolidated Mining reported discovering a large gold-silver ore shoot in the Franklin Mine.

The Crystal Hill Mine near La Garita, Saguache County, operated by Draco Mines Ltd. and Wytana Inc., ceased operation in October, but heap leaching already-mined material continued. Newmont Mining Corp. wrote off $2.2 million, the net book value of plant and equipment at the Idarado Mine in Telluride, and set aside a $1.5 million re-

serve for final closure costs; once one of Colorado's largest base- and precious-metals mines, the Idarado had been closed since 1978. Marathon Gold Corp., Centennial Gold Corp., and Hampton Gold Mining Areas PLC restructured their joint venture operation near Craig but reported no production during 1985. Cobb Resources of Albuquerque, NM, negotiated with Houston Natural Gas Co. (HNG) to acquire HNG's share of their joint venture at the London Mine near Fairplay. Cobb Resources reported discovering high-grade ore at the London Mine, but did not get into production in 1985.

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
1983, total	15	1	1,017,259	63,063	$26,738,712	2,145,616	$24,545,846
1984, total	16	--	903,525	60,010	21,643,088	2,199,888	17,908,540
1985:							
Clear Creek	1	--	W	W	W	W	W
Hinsdale	1	--	W	W	W	W	W
Lake	2	--	W	W	W	W	W
Mineral	2	--	W	W	W	W	W
Ouray	2	--	W	W	W	W	W
Saguache	1	--	W	W	W	W	W
San Juan	1	--	W	W	W	W	W
Teller	1	--	W	W	W	W	W
Total	11	--	[3]944,556	[3]43,301	[3]13,754,953	[3]548,696	[3]3,370,200

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1983, total	W	W	W	W	W	W	W
1984, total	W	W	W	W	W	W	W
1985:							
Clear Creek	W	W	W	W	--	--	W
Hinsdale	W	W	W	W	--	--	W
Lake	W	W	W	W	W	W	W
Mineral	W	W	W	W	--	--	W
Ouray	W	W	W	W	--	--	W
Saguache	--	--	--	--	--	--	W
San Juan	W	W	W	W	W	W	W
Teller	--	--	--	--	--	--	W
Total	W	W	W	W	W	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 are not counted as producing 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 1985, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Amalgamation	W	--	--	--	--
Cyanidation	W	W	--	--	--
Smelting of concentrates	W	506,154	W	W	W
Direct smelting of ore	W	W	W	--	--
Total	[1]43,301	[1]548,696	W	W	W

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

Table 6.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1985, by class of ore or other source material

Source	Number of mines	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[1]	5	736,208	27,067	69,317	W	W	W
Silver	5	W	W	W	W	W	--
Total	10	W	W	W	W	W	W
Lead-zinc	1	W	W	W	W	W	W
Grand total	11	[2]944,556	[2]43,301	[2]548,696	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1]Includes material that was leached.
[2]Includes items indicated by symbol W.

Iron Ore.—Colorado, which contributes a minute fraction of the Nation's total iron ore output, showed a considerable percentage increase over that of 1984. Pitkin Iron Corp.'s Cooper Mine near Ashcroft in Pitkin County was Colorado's only iron ore mine. Ore produced went mainly to cement production.

Iron and Steel.—Colorado's only iron and steel producer, CF&I Steel Corp. of Pueblo, which closed its four blast furnaces and its two basic oxygen furnaces in 1982, was permanently out of basic steelmaking. Two electric furnaces continued operating, making steel out of scrap. During 1982-84, the company cut its operations in half, reducing annual output from 1.9 million short tons of steel products per year to 0.9 million tons. Employment fell from 5,500 in 1981 to about 2,000 by the end of 1985. Most of the CF&I iron ore and coal mining facilities and sand and gravel and limestone pits and quarries were sold. The company became a specialty steelmaker, concentrating on producing tubular goods for the oil industry, rails for railroads, and wire goods. CF&I earned $39.2 million in profits in 1981, lost $23.4 million in 1982, lost $94.2 million in 1983, earned $8.8 million in profits before a $74.8 million writeoff on an unfinished tube mill in 1984, and ended 1985 with a $3.4 million loss. CF&I was the 17th largest steelmaker in the country.

In May, stockholders of Crane Co., CF&I's parent company, voted to spin off CF&I into a separate company. Crane shareholders received two-fifths of a share in CF&I for each share Crane held. Crane had, earlier in the year, sold 13,372 acres of surface and mineral rights CF&I held in southern Colorado to The Anaconda Co. for $5 million.

The newly independent CF&I operated at about 80% of its reduced capacity during the year, including a 1-week shutdown in July. In October, the United Steelworkers of America, representing 1,500 of CF&I's workers, agreed to freeze wages and benefits in an attempt to reduce costs by $2.5 million per month. Also in October, the company announced it would invest $7.2 million in facilities to produce head-hardened rails under license from BHP Steel International of Australia.

Lead.—Although Colorado ranked third among the 10 States producing lead in 1985, its output was less than 2% of the national total. Lead was reported at seven mines, but most of it came from Asarco's Leadville Unit as a coproduct of copper, gold, silver, and zinc. Lead comprised less than 10% of the value of these base and precious metals produced in Colorado. Lead production in Colorado was less than 50% of that produced in 1984. The average price of lead in 1985 was $0.19 per pound.

Molybdenum.—Molybdenum, clearly Colorado's most important nonfuel mineral again in 1985, accounted for nearly 40% of the total value of nonfuel minerals produced. The 45 million pounds of molybdenum produced in Colorado (according to AMAX Inc.'s 1985 annual report) was also nearly 40% of all the molybdenum produced in the Nation that year. Yet, output in the State reflected the continuing glut of molybdenum in the world market as AMAX's two large primary molybdenum mines in the State, Climax and Henderson, were operated at about 50% capacity.

The two mines avoided a prolonged shutdown such as they experienced from September 1982 to January 1984 (Henderson)

and April 1984 (Climax). Nevertheless, both mines were closed for 9 weeks during the year, July 1 to September 3, for maintenance, vacation, and inventory adjustment, and because of lower prices; both reopened with smaller labor forces. Climax employment dropped from 800 to 500, Henderson from 900 to about 800. In the peak production year, 1980, Climax employed 3,000 people and Henderson, 2,000.

Along with a 38% increase in productivity at Climax over that of 1981 and a 32% increase at Henderson, a gradual shift in production from Climax to Henderson took advantage of Henderson's more modern facilities and higher ore grade. Two-thirds came from Henderson (about 28 million pounds of MoS_2) and one-third from Climax (about 17 million pounds of MoS_2), about the same combined output as in 1984. A revised mining plan at Climax resulted in lower proven and probable reserve estimates—241 million short tons (136 million tons in the open pit and 105 million tons underground), compared with 408 million tons in 1984—but at a higher average grade—0.348% molybdenum disulfide in 1985, compared with an average 0.306% in 1984. The change in the mining plan also resulted in a write-off of approximately $17 million in capitalized development costs at Climax. Capital spending at Climax was about $2.3 million in 1985, compared with $2.4 million in 1984.

At Henderson, proven and probable reserves were estimated at 232 million tons averaging 0.375% molybdenum disulfide, not much different from that of 1984. Capital spending at Henderson, however, was $7.7 million in 1985, compared with $1.3 million in 1984.

AMAX transported molybdenum concentrates produced at Climax and Henderson to conversion plants outside the State.

About 44% of molybdenum produced was consumed in alloy steel, where it improved toughness and temperature, wear and corrosion resistance; 22% in stainless steel; 6% in cast iron; 3% in special alloys; and 11% in chemicals and lubricants. The demand for and price of molybdenum was closely related to steel production. Molybdenum prices during the year ranged from about $3.05 to $4.50, with a representative average of about $3.25 per pound of molybdic oxide, compared with a representative average price of about $8.64 in 1981 and spot prices as high as $30 in that year.

Silver.—Silver production in Colorado fell 75% from the 1984 level, to 548,696 troy ounces. The value of silver produced declined more than 80% as prices for the metal continued downward from the 1984 average of $8.14 per ounce. Colorado ranked eighth of 17 States producing silver, with just 1% of national output. Only one of the major silver producing mines in the State remained open throughout the year, Asarco's Black Cloud Mine near Leadville.

The State's major silver producer, Homestake's Bulldog Mountain Mine at Creede, closed at the end of January because low silver prices made it uneconomical to continue operation; the mine did not reopen during the year. About 97 of 114 workers, one-sixth of the population of Creede, were laid off. It was the first total shutdown of the mine since the beginning of the Bulldog project in 1963. The Bulldog Mine produced about 1.5 million troy ounces of silver in 1980, 1.4 million in 1981 and 1982, 1.3 million in 1983, and slightly less than that in 1984. With production costs of $7.50 to $8.00 per ounce, it was uneconomic to operate with silver prices at about $6 per ounce.

The Sherman Mine near Leadville, operated by Hecla under lease agreement with Leadville Corp., was shut down in September 1984 and not reopened in 1985. The Leadville Corp. agreed to purchase back Hecla's lease on the Sherman Mine for $1.5 million. Hecla, or Day Mines Inc., which had merged with Hecla, had operated the mine on a lease basis since 1981 for 60% of the profits produced. The Sherman Mine had been one of the State's leading silver mines since the late 1970's, reportedly producing as much as 1 million ounces per year. Leadville Corp. also purchased back Asarco's share of their joint venture at the Resurrection No. 2 Mine, also near Leadville.

The fourth of the larger silver producing mines in Colorado, Standard Metals' Sunnyside Mine at Silverton, was closed in March 1985 and did not reopen during the year. The closure of the Sunnyside Mine was related to the bankruptcy and cash-flow problems of Standard Metals. Toward the end of the year, the mine was sold to Echo Bay Mining Co. of Vancouver, British Columbia, Canada, which prepared to reopen the mine in 1986.

North American Power Petroleum Inc., a Canadian firm, bought the Caribou Mine above Nederland in August 1983, and Hendricks Mining and Harrison Western Corp. were readying the operation for pro-

duction. Low silver prices, however, forced the closure in March 1985 before it could be brought into full production.

The bleak silver production picture in 1985 was brightened somewhat by encouraging exploration results, which seemed to presage future production, at least when the price of silver improves.

Homestake continued exploring and developing a prospect at the Equity Mine property 8 miles northwest of its Bulldog Mountain Mine. Homestake began drilling on the property in 1983, drove a decline and production tunnel in 1984, and began drifting along the Amethyst vein system to sample and test the ore. Although no conclusions were announced, the company acquired control of 10,000 to 15,000 acres in the area and was making a major investment in developing the property.

Also in the Creede area, Pioneer Nuclear and MECO were blocking out defined ore bodies on the Amethyst vein system northwest of Creede, following 2 years of exploration at the Commodore Mine. MECO controlled extensive mining property in the Creede area, including property adjoining the Equity Mine. MECO and the Santa Fe Mining Co., a subsidiary of the Santa Fe Railroad Co., formed a joint venture to explore the Alpha-Corsair vein west of Creede. Crown Resources of Denver and joint venture partner Sutton Resources completed purchasing claims around the Equity Mine.

At Leadville, Leadville Silver and Gold entered into a joint venture with Golden Gate Minerals Inc. to acquire a majority interest in mining properties controlled by Windsor Resources Inc. in the St. Kevin Mine, Lake Creek, and Montezuma mining districts, where average values of 22 ounces of silver per short ton were reported. Great West Gold and Silver Inc. signed options to acquire silver claims in the nearby Sugarloaf District.

Other silver developments included the Alma Queen Mine near Fairplay, Chiwawa Mines Inc.'s Mount Bross property near Alma, and the Emma No. 2 Mine on Aspen Mountain at Aspen.

Tin.—A relatively small amount of tin was extracted as a byproduct of molybdenum production at the Climax Mine. Climax ore contained about 0.002% tin.

Tungsten.—Colorado was the second of two States producing tungsten in 1985. Tungsten was produced in Colorado as a byproduct of molybdenum production at the Climax Mine near Leadville; output was affected by the reduced operating schedules at that mine in 1984 and 1985 and the closure of the mine in 1983. In its 1985 annual report and 10K Annual Report to the Securities and Exchange Commission, AMAX, owner and operator of the Climax Mine, noted production of about 35,000 short ton units of tungsten concentrate containing about 500,000 pounds of tungsten in 1985, compared with 29,000 short ton units containing 400,000 pounds of tungsten produced in 1984. Average price was $61.45 per short ton unit of tungsten concentrate in 1985 and $73.63 in 1984.

Tungsten—noted for its unique electronic properties, high melting point, and high density—was used primarily in tungsten-carbide tools, lamp filaments, and electrical contacts. Climax-produced tungsten was sold principally in the United States.

The Fremont County Board of Commissioners granted a permit to Strategic Earth Resources Corp. of Canon City to mine tungsten south of Texas Creek. Extraction of up to 70,000 tons of tungsten annually was planned when the mine becomes operational.

Vanadium.—No vanadium was recovered in Colorado in 1985. Colorado had been the Nation's leading vanadium producer, a steel-alloying metal, in 1984 and for a number of recent years. Vanadium had long been produced as a coproduct with uranium from sandstone ores, mostly mined in the Uravan Mineral Belt on the Colorado Plateau in western Colorado. The U.S. Department of Energy estimated almost 14 million short tons of ore averaging 1.29% vanadium pentoxide (V_2O_5) and 0.25% uranium oxide (U_3O_8) were mined in the mineral belt between 1947 and 1979.

Uranium-vanadium mining and milling activity in western Colorado, as elsewhere, declined rapidly since 1980 as the price and demand for uranium fell. The decline of steelmaking in the United States during the same period contributed to the fall in price and production of vanadium. The Umetco Minerals Corp., a subsidiary of Union Carbide Corp., Uravan mill and its Rifle vanadium-finishing facility, major producers of vanadium in the past, were closed throughout the year. The Uravan mill had been in continuing hearings with the Colorado Health Department since 1975 seeking a renewal of its operating license. In early 1985, the State of Colorado sued Umetco over plans to clean up alleged uranium

contamination around the Uravan mill. The site was also cited as one of the Superfund environmental cleanup targets in Colorado. About 100 citizens of the small town of Uravan turned out for a celebration in May honoring Union Carbide for its role in the town's history.

Colorado's other uranium-vanadium mill, the Cotter Corp. mill at Canon City, closed since January, was reopened in September to process ore to meet its contracts for U_3O_8. Its vanadium circuit, however, remained closed. Ore processed was from Cotter's Schwartzwalder Mine near Golden in Jefferson County, whose ore did not contain vanadium. The State sued Cotter in 1983 over possible uranium contamination around its millsite.

The number of uranium miners employed in Colorado fell to about 10% of its peak number. Nationwide, about 2,000 of a peak number of 22,000 uranium miners were still employed in the industry. It was estimated that only 3 of 25 major uranium mills in the Nation operated in 1985.

Zinc.—Zinc production in Colorado was 34% lower in 1985 than in 1984 and value of production was 45% lower as the price of zinc fell to an average $0.40 per pound. Although Colorado ranked fifth among the eight States producing zinc, its contribution to the national total was relatively small. Zinc was produced as a coproduct with other base and precious metals in Colorado's complex ores. Three mines in the State reported zinc output, but most of the production was from one mine, Asarco's Leadville Unit, the Black Cloud Mine. Zinc was second only to gold in value of base and precious metals mined in Colorado, with 34% of that total.

Environmental controversy continued to embroil the Eagle Mine at Gilman, one of the Nation's major zinc producers during the 100 years prior to its closure in 1981. The Colorado Department of Health filed a $50 million lawsuit against Gulf + Western Industries Inc. and against The New Jersey Zinc Co., former owners of the mine, for degrading water quality in the Eagle River, a result of pollution from the mine and tailings ponds. The old operation is on the Superfund list of sites requiring environmental cleanup.

INDUSTRIAL MINERALS

Cement.—Portland cement shipments declined more than 10% from that of 1984; masonry cement, more than 22%. Two companies produced cement in Colorado, Ideal Basic Industries Inc. at its portland cement plant in Fremont County and Boettcher plant in Larimer County, and Southwestern Portland Cement Co., a subsidiary of Southdown Inc., at its Lyons plant in Boulder County. Ideal produced more than two-thirds of the total, mostly at its portland plant. The amount of masonry cement produced was relatively small.

More than two-thirds of total production was sold to ready-mixed concrete companies; a little more than 10% went to concrete product manufacturers; and the balance was sold to highway contractors, building material dealers, and other contractors. Most was shipped in bulk, by truck, directly to the purchaser.

Ideal's portland plant had three wet-process kilns with electric-precipitator pollution control and a combined productive capacity of about 885,000 short tons annually. Ideal's Boettcher and Southwestern's Lyons plants each had one dry-process kiln with glass-bag pollution control and annual productive capacities of about 460,000 tons and 430,000 tons, respectively.

At yearend, financially troubled Ideal had negotiated agreements to sell both its U.S. and Canadian potash operations and a temporary "stand still" agreement with its lenders on payments on $385 million in unsecured debt.

Clays.—Colorado was a relatively small producer of clay, with about one-half of 1% of the Nation's total. More than 90% of production was common clay. Some fire clay and a very small amount of bentonite were also produced. Clay was produced in seven counties—80% in Douglas, Jefferson, and Pueblo Counties. Leading companies were Robinson Brick, Summit Pressed Brick & Tile Co., and Lakewood Brick and Tile Co.

Gem Stones.—Colorado again produced about 1% of the Nation's gem stones, including amethyst, aquamarine, smokey quartz, turquoise and a small number of micrometer-size diamonds. The "Mineralogical Record" (V. 16, No. 3, May-June 1985) featured Colorado gem stones.

Gypsum.—Three companies reported crude gypsum output in Colorado in 1985: Eagle Gypsum Ltd. in Eagle County, Genstar Gypsum Products Co. in Fremont County, and Quad Honstein Joint Venture in Larimer County. Total gypsum produced declined about 20%. Only Genstar reported also calcining gypsum. Colorado production was less than 2% of the national total.

Ramo Corp. reportedly began mining gypsum near the town of Gypsum in mid-April under a 45,000-short-ton-per-year contract with Ideal, which planned to use the material in cement manufacture. Eagle County commissioners approved plans for a gypsum-based drywall plant to be built near Gypsum. Proposed by Eagle Gypsum, the plant would begin production in 1987 if plans materialize.

Lime.—Quicklime production was reported by one company in 1985, Calco Inc., in Chaffee County. The quantity of lime produced in the State was 65% less than in 1984. The principal reason for the lower production was absence from the industry of The Great Western Sugar Co., which had produced lime for many years to use in the processing of sugar beets. Hunt International Resources Co. of Dallas, parent company of Great Western, put the company up for sale at the end of 1984, including 10 properties in Colorado. A decline in sugar use and competition from artificial sweetners had affected the market for sugar from sugar beets. A farmer cooperative hoped to buy the company.

Nahcolite.—Industrial Resources Inc. and Northern Natural Resources Co. received permits and completed design work on a pilot plant to solution mine nahcolite in the Piceance Creek Basin of northwestern Colorado. Nahcolite is a naturally occurring sodium bicarbonate. The pilot plant could produce 10,000 to 13,000 short tons per year, whereas a full-scale conventional plant would produce 50,000 to 120,000 tons per year over a 30-year period and employ 80 to 100 workers. Industrial Resources held 8,359 acres of Federal sodium mineral leases with an estimated nahcolite resource of 6 billion tons.

The company produced 10,000 tons of nahcolite between November 1983 and February 1984 for testing. Initial markets would be as animal feed additives, drilling muds, fire extinguishers, and other industrial uses. A major future market was expected to be removal of sulfur dioxide from smokestack emissions. According to the companies involved, sodium bicarbonate could be used to remove 80% of sulfur dioxide from coal-burning plant stacks at 65% of the cost of conventional wet scrubbers and spray dryer systems. Nahcolite in the Piceance Creek Basin is interbedded with oil shale and dawsonite (a sodium-aluminum-bearing material). The U.S. Bureau of Land Management was conducting an environmental impact study of the project. Another company, Multi-Mineral Corp., experimented with nahcolite mining in the same general area several years ago.

Peat.—Four companies in four counties reported peat production: Colorado Peat Industries in Boulder County, Glacier View Peat Corp. in Chaffee County, Universal Peat Co. in Park County, and Hyponex Corp. in Teller County. The volume of production increased more than 10% over that of 1984, and the value of that production increased more than 22%. Universal Peat was the major producer. About two-thirds of the material produced was shipped in bulk.

Perlite.—Crude perlite production was reported by one company, Persolite Products Inc. at its Rosita Mine in Custer County. Although the volume of production remained about the same as in 1984, the price was lower. Two companies produced expanded perlite, Persolite at its plant at Florence and Grefco Inc. at its Building Products Div. plant at Antonito. The expanded product was used as filter aid, cavity-fill insulation, concrete aggregate, fillers, horticultural aggregate, low-temperature insulation, and plaster aggregate.

Pyrites.—AMAX produced pyrite as a byproduct of molybdenum at its Climax Mine near Leadville. Three to five pounds of pyrite was removed from each short ton of ore processed at the Climax mill. Among other uses, pyrite was used in coloring glass.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Colorado ranked eighth in the Nation in estimated construction sand and gravel production but accounted for less than 3% of total national production.

Industrial.—Industrial sand and gravel was produced at two sites in Colorado, by Cherry Creek Sand Specialties Inc. in Arapahoe County and Colorado Silica Sand Inc. in El Paso County, both small operations. Industrial sand output, a minor portion of total sand and gravel produced, fell significantly in 1985. Industrial sand was used mostly as a sandblasting medium. Small amounts were used for roofing granules and filtration.

Stone.—Stone production is surveyed by

the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

The quantity of stone produced in Colorado in 1985 was about 4% greater than in 1983, the last year stone was canvassed. All but an insignificant amount was crushed stone. Twenty-six companies produced crushed stone at 31 quarries in 11 counties. Three companies produced dimension stone, all in Larimer County. Jefferson County was the source of nearly one-half the crushed stone output; Fremont County, more than one-fourth of the total.

The major crushed stone producers, in order of output, were Ideal Basic and Mobile Premix Concrete Inc., followed by Cooley Gravel Co. (J. L. Shiely Co.), Southwestern Portland Cement Co., and Asphalt Paving Co. The top three companies produced more than one-half the State total; the top five companies accounted for nearly 80% of the total output.

About one-half of stone produced was granite; more than 40% was limestone. Most of the limestone output was used in cement manufacture. Primary uses of granite were for concrete aggregate, bituminous aggregate, and dense road base. Sandstone was used mainly for riprap, dense road base, and cement manufacture.

Table 7.—Colorado: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	135	695
Combined coarse and fine aggregates:		
Graded road base or subbase	443	1,849
Other construction[2]	1,498	5,459
Chemical and metallurgical: Cement manufacture	2,656	7,809
Special:		
Other miscellaneous[3]	4	11
Other unspecified[4]	2,300	10,107
Total	[5]7,037	25,930

[1]Includes granite, limestone, sandstone, traprock, volcanic cinder and scoria, and miscellaneous stone.
[2]Includes concrete aggregate (coarse), bituminous aggregate (coarse), bituminous surface-treatment aggregate, unpaved road surfacing, filler stone, terrazzo and exposed aggregate, crusher run (select material or fill), stone sand (bituminous mix or seal), fine aggregate screen, coarse aggregate (large), coarse aggregate (graded), combined coarse and fine aggregates, and other construction and maintenance uses.
[3]Includes waste material.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data do not add to total shown because of independent rounding.

Sulfur.—Continental Oil Co. recovered elemental sulfur from acid gases at its petroleum refinery in Adams County near Denver. Elemental sulfur is not included in table 1 because it is considered a byproduct.

Monex Engineering Inc. of Calgary, Alberta, Canada, in a joint venture with Starfire Industries of Vancouver, British Columbia, Canada, announced plans to develop old sulfur beds on Trout Creek, 17 miles southwest of Creede. An $11 million open pit mine and plant employing 50 to 60 people was proposed. Reserves at the site were estimated to be 2 million metric tons, allowing 5 to 6 years of operation. Output would be used for fertilizer. The site, mined as early as the 1880's, had not been worked since World War I. It is on National Forest Service land adjacent to the Weminuche Wilderness.

Vermiculite (Exfoliated).—W. R. Grace & Co. exfoliated 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. Other uses included concrete aggregate, horticulture agriculture, loose-fill insulation, and plaster aggregates.

[1]State Mineral Officer, Bureau of Mines, Denver, CO.

Table 8.—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.
Southwestern Portland Cement Co.[1]	1111 South Colorado Blvd. Denver, CO 80222	Plant	Boulder.
Clays:			
Lakewood Brick and Tile Co	1325 Jay St. Lakewood, CO 80214	Mines and plant	Jefferson.
G. W. Parfet Estate Inc	1213-1/2 Washington Ave. Golden, CO 80401	Mines	Do.
Robinson Brick Co	Box 5243 Denver, CO 80217	Mines and plant	Douglas, Elbert, El Paso, Jefferson.
Summit Pressed Brick & Tile Co	Box 533 Pueblo, CO 81002	Mines	Pueblo.
Gold:			
ASARCO Incorporated[2]	Box 936 Leadville, CO 80461	Mine and mill	Lake.
Nerco Minerals Co	2917 County Rd. 84 Victor, CO 80860	Mine	Teller.
Standard Metals Corp.[2]	Box 247 Silverton, CO 81433	Mine and plant	San Juan.
Gypsum:			
Genstar Gypsum Products Co	1153 State Hwy. 120 Florence, CO 81226	do	Fremont.
Iron ore:			
Pitkin Iron Corp	105 West Adams St. Chicago, IL 60603	Mine	Pitkin.
Lime:			
Calco Inc	400 East Railroad Box 1044 Salida, CO 81201	Mine and plant	Chaffee.
Molybdenum:			
AMAX Inc.[3]	13949 West Colfax Ave. Golden, CO 80401	Mines and mills	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.
Stone:			
Asphalt Paving Co	14802 West 44th Ave. Golden, CO 80401	Quarries	Jefferson.
Cooley Gravel Co. (J. L. Shiely Co.)	Box 5485 Terminal Annex Denver, CO 80217	Quarry	Do.
Mobile Premix Concrete Inc	Box 5183 T.A. Denver, CO 80217	do	Do.

[1]Also stone.
[2]Also copper, lead, silver, and zinc.
[3]Also pyrites, tin, and tungsten.

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] and R. J. Altamura[2]

The value of nonfuel mineral production in Connecticut in 1985 was $72.4 million. The apparent decline of $7.3 million in the value of production, primarily for crushed stone, appeared incongruent with the increased demand by the construction industry for that mineral commodity. Total employment and employee hours worked in the State's crushed stone industry both increased 21% from 1983 to 1985. Another indicator of demand for stone—housing starts—increased 56% for the same period. Reported crushed stone production and value declined 5% and 4%, respectively, during those same years. Uncharacteristically low reporting by producers probably was the reason for this apparent difference.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	99	$565	106	$632
Lime do.	W	W	--	--
Sand and gravel (construction) do.	6,718	22,817	e6,000	e21,000
Stone:				
Crushed do.	e8,300	e49,400	7,277	43,937
Dimension do.	e18	e1,080	20	1,285
Combined value of feldspar, gem stones, mica (scrap), sand and gravel (industrial), and value indicated by symbol W	XX	5,834	XX	5,532
Total	XX	79,696	XX	72,386

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

Table 2.—Nonfuel minerals produced in Connecticut in 1984, by county

County	Minerals produced in order of value
Fairfield	Sand and gravel.
Hartford	Sand and gravel, clays.
Litchfield	Sand and gravel, lime.
Middlesex	Feldspar, sand and gravel, mica, clays.
New Haven	Sand and gravel.
New London	Do.
Tolland	Do.
Windham	Do.
Undistributed[1]	Stone (crushed and dimension), gem stones.

[1]Data not available by county for minerals listed.

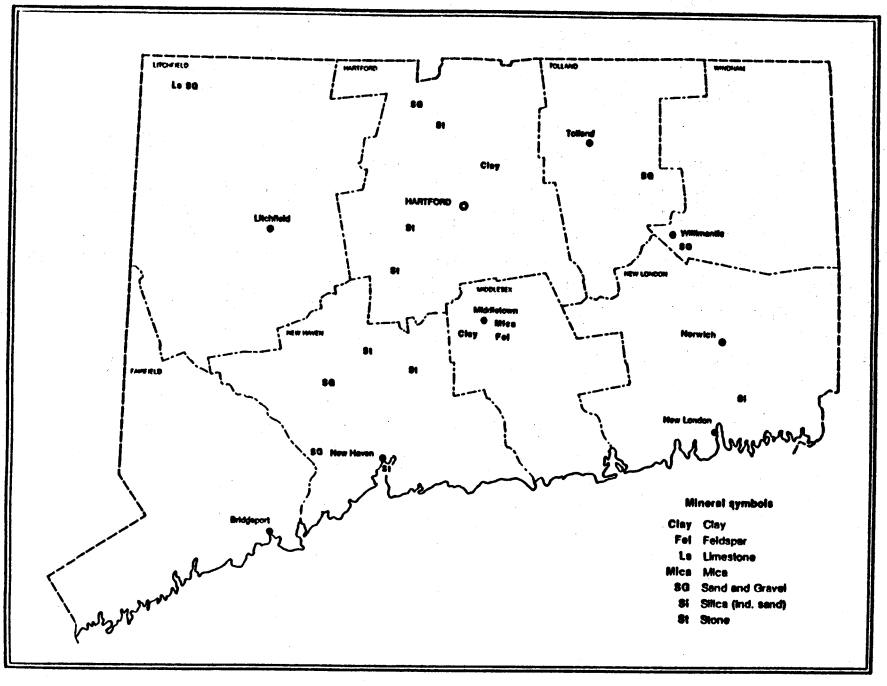

Figure 1.—Principal mineral producing localities in Connecticut.

Table 3.—Indicators of Connecticut business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	3,140	3,155	3,174
Total civilian labor force	do.	1,612	1,672	1,711
Unemployment	percent	6.0	4.6	4.9
Employment (nonagricultural):				
Mining total[1]	thousands	1.5	1.5	1.6
Nonmetallic minerals except fuels[2]	do.	1.0	1.0	1.1
Manufacturing total	do.	403.4	415.3	410.6
Primary metal industries	do.	16.3	16.1	14.6
Stone, clay, and glass products[2]	do.	6.2	6.1	5.8
Chemicals and allied products	do.	22.0	22.4	22.6
Petroleum and coal products[2]	do.	.3	.3	.2
Construction	do.	54.1	60.8	66.0
Transportation and public utilities	do.	61.7	66.6	68.8
Wholesale and retail trade	do.	312.8	332.8	349.8
Finance, insurance, real estate	do.	117.4	123.3	130.3
Services	do.	313.8	335.0	352.5
Government and government enterprises	do.	181.9	185.2	188.9
Total	do.	[3]1,446.5	1,520.5	1,568.5
Personal income:				
Total	millions	$48,046	$53,109	$57,408
Per capita		$15,299	$16,835	$18,089
Hours and earnings:				
Total average weekly hours, production workers		41.3	42.5	41.9
Total average hourly earnings, production workers		$8.8	$9.2	$9.6
Earnings by industry:				
Farm income	millions	$119	$136	$98
Nonfarm	do.	$33,700	$37,628	$41,113
Mining total	do.	$161	$196	$194
Nonmetallic minerals except fuels	do.	$24	$27	$30
Oil and gas extraction	do.	$104	$138	$124
Manufacturing total	do.	$11,051	$12,083	$12,658
Primary metal industries	do.	$491	$537	$496
Stone, clay, and glass products	do.	$154	$155	$152
Chemicals and allied products	do.	$810	$855	$928
Petroleum and coal products	do.	$21	$8	$9
Construction	do.	$1,986	$2,341	$2,535
Transportation and public utilities	do.	$1,788	$1,990	$2,170
Wholesale and retail trade	do.	$5,182	$5,755	$6,399
Finance, insurance, real estate	do.	$2,904	$3,189	$3,703
Services	do.	$6,774	$7,796	$8,635
Government and government enterprises	do.	$3,734	$4,150	$4,681
Construction activity:				
Number of private and public residential units authorized[4]		15,672	17,810	24,545
Value of nonresidential construction[4]	millions	$655.2	$810.1	$932.8
Value of State road contract awards	do.	$149.4	$331.4	$404.5
Shipments of portland and masonry cement to and within the State[5]	thousand short tons	641	775	887
Nonfuel mineral production value:				
Total crude mineral value	millions	$71.2	$79.7	$72.4
Value per capita		$23	$25	$23

[p]Preliminary. [r]Revised.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample, 1984 and 1985 data based upon 17,000-place sample.

[5]Has no cement producing plants.

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 Connecticut General Assembly adopted a statewide water resources plan with enactment of Public Act 85-535. The act included a structure for coordination and regulation of supply, quality, service, and planning.

Also enacted by the 1985 legislature was Public Act 85-88, establishing a registration program and standards for oil and gas exploration. 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 1985 General Assembly." The index lists measures by bill number and includes amendments to existing statutes.[3]

An order to cease and desist from using a parcel of land for removal of peat was upheld in State Superior Court (A. B. Douglas Thibodeau, et al., versus Marlborough

Zoning Board of Appeals, Superior Court, Judicial District of Hartford-New Britain, No. CV83-0279409, Dec. 20, 1985). The peat mining project was initiated in 1982 but was shut down shortly after its start by Marlborough zoning officials. The Court's decision reflects the overall impact of local control over the State's mining industry.

The Natural Resources Center and the Connecticut Geological and Natural History Survey continued programs to collect, interpret, and disseminate information on Connecticut's natural resources. For the second year, the Connecticut Survey, in conjunction with the U.S. Geological Survey (USGS), worked on the development of a statewide geographic information system that includes data bases for geology, soils, drainage basins, and land use. This system was demonstrated by the Connecticut Survey when it hosted the 1985 American Association of State Geologists Meeting.

The Connecticut Survey continued bedrock and surficial mapping programs in cooperation with the USGS. A new State bedrock geological map was published, and a surficial materials map was open-filed. Side-looking airborne radar (SLAR) lineament mapping of the State was completed and open-filed. Geological interpretations of the lineament mapping and subsequent field checking resulted in the discovery of a previously unidentified fault in eastern Connecticut (the Snake Meadow Brook Fault). Continuing research utilizing SLAR data was focused on the relationship between bedrock ground water and radar lineaments (possible fracture zones). The hypothesis that ground water yields increase near zones of higher fracture permeability was tested.

A layman's guide to the geology of Connecticut, "The Face of Connecticut," which explains the geology to the general public, was published.[4] A bedrock mines and quarries map (historic and present) was expected to be published in 1986.

Other Survey activities included geophysical research on Long Island Sound including seismic reflection profiling of the western one-third of Long Island Sound, completing a total of 404 miles of seismic line as part of a larger study to understand the stratigraphy, geologic history, and mineral resources. Part of the work involves grants from the U.S. Minerals Management Service concerning offshore nonfuel minerals such as sand and gravel. In addition, the Connecticut Survey was involved in the proposed compilation of a bedrock geological map of southernmost New England (to include Connecticut, Massachusetts, and Rhode Island) at a scale of 1:250,000.

Also during the year, Texaco Oil Co. conducted seismic surveys for oil and gas in the Connecticut Valley as part of a preliminary investigation of the Mesozoic age Hartford Basin.

The University of Connecticut announced what was considered the first documented discovery of gold in the State's history. Traces of gold were found in several quartz samples near the town of East Hampton. The area near where the gold was found includes both private and State forest land.

Trumbull town officials retained mineral rights for property exchanged with a development company. The area near Long Hill was mined for tungsten between 1890 and 1916. The deposit was also worked for copper, lead, and silver with the mineralized rock ranging in grade from about 0.17% to 0.21% WO_3.[5]

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Clays.—In 1985, Connecticut's clay industry operated at full capacity, producing 106,000 short tons of clay, 7,000 tons more than in 1984. Two companies mined glacial lake clays and selected Mesozoic shales for use in brick manufacture.

K-F Brick Co. mined clay at its East Windsor Hill brickworks and shale near Suffield. About 80% of the fuel used in brick manufacture was low-sulfur coal shipped from eastern Kentucky, and about 20% was natural gas. The company operated 11 months in 1985 as allowed by a State permit that K-F received when it began burning coal about 2 years ago. Because of the low-sulfur coal used, the firm could operate year-round and still be in compliance, but instead used the month for maintenance. If the company had been unable to burn coal or some other cheaper fuel, it would have considered closing.

The firm experimented with using locally purchased crushed traprock in lieu of shale in the brick manufacture, thus reducing machinery wear and tear and operation costs. This alternative saved transportation

costs because the shale had to be trucked from Suffield about 15 miles from the brick plant. Also, 11 of the State's 12 traprock quarries were in the central part of the State, as was K-F.

The State's other producer, The Michael Kane Brick Co., mined clay and manufactured brick at its operations in Middletown.

Feldspar.—Connecticut ranked a distant second nationally in feldspar production. North Carolina, the leading producing State, accounted for about 70% of the total domestic output of 700,000 short tons.

The Feldspar Corp. mined feldspar from pegmatites at the White Rocks (Middletown) and the Hale and Gotta-Apple Orchard (Portland) quarries. The ore was ground and concentrated at a plant near Middletown, Middlesex County, at the site of the White Rocks Quarry. The feldspar was beneficiated by froth flotation and for use by the glass and ceramics industries.

Production at Feldspar's Middletown operations remained about the same as in 1984. The decline in demand for feldspar used in glassmaking was offset by the improved conditions in the housing and construction-related markets. In those industries, feldspar was used in the manufacture of ceramic fixtures such as toilets and in the production of fiberglass.

Gem Stones.—Typically gem stones are collected from pegmatites and from areas of hydrothermal mineralization. Individual collectors and mineral clubs recovered mineral specimens in quarries and abandoned minesites, primarily in the central part of the State.

Lime.—Production ceased in 1984 with the closing of Pfizer Inc.'s lime plant in Canaan. Historic data show lime manufacturing in Connecticut began in the early 1900's and peaked in 1910 when 94,000 short tons of lime was manufactured.[6] Through the 1970's and early 1980's, production averaged about 25,000 tons annually.

Mica.—The Feldspar Corp. recovered crude mica as a byproduct of feldspar mining operations in Middletown, Middlesex County. Production was about the same as in 1984. The mica was marketed as a filler and as an additive in well drilling mud.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

In 1985, output of construction sand and gravel declined about 700,000 short tons to 6 million tons. For the 10-year period 1971-80, production averaged 7.2 million tons per year. From 1981 through 1985, annual production averaged about 5.8 million tons. Sand and gravel was mined from numerous glacial drift deposits throughout the State.

Industrial.—Ottawa Silica Co. produced industrial sand at Ledyard in New London County. Ottawa was the State's only producer.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Hartford and New Haven Counties accounted for most of the State's output with lesser amounts produced in Litchfield and Windham Counties. The dominant crushed stone produced was traprock (basalt) quarried from Mesozoic lava flows and shallow intrusions, which are found in the central part of the State. Situated in a belt extending from west-central Hartford County to north-central New Haven County are 11 of the State's 12 active traprock quarries.

Limestone was mined in western Connecticut at four quarries and used as agricultural lime, filler, and decorative stone. In 1985, Red Wing Properties Inc. purchased and reopened USG Corp.'s Falls Village limestone quarry, which had been inactive since 1971. Pfizer, the State's leading limestone producer, also manufactured calcium metal at its Canaan operations.

Table 4.—Connecticut: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,239	7,518
Bituminous aggregate, coarse	1,355	7,917
Combined coarse and fine aggregates:		
Terrazzo and exposed aggregate	2	W
Other construction materials[2]	2,805	17,462
Agricultural: Agricultural limestone	28	W
Chemical and metallurgical:		
Cement manufacture	46	93
Lime manufacture	26	54
Flux stone	(3)	W
Special:		
Whiting or whiting substitute	106	156
Other fillers or extenders	34	67
Other miscellaneous[4]	427	2,818
Other unspecified[5]	1,210	7,856
Total[6]	7,277	43,937

W Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."
[1]Includes limestone and traprock.
[2]Includes macadam, graded road base or subbase, bituminous surface-treatment aggregate, riprap and jetty stone, stone sand (concrete), and crusher run (select material or fill).
[3]Less than 1/2 unit; included with "Other miscellaneous uses."
[4]Includes chemicals, uses not specified, and uses indicated by symbol W.
[5]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[6]Data may not add to totals shown because of independent rounding.

Table 5.—Connecticut: Dimension stone

Year	Quantity (thousand short tons)	Value (thousands)	Number of quarries
1981	19	$910	7
1982[e]	20	1,046	NA
1983	18	1,028	6
1984[e]	18	1,080	NA
1985	20	1,285	6

[e]Estimated. NA Not available.

Dimension.—Dimension granite was quarried in New Haven County, and dimension granite and sandstone (quartzite) were quarried in Tolland and Windham Counties. Most of the stone was sold as irregular-shaped stone, rough blocks, and cut stone.

Beginning in the early 1980's, architectural trends, which influence the selection of building materials, moderated from strong emphasis on steel and glass, somewhat reviving the dimension stone industry in Connecticut. Average annual output has doubled since the late 1970's.

[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.
[2]Geologist, State Geological and Natural History Survey of Connecticut, Department of Environmental Protection, Hartford, CT.
[3]Greater Hartford Chamber of Commerce. The Classified Index of Legislation Enacted by the 1985 General Assembly. State Legislation Committee, Aug. 1985, 28 pp. For more information, write to the Greater Hartford Chamber of Commerce, 250 Constitution Plaza, Hartford, CT 06103.
[4]Bell, M. The Face of Connecticut. CT Geol. and Nat. Hist. Surv. Bull. 110, 1985, 196 pp.
[5]Fisher, J. O. Report on the Geology of the Old Tungsten Mine Near Trumbull, Connecticut. CT State Geologist OFR, Univ. CT, Storrs, CT, 1942.
[6]Coons, A. T. Lime. Ch. in Mineral Resources of the United States, Nonmetallic Products. U.S. Geol. Surv., v. 2, 1910, p. 511.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
The Michael Kane Brick Co	654 Newfield St. Middletown, CT 06457	Pit and mill	Middlesex.
K-F Brick Co	Box 375 East Windsor Hill, CT 06028	Mine and mill	Hartford.
Feldspar:			
The Feldspar Corp.[1]	Box 99 Spruce Pine, NC 28777	Mines and plant	Middlesex.
Sand and gravel:			
Construction:			
Dan Beard Inc	Box 71, Mary St. Shelton, CT 06484	Pit and plant	New Haven.
Connecticut Sand & Stone Corp	7 West Main St. Plainville, CT 06062	Pit and plants	Hartford and Litchfield.
D.B.D. Inc	Box 62, Sandcut Rd. Brookfield, CT 06805	Pit and plant	Fairfield.
Roncari Industries Inc.[2]	1776 South Main St. East Granby, CT 06026	do	Hartford.
Tilcon Inc.[2]	Box 67, 909 Foxen Rd. North Branford, CT 06471	Pits and plants	Do.
Industrial:			
Ottawa Silica Co., Connecticut Div	Box 577 Ottawa, IL 61350	Pit and plant	New London.
Stone:			
Crushed and broken:			
Edward Balf Co	Box 11190 Newington, CT 06111	Quarry	Hartford.
O&G Industries Inc	112 Wall St. Box 907 Torrington, CT 06790	Quarries	Litchfield and New Haven.
York Hill Trap Rock Quarry Co	Westfield Rd. Meriden, CT 06450	Quarry	New Haven.
Dimension:			
Box Mountain Quarries Inc	1111 Mott Hill Rd. South Glastonbury, CT 06073	do	Tolland.
Castellucci & Sons Inc	West River St. Providence, RI 02904	do	New Haven.
Wayne C. Williams General Construction Inc.	174 Kozley Rd. Tolland, CT 06073	do	Tolland.

[1]Also crude mica and industrial sand.
[2]Also traprock.

The Mineral Industry of Delaware

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

By William A. Bonin[1]

Magnesium compounds, which were extracted from seawater, construction sand and gravel, and greensand, were the only mineral commodities produced in Delaware in 1985. The value of magnesium compounds, which was large relative to the State's total crude mineral value, is excluded from the State's total to prevent disclosure of company proprietary data.

Chrome ore, dolomite, gypsum, ilmenite, magnesium and manganese oxides, perlite, and evaporated salt were shipped into the State for processing into higher value-added products. Aluminum, iron and steel, and road salt were also received at the Port of Wilmington.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Greensand thousand short tons	1	$18	2	$29
Sand and gravel (construction) do	1,003	2,795	e1,300	e4,000
Total[2]	XX	2,813	XX	4,029

eEstimated. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Partial total; excludes the value of magnesium compounds, which must be concealed to avoid disclosing company proprietary data.

Table 2.—Indicators of Delaware business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	606	614	622
Total civilian labor force	do.	296	308	315
Unemployment	percent	8.1	6.2	5.3
Employment (nonagricultural):				
Mining total[1]	thousands	0.1	0.1	0.1
Manufacturing total	do.	68.2	70.6	72.1
Primary metal industries	do.	1.7	1.8	1.8
Stone, clay, glass products[1]	do.	.8	.9	.8
Chemicals and allied products	do.	30.8	31.9	31.6
Petroleum and coal products[1]	do.	1.2	1.1	1.1
Construction	do.	16.1	16.9	17.8
Transportation and public utilities	do.	11.9	11.9	11.9
Wholesale and retail trade	do.	58.3	61.9	64.6
Finance, insurance, real estate	do.	15.5	17.1	19.5
Services	do.	52.6	57.7	62.3
Government and government enterprises	do.	43.4	43.7	44.8
Total[2]	do.	266.1	280.0	293.0
Personal income:				
Total	millions	$7,617	$8,316	$8,876
Per capita		$12,571	$13,555	$14,272
Hours and earnings:				
Total average weekly hours, production workers		40.6	41.5	41.1
Total average hourly earnings, production workers		$9.2	$9.3	$9.8
Earnings by industry:				
Farm income	millions	$98	$154	$121
Nonfarm	do.	$6,076	$6,555	$7,092
Mining total	do.	$20	$25	$23
Manufacturing total	do.	$2,264	$2,429	$2,595
Primary metal industries	do.	W	W	W
Stone, clay, glass products	do.	$3	$4	$5
Chemicals and allied products	do.	$1,303	$1,369	$1,454
Petroleum and coal products	do.	$66	$68	$67
Construction	do.	$519	$561	$586
Transportation and public utilities	do.	$328	$344	$349
Wholesale and retail trade	do.	$788	$850	$903
Finance, insurance, real estate	do.	$304	$342	$432
Services	do.	$971	$1,069	$1,208
Government and government enterprises	do.	$862	$914	$975
Construction activity:				
Number of private and public residential units authorized		3,648	4,364	4,636
Value of nonresidential construction	millions	$136.6	$239.9	$186.3
Value of State road contract awards	do.	$64.9	$60.0	$66.5
Shipments of portland and masonry cement to and within the State	thousand short tons	154	175	204
Nonfuel mineral production value:				
Total crude mineral value	millions	$3.2	$2.8	$4.0
Value per capita		$5	$6	$6

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[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.

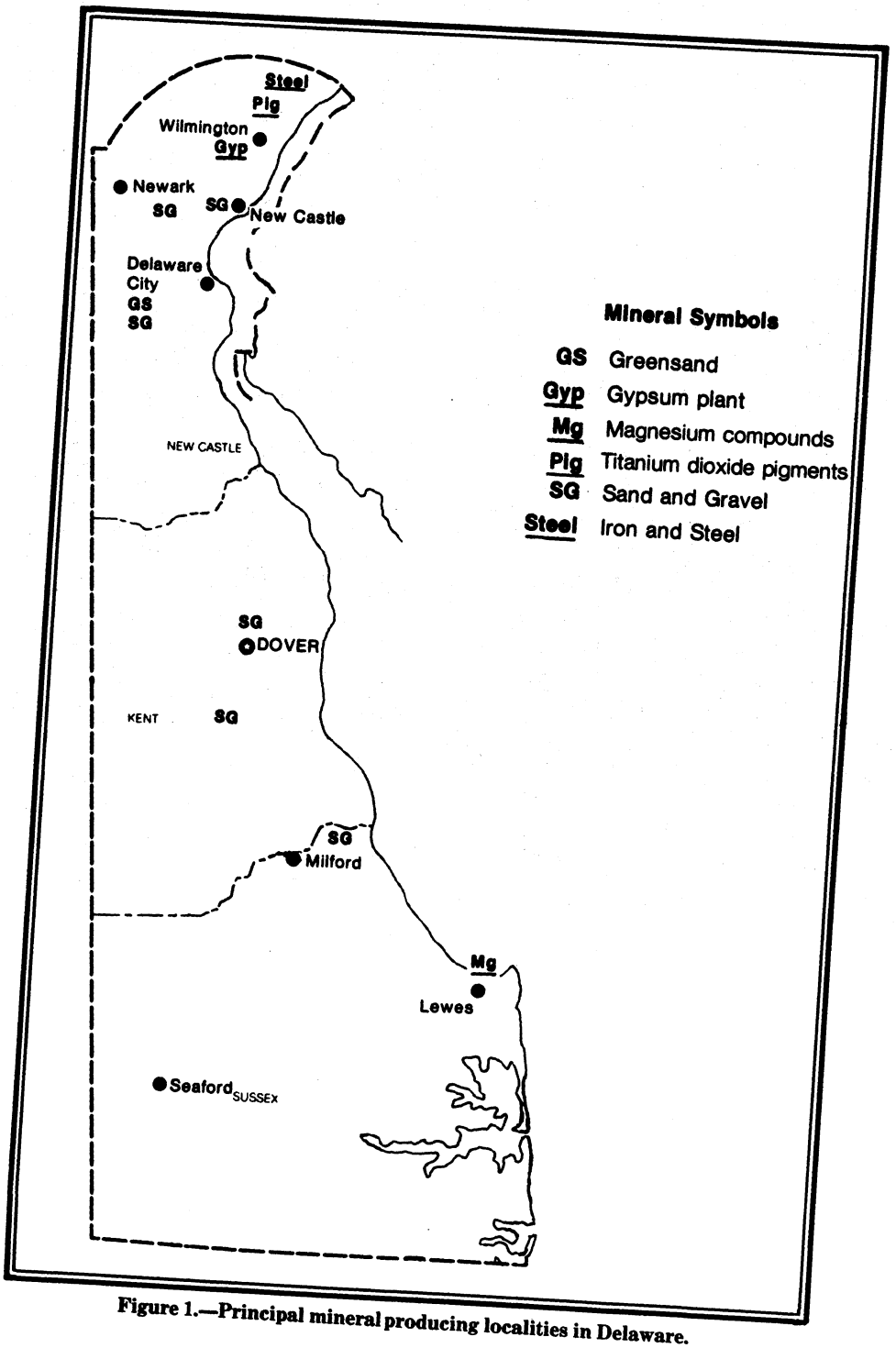

Figure 1.—Principal mineral producing localities in Delaware.

Legislation and Government Programs.—The Governor signed into law Senate joint resolution 4, which requires the State geologist to evaluate and report on activities relating to energy exploration. Also signed into law was House Bill 100, which extended until January 1, 1992, the existing exemption of aluminum cans from the mandatory beverage container law. This continued exemption was cited by the Washington-based Aluminum Association as "another sign of aluminum's unmatched recyclability in a nonregulated environment."

The 7.5-minute quadrangle geologic mapping by the Delaware Geological Survey (DGS), proceeding north to south across the State, was in southern Kent County. The DGS also published the detailed stratigraphy of the Dover area in bulletin 17. In cooperation with the Northeast Seismic Net, the DGS studied Delaware earthquakes and operated seismological stations at Newark, Georgetown, Blackbird, and the two newly established stations in the Wilmington area—Bellevue and Brandywine. Also in preparation was the hydrologic atlas of 7.5-minute quadrangles of Delaware. In cooperation with the U.S. Bureau of Mines, the DGS further evaluated the quality of the State's greensand resources and investigated heavy mineral placers of potential economic value, specifically titanium-bearing sands in the Delaware Coastal Plain.

Also under investigation by the DGS, in cooperation with the Delaware Division of Public Health and the Department of Natural Resources and Environmental Control, was the potential for the accumulation of radioactive gaseous radon in buildings and homes in Delaware. The joint 1-year effort will gather background information on natural radon levels in buildings and soils in selected areas in the Piedmont province, which is the northernmost part of the State underlain by crystalline rocks. The DGS provided guidance in the selection of sampling sites based on the geology and soil type.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Greensand.—Contractors Sand & Gravel Co. Inc. produced greensand from its Mount Pleasant sand and gravel pit near Middletown. In 1985, the first full year of coproduction, Zook & Ranck Inc. trucked 2,066 short tons of the glauconite sand, valued at $29,000 f.o.b., to its processing facility in Gap, PA, 50 miles north of the Delaware pit. Classified raw greensand was resold by Zook & Ranck as a soil conditioner and source of slow-release potash to organic farmers in North America.

Gypsum (Calcined).—At the Port of Wilmington, the Gypsum Div. of Georgia-Pacific Corp. (G-P) calcined Canadian crude gypsum and manufactured wallboard, plaster, and related products. The quantity and value of production remained essentially unchanged from 1984 levels. In the fiscal year ending June 30, 1985, G-P received 310,000 short tons of crude gypsum from mines in Nova Scotia.

Magnesium Compounds.—Barcroft Co., a subsidiary of Rorer Group Inc., produced a complete line of high-quality, pharmaceutical-grade magnesium and aluminum hydroxides in a variety of forms for pharmaceutical manufacturers worldwide. Rorer Group, an antacid and drug company, was best known for its Maalox and other digestible pharmaceuticals such as buffers, laxatives, and specialty products. Most of the plant's production was for Rorer's captive use. Some was sold to other pharmaceutical companies or marketed for industrial uses.

On the magnesium hydroxide side of the production line, seawater was taken from seven wells situated beneath the deck of the fishing pier at Cape Henlopen State Park; and, using the magnesium hydroxide process, 30% magnesium hydroxide was produced. On the aluminum hydroxide side of the production line, bulk dry shipments of specified quality aluminum trihydrate were received by rail from the Aluminum Co. of America, Kaiser Aluminum & Chemical Corp., Reynolds Aluminum Corp., and the Aluminum Co. of Canada Ltd. for manufacturing 15% aluminum hydroxide. Production was shipped in reusable sanitary-sealed, 500-pound barrels as compressed gels, dried gels, pastes, and powders.

Since startup in 1979, except for two annual 2-week shutdowns, the plant has operated continuously with seven workers per shift. Annual production capacity was 5,000 short tons of magnesium oxide equivalent.

Manganese Compounds.—American Minerals Inc. processed imported manga-

nese ores at its grinding plant near the Wilmington Marine Terminal. The plant shipped most of its manganese products to the face brick industry for coloring purposes; the balance was sold for animal feeds and fertilizers. Also, imported chrome ore, various grades of magnesium oxides, and dolomite were ground for use in refractory bricks.

Salt.—Both rock salt and solar evaporated salt were received at the Port of Wilmington and stockpiled on land adjacent to the Marine Terminal for transshipment to final destinations. The Delaware and Pennsylvania Departments of Transportation purchased the rock salt for highway deicing. Diamond Shamrock Corp. used the evaporated salt as feedstock in the manufacture of chlorine at its Delaware City chemical manufacturing plant. In fiscal year 1985, 130,000 short tons of salt, produced by solar evaporation in the Caribbean and South America and used principally in chlorine manufacture, was received at the Port of Wilmington.

Sand and Gravel (Construction).—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Based on these estimates, Delaware's production in 1985 of 1.3 million short tons, valued at $4.0 million, was about 30% over 1984 shipments. Large quantities of construction aggregate, possibly as much as two-thirds of the State total, continued to be shipped from eastern Maryland and southeastern Pennsylvania for use in Delaware.

Slag—Steel.—International Mill Service Co. processed and sold, mainly as road base material, the steel slag generated by the two electric arc furnaces at the plate mill of Phoenix Steel Corp. in Claymont. The quantity and value of shipments increased 4.7% and 16.7%, respectively, over 1984 levels.

Sulfur (Recovered).—Elemental sulfur was recovered as a nondiscretionary byproduct from petroleum refining at the Texaco Refining & Marketing Co. in Delaware City. The quantity and value of shipments, in terms of sulfur content, decreased 16% and 10%, respectively, below those of 1984. The refinery, which is specifically designed to refine the less expensive, very high-sulfur crude oil imported from Venezuela and Mexico, also produced sulfuric acid and petroleum coke.

Titanium Dioxide.—E. I. du Pont de Nemours & Co. Inc. operated one of its four domestic titanium dioxide (TiO_2) white pigment plants in Edgemoor. The plant used the chloride process and utilized ilmenite rather than the higher cost rutile as feedstock. It had an annual pigment capacity of 100,000 metric tons. The ilmenite was shipped from the DuPont operations at Starke, FL, and Eneabba, Western Australia.

In addition to the white pigments, zircon and foundry mixes were produced at the Edgemoor facility.

METALS

Steel.—On July 31, Phoenix Steel emerged from chapter 11 protection when the company's reorganization plan was confirmed by the U.S. Bankruptcy Court in Wilmington. Guardian Ventures, a partnership of two Detroit businessmen, acquired all of the company's common stocks and was able to shed $100 million of the company's debts. Phoenix Steel employed 900 people at its steel plate mill in Claymont and 250 at its tubular steel mill in nearby Phoenixville, PA.

In fiscal year 1985, 160,000 short tons of steel coils, slabs, plate, beams, and wire rods, used in construction and manufacturing, were received at the Port of Wilmington from Brazil, Western Europe, and the Republic of Korea.

Reclaimed Metals and Materials.—The Delaware Reclamation Project at Pidgeon Point, just north of the Delaware Memorial Bridge, produced 850 short tons of aluminum, 6,000 tons of ferrous metals, and 1,300 tons of glass from all the municipal, commercial, and light industrial solid waste generated in New Castle County. Production was valued at $554,000 and sales totaled $358,000 in 1985—the facility's first full year of commercial operation. The project was managed by the Delaware Solid Waste Authority and operated by Raytheon Service Co., the facility's designer and builder. The $65 million complex processed up to 1,000 tons of mixed solid waste and 350 tons of sewage sludge daily. On an annual basis, the plant was designed to extract 1,300 tons of nonferrous metals, 18,000 tons of ferrous metals, and 18,000 tons of glass, and to produce 103,000 tons (dry weight) of refuse-derived fuel (77% of which must be combustible) and 47,000 tons of humus. Raytheon had guaranteed revenues of $1.4 million annually from the sale of recovered products—glass, humus, and ferrous-nonferrous materials.

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[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

Table 3.—Principal producers

Commodity and company	Address	Type of activity	County
Greensand:			
Contractors Sand & Gravel Co. Inc	Box 2630 Wilmington, DE 19805	Pit	New Castle.
Gypsum (calcined):			
Georgia-Pacific Corp., Gypsum Div	Wilmington Marine Terminal Box 310 Wilmington, DE 19899	Plant	Do.
Magnesium compounds:			
American Minerals Inc	One Montgomery Plaza Suite 906 Norristown, PA 19401	Plant (grinding)	Do.
Barcroft Co	40 Cape Henlopen Dr. Lewes, DE 19958	Plant (pharmaceutical-fine chemical).	Sussex.
Sand and gravel (construction):			
Contractors Sand & Gravel Co. Inc	Box 2630 Wilmington, DE 19805	Pit	New Castle.
Dover Equipment & Machine Co	113 West 6th St. New Castle, DE 19720	Dredge	Kent.
Parkway Gravel Inc	4048 New Castle Ave. New Castle, DE 19720	Pits	New Castle.
Slag—steel:			
International Mill Service Inc	Philadelphia Pike Box 160 Claymont, DE 19703	Plant (processing).	Do.
Steel:			
Phoenix Steel Corp	4001 Philadelphia Pike Claymont, DE 19703	Mill (plate)	Do.
Sulfur (recovered):			
Texaco Refining & Marketing Co.[1]	Wrangle Hill Rd. Delaware City, DE 19706	Refinery (petroleum).	Do.
Titanium dioxide:			
E. I. du Pont de Nemours & Co. Inc.[2]	1007 Market St. Wilmington, DE 19898	Corporate headquarters.	Do.
Do	Edgemoor, DE 19809	Plant (chemical).	Do.

[1]Also sulfuric acid and petroleum coke.
[2]Also zircon and foundry mixes.

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 1985 value of nonfuel mineral production in Florida was nearly $1.6 billion, an increase of nearly $49 million over that of 1984. This is the third consecutive annual increase, but the value was still below that of the 1981 record-high year. Output for most minerals produced in Florida had increased output, resulting in the State ranking third in the Nation in value of nonfuel minerals produced, and third in value of industrial minerals. Florida produced 8.7% of the Nation's industrial minerals, valuewise. Industrial minerals accounted for nearly all of the value of Florida's mineral output, with the State ranking first in the production of phosphate rock; second in masonry cement, peat, and crushed stone; third in fuller's earth; and seventh in portland cement. Staurolite and zircon concentrates were produced only in Florida. Principal industrial minerals, in order of value, were phosphate rock, crushed stone, cement, sand and gravel, and clays.

Florida remained the predominant producer of phosphate rock and for the 92d consecutive year supplied more than any other State. Florida and North Carolina supplied nearly 89% of the domestic phosphate rock output, with Florida being the dominant exporter.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	383	$24,624	316	$17,137
Portland do	3,564	172,548	3,282	148,908
Clays do	772	34,048	672	33,074
Gem stones	NA	6	NA	6
Lime thousand short tons	171	9,379	W	W
Peat do	263	5,454	243	5,333
Sand and gravel:				
Construction do	21,032	48,494	e22,500	e49,500
Industrial do	1,533	9,815	2,123	12,642
Stone (crushed) do	e68,500	e290,000	69,266	287,237
Combined value of magnesium compounds, phosphate rock, rare-earth metal concentrates, staurolite, titanium concentrates (ilmenite and rutile), zircon concentrates, and value indicated by symbol W	XX	915,996	XX	1,005,429
Total	XX	1,510,364	XX	1,559,266

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

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

Table 2.—Nonfuel minerals produced in Florida in 1984, by county[1]

County	Minerals produced in order of value
Bay	Sand and gravel.
Brevard	Clays, sand and gravel.
Broward	Sand and gravel.
Calhoun	Do.
Clay	Ilmenite, zirconium, rutile, staurolite, sand and gravel, monazite, clays, peat.
Dade	Cement.
Escambia	Sand and gravel.
Gadsden	Clays, sand and gravel.
Glades	Sand and gravel.
Gulf	Magnesium compounds, lime.
Hamilton	Phosphate rock.
Hardee	Do.
Hendry	Sand and gravel.
Hernando	Cement, lime, clays.
Highlands	Peat.
Hillsborough	Phosphate rock, cement, peat.
Jackson	Sand and gravel.
Lake	Sand and gravel, peat, clays.
Leon	Sand and gravel.
Madison	Peat.
Manatee	Phosphate rock, cement.
Marion	Clays, sand and gravel.
Palm Beach	Peat.
Polk	Phosphate rock, sand and gravel, peat.
Putnam	Sand and gravel, clays, peat.
St. Lucie	Sand and gravel.
Sarasota	Do.
Sumter	Lime, peat.
Walton	Sand and gravel.
Undistributed[2]	Stone (crushed), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Trends and Developments.—Florida's economy remained one of the strongest in the Southeast and also in the Nation. The growth in the economy in 1985, although not as strong as that of 1984, still managed to be larger than that of any of the other Southeastern States. Construction activity in 1985 continued to provide markets for the State's nonfuel minerals industry. One major construction project beneficial to the industry was the construction of I-595 in south Florida. The $1.2 billion project was one of the five largest highway construction projects in the Nation.

The Port of Tampa handled nearly 49 million short tons of cargo in the fiscal year ending September 30, 1985, a slight increase over that of the previous fiscal year. Of the cargo handled, 98% was bulk shipments. Exports included bulk phosphate rock (8,992,347 short tons), bulk phosphate chemicals (5,816,678 short tons), and phosphoric acid (496,308 short tons). Exports of phosphate rock and phosphoric acid decreased, while that of phosphate chemicals increased. The port also handled over 4 million short tons of sulfur (liquid), nearly 700,000 tons of which was imported; the balance came from domestic sources. The port handled imports of aragonite (45,000 short tons), down considerably from that of 1984. Aragonite was imported from the Bahamas for use in the manufacture of cement. Increased imports of cement and clinker caused the decrease in imports of aragonite. Other imports included anhydrous ammonia, cement, clinker, gypsum, and potash. Also handled was over 5 million short tons of coal from domestic sources. Cement imports through Tampa totaled 1,987,000 short tons, and 1,224,000 tons was imported through Miami. Of that total, 483,000 tons was clinker through the Port of Tampa. Major sources of imported cement were Mexico, Spain, and Venezuela.

The phosphate industry remained in a distressed condition during the year. All companies operated intermittently with shorter work weeks. Production picked up early in 1985, but as stockpiles increased, reduced schedules and closures of mines occurred. At least five companies were for sale, with two operating under chapter 11 provisions of the Federal Bankruptcy Code. Cargill Inc. purchased Gardinier Inc., one of the companies operating under chapter 11 provisions. Hopewell Land Corp. and W. R. Grace & Co. started production from new mines early in the year.

Handy & Harman & Co. reached an agreement with Cabot Corp. to manufacture and sell complex powder metal parts using Cabot's injection molding technology. The parts will be manufactured at Handy's subsidiary, New Industrial Techniques, in Coral Springs.

Total oil and gas production in Florida declined for the seventh consecutive year. Oil production dropped from 14.5 million barrels in 1984 to 11.5 million barrels in 1985; gas production dropped from 13.9 to 11.7 billion cubic feet. Of the 286 wells in the south Florida and northwest Florida fields, 149 were producing, 46 were injection, 88 were shut-in, and 3 were temporarily abandoned.

Employment.—Florida's 1985 unemployment rate was 6.0% compared with 6.3% in 1984. Average annual employment in the mining industry was about 10,100 in 1985. Phosphate rock employment during the first half of 1985 was above 1984 levels, but in the second half of the year dropped below those levels. Construction employment picked up in the second half of the year to levels exceeding 1984 employment. The unemployment rate in Polk County, the center of the phosphate industry, ranged from 9% to nearly 16%. During most of the year, Polk

Table 3.—Indicators of Florida business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	10,754	11,050	11,366
Total civilian labor force	do.	4,932	5,140	5,338
Unemployment	percent	8.6	6.3	6.0
Employment (nonagricultural):				
Mining total[1]	thousands	9.6	10.2	10.1
Nonmetallic minerals except fuels	do.	8.2	8.7	8.7
Oil and gas extraction[2]	do.	1.0	1.1	1.1
Manufacturing total	do.	464.3	501.8	515.2
Primary metal industries	do.	4.9	5.2	5.2
Stone, clay, and glass products	do.	20.9	24.0	23.8
Chemicals and allied products	do.	25.9	26.4	26.2
Petroleum and coal products	do.	1.7	1.8	1.9
Construction	do.	268.8	318.4	334.6
Transportation and public utilities	do.	231.4	241.1	243.5
Wholesale and retail trade	do.	1,037.6	1,121.4	1,195.2
Finance, insurance, real estate	do.	283.2	299.2	317.6
Services	do.	971.4	1,065.9	1,133.0
Government and government enterprises	do.	639.3	650.7	673.2
Total	do.	3,905.6	4,208.7	4,422.4
Personal income:				
Total	millions	$130,472	$143,983	$156,184
Per capita		$12,132	$13,031	$13,742
Hours and earnings:				
Total average weekly hours, production workers		40.7	41.2	41.3
Mining (nonmetallic minerals)		46.0	48.0	47.2
Total average hourly earnings, production workers		$7.3	$7.6	$7.9
Mining (nonmetallic minerals)		$8.1	$8.3	$8.5
Earnings by industry:				
Farm income	millions	$2,408	$2,023	$2,030
Nonfarm	do.	$78,401	$87,823	$96,398
Mining total	do.	$576	$710	$675
Metal mining	do.	$8	$12	$13
Nonmetallic minerals except fuels	do.	$200	$224	$226
Oil and gas extraction	do.	$363	$466	$426
Manufacturing total	do.	$9,890	$11,169	$12,034
Primary metal industries	do.	$115	$128	$137
Stone, clay, and glass products	do.	$409	$465	$555
Chemicals and allied products	do.	$693	$757	$780
Petroleum and coal products	do.	$47	$52	$57
Construction	do.	$6,234	$7,520	$8,111
Transportation and public utilities	do.	$6,608	$7,049	$7,511
Wholesale and retail trade	do.	$15,283	$16,902	$18,626
Finance, insurance, real estate	do.	$5,869	$6,228	$7,486
Services	do.	$19,887	$23,126	$25,421
Government and government enterprises	do.	$13,287	$14,322	$15,675
Construction activity:				
Number of private and public residential units authorized[3]		189,440	205,047	70,289
Value of nonresidential construction	millions	$4,109.0	$4,823.4	$6,083.9
Value of State road contract awards	do.	$340.0	$788.0	$788.0
Shipments of portland and masonry cement to and within the State	thousand short tons	5,262	6,733	6,608
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,275.8	$1,510.4	$1,559.3
Value per capita		$119	$137	$137

[p]Preliminary. [r]Revised.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add owing to the inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

County recorded the highest unemployment rate among Florida's 20 metropolitan areas.

Legislation and Government Programs.—The Florida Environmental Regulation Commission approved a set of guidelines for the handling and storage of solid sulfur. Sulfur is used in the production of fertilizer, and over 4 million short tons of liquid sulfur was utilized in 1985. Solid sulfur costs less than liquid, and one company proposed using solid sulfur, resulting in guidelines as set forth by the commission. The proposed pellet form of sulfur was considered by the Department of Environmental Regulation as less of an environmental hazard than earlier forms of solid sulfur. The guidelines require that loading and unloading facilities be enclosed and the enclosures be equipped with water sprays to control dust. Companies will be required to monitor emissions of sulfur dust from their operation for at least 2 years after construction is completed. In addition, ships that bring sulfur into Tampa Bay must be surrounded by a floating boom while the chemical is unloaded to ensure that any spilled

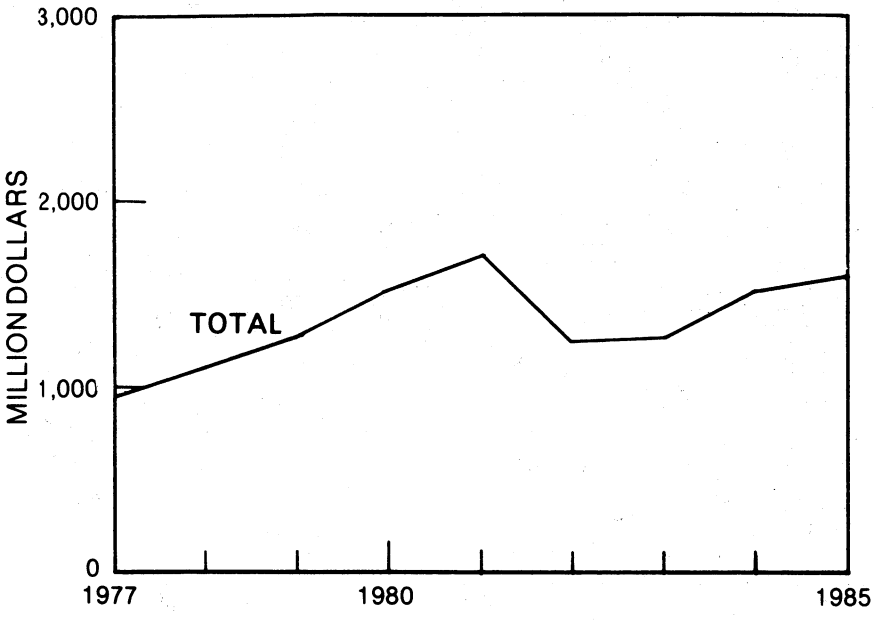

Figure 1.—Total value of nonfuel mineral production in Florida.

sulfur is contained and recovered.

The Florida Bureau of Geology continued its geologic investigation in the State, which included studies of both nonfuel and fuel resources. The Geologic Investigations Section completed notes on the geology of six counties, heavy mineral reconnaissance in northwest Florida, geology of the Florida peninsula and its relationship to phosphate deposits, hydrocarbon reservoir formations in the Jay Field, and the lithostratigraphy of the central Florida phosphate district. Work under way included county studies, geology of significant outcrops, and industrial minerals of Florida. The Mineral Resources Investigation and Environmental Geology Section, formed in 1985, completed geologic studies in Hendry County, peats of Florida, carbonate rock environments of south Florida, and stratigraphic correlation across north Florida. Work under way included a summary of geologic parameters to be assessed for hazardous waste disposal, geology of Madison County, mineral producers directory, and an overview of peat in Florida. Publications during the year included "Neogene Stratigraphy and Geologic History of the Apalachiola Embayment," "Annotated Bibliography of Florida Basement Geology and Related Tectonic Studies," "Palynology and Paleoecology of a Lignitic Peat From Trail Ridge, Florida," "Sinkhole Type, Development, and Distribution in Florida," and geologic studies of De Soto and Sarasota Counties.

The Florida Department of Revenue reported receipts of severance taxes during fiscal year 1985 for solid minerals of $84.0 million, down from $86.8 million in 1984. The severance tax for phosphate rock was $2.28 per short ton in 1985; the tax is adjusted annually based on the producers' price index. Severance taxes from oil and gas totaled $21.6 million during fiscal year 1985.

The Florida Institute of Phosphate Research continued its funding of research activities with respect to mining and processing phosphate rock and reclamation of disturbed lands. Over $6 million was directed toward chemical processing, beneficiation, reclamation, mining, and environmental studies, both in-house and sponsored research. The studies involved utilization of phosphogypsum, reduction of waste pond areas, innovative reclamation, mining concepts, and radiation effects. The institute has designated the high-volume use of phosphogypsum, a byproduct of fertilizer production, as a top priority for research.

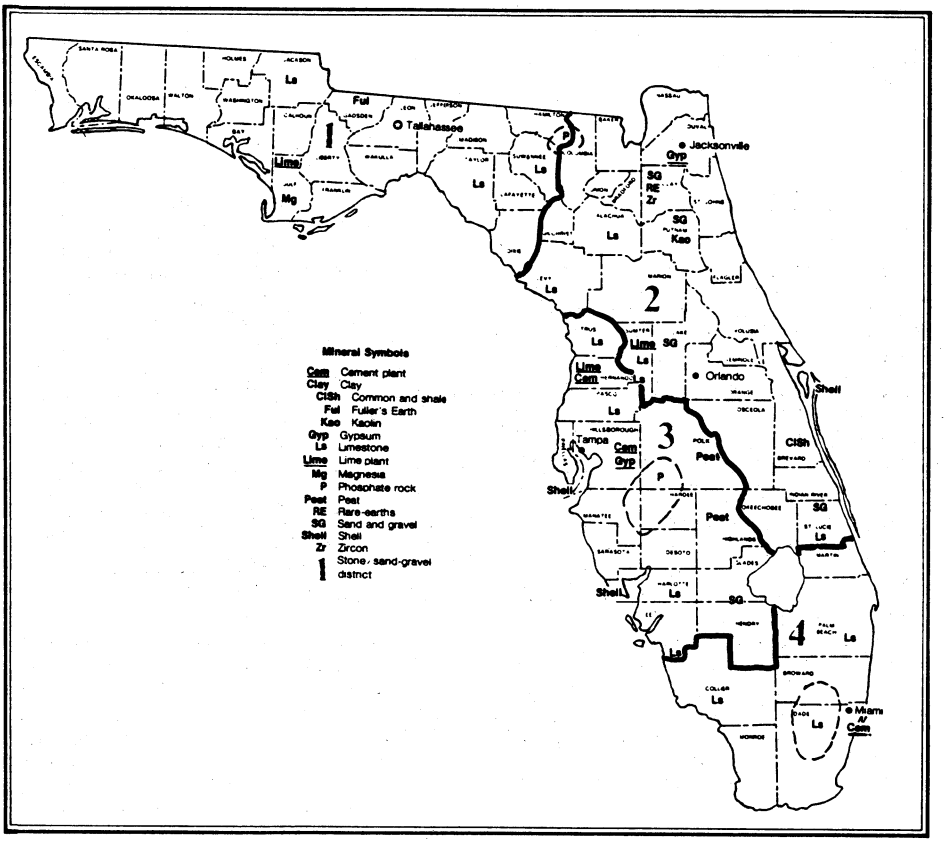

Figure 2.—Principal mineral producing localities in Florida.

As a result, the institute sponsored a seminar on phosphogypsum to present the most recent information on uses of the material as a chemical raw material, as a building product, and for agricultural applications. Publications during the year included "Ecological Consideration of Reclaimed Lakes in Central Florida's Phosphate Region—Two Volumes," "Studies of a Method of Wetland Reconstruction Following Phosphate Mining," "Inventory of Environmental Quality Monitoring Locations in the Central Florida Phosphate District," and "Radioelement Migration in Natural and Mined Phosphate Terrains."

Since 1972, the U.S. Bureau of Mines Tuscaloosa Research Center has conducted various research projects with regard to phosphate mining and beneficiation. In-house Bureau activities during 1985 included dewatering of waste clay slime by flocculation, recovery of phosphate from dewatered slimes, recovery of sulfur from phosphogypsum wastes, and procedures for establishment of wetland ecosystems after mining.

U.S. Bureau of Mines publications issued during the year pertaining to the mineral industry of Florida included Report of Investigations (RI) 8928, "Large-Scale Dewatering of Phosphatic Clay Waste From Northern Florida"; RI 8939, "Assessment of Phosphogypsum as a Constituent of Aggregate Material"; and RI 8953, "Removal of Magnesia From Dolomitic Southern Florida Phosphate Concentrates by Aqueous SO_2 Leaching." Information Circulars (IC) issued included IC 9008, "Analysis of Dredge Safety Hazards," and IC 9043, "Phosphate Resource Potential for Borehole Mining in the Southeastern Coastal Plain." Additionally, Bulletin 681, "Dewatering of Mineral Wastes Using the Flocculant Polyethylene Oxide," was issued.

In 1985, the U.S. Bureau of Mines had several contracts in the State. The Florida Bureau of Geology was conducting an evaluation of Florida phosphate deposits from the Miocene-Hawthorn Formation, and Engineering Contractors Association of Hialeah was evaluating alternatives for Kelly bar loading.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Cement.—In 1985, shipments of both masonry and portland cement decreased compared with that of 1984. Cement remained the third leading commodity by value in the State. Production of masonry cement ranked second nationally, while that of portland cement ranked seventh. High levels of construction activity impacted favorably on the cement industry as masonry cement output was at its highest level in 15 years. Five companies produced portland cement at five plants; masonry cement was produced at four plants. Most of both cement types was used within the State; Florida remained a net importer of cement as imports increased from 2.3 million short tons in 1984 to 3.2 million tons in 1985. Daily clinker capacity of the masonry cement plants was 9,000 tons, down from 10,500 tons in 1984. Clinker imports also increased from nearly 400,000 tons in 1984 to 483,000 tons in 1985. The cement industry in Florida is undergoing a period of transition because of increased levels of lower priced imports. By yearend, three companies were producing cement, six were importing cement, two were importing clinker and grinding it, and one new cement plant was under construction. The major portion of imports was from Mexico, Spain, and Venezuela.

Portland cement shipments, mainly in bulk form, were made by truck and rail. Principal consumers were ready-mixed concrete contractors, building material dealers, and concrete product manufacturers, with the remainder used by other contractors and government agencies. Raw materials from within the State used to manufacture cement included limestone, clays, sand, and staurolite. Oolitic aragonite was imported from the Bahamas and used along with gypsum, fly ash, and iron ore, most of which was from out-of-State sources.

Seven rotary kilns were operated at the five plants; two were wet process and five were dry process. Energy requirements in the manufacture of cement included 386 million kilowatt hours of electrical energy, along with natural gas, fuel oil, and coal.

Florida Crushed Stone Co. began construction of its 600,000-ton-per-year cement plant at Brooksville. The clinker grinding and storage facilities were scheduled for completion early in 1986, with the cement plant due for completion late in 1986. The 125-megawatt cogeneration facilities, along with the 350,000-ton-per-year lime plant, were scheduled for completion by early 1987. The facility was estimated to cost over $100 million.

Eastern Portland Cement Corp. completed construction of storage facilities at Port

Manatee. Capacity was increased to 45,000 tons. Eastern imports cement through Port Manatee and also at its 30,000-ton-capacity facility at Palm Beach. Also importing cement were General Portland Inc. at Miami, and Tampa Cement Inc., Gulf Portland Cement, and Ideal Basic Industries Inc. at Port Sutton. Importing clinker for grinding were National Portland Cement Co. at Port Manatee and General Portland at Tampa.

General Portland shut down its kiln at its Tampa plant to import clinker from Mexico. The company plans to build storage silos with a capacity of 60,000 tons by mid-1986. Gulf Portland at Tampa is a new import terminal owned by Glen-Mar Ready Mix Inc. Tampa Cement, an importer at Tampa, is a joint venture between Florida Mining & Materials Corp. and Spanish interests. The 30,000-ton-capacity terminal began shipping cement in April; the company's import goal for 1986 is 250,000 tons. Lonestar Florida Pennsuco Inc. acquired certain assets of Charley Toppino and Sons Inc.; included were four ready-mixed concrete plants and a block facility. Lonestar now operates 30 ready-mixed concrete plants, 9 concrete block plants, and a quarry and cement plant in Dade County.

Clays.—Production of clays in the State included common clay, fuller's earth, and kaolin. Total clay production decreased 100,000 short tons, while value decreased nearly $1 million, compared with a 90,000-ton increase in output and a $2.5 million increase in value that was experienced in 1984. Common clay output and value decreased from those of 1984. Three companies produced common clay at three pits in Clay, Hernando, and Lake Counties, all in the northern part of Florida. Common clay was used in the manufacture of cement and lightweight aggregate. Florida ranked third in the Nation in production of fuller's earth with output and value decreasing from those of 1984. Four companies mined fuller's earth at four pits in Brevard, Gadsden, and Marion Counties. Main end uses were for pet waste absorbents and oil and grease absorbents, in fertilizers, pesticides, and saltwater drilling muds. Material mined was a montmorillonite attapulgite product with end products shipped nationwide. Basic processing includes air drying to reduce moisture content, further drying in fluid bed dryers, grinding, and screening. Floridin Co., Quincy, doubled production capacity of its finely ground attapulgite, which is used as a thickening and suspending agent.

One company produced kaolin in Putnam County with output increasing slightly. The kaolin was used in jiggering and extrusion processes where a high degree of workability was required. The material has excellent suspending power and was used in glazes. Principal uses were electrical porcelain, whiteware, and wall tile; the major marketing area was the Southeast. Additionally, byproduct industrial sand was recovered for glass and other uses.

Fluorspar.—Fluorine in the form of fluosilicic acid was recovered as a byproduct of wet-process phosphoric acid manufacture. Six companies operated facilities in Florida. Fluosilicic acid was used to produce cryolite, aluminum fluoride, and sodium silicofluoride and was also used in water fluoridation.

Gypsum.—Three companies calcined imported gypsum at two plants in Duval County and one in Hillsborough County. USG Corp., Jim Walter Corp., and National Gypsum Co. calcined gypsum in kettles, a rotary kiln, and a holoflite unit, respectively, prior to wallboard manufacture; Florida ranked third nationally in output of wallboard. USG's plant ranked fifth. Output and value increased over those of 1984. Southern Georgia and Florida were the principal marketing areas for Florida's output of gypsum wallboard. Byproduct gypsum was recovered by Occidental Chemical Co. at its plant near White Springs; output and value decreased from those of 1984. Standard Gypsum Co. imported gypsum through its facilities in Tampa.

Lime.—Quicklime and hydrated lime were produced in the State, with production of both decreasing from that of 1984. Quicklime was produced by Chemical Lime Inc., Hernando County, and Dixie Lime & Stone Co., Sumter County. Basic Magnesia Inc. did not operate its Port St. Joe kiln during the year. Hydrated lime was produced by Chemical Lime. Total lime production decreased from that of 1984, along with a slight decrease in unit values. Lime was used in water purification, magnesia recovery from seawater, and paper and pulp manufacturing.

Magnesium Compounds.—Florida ranked second nationally in the recovery of magnesium compounds from seawater in 1984. Capacity of the Port St. Joe facility was 100,000 short tons of MgO equivalent. Output had been on a gradual decline since the record-high year, 1973.

Nitrogen.—Anhydrous ammonia was produced by Air Products & Chemicals Inc. at its 100,000-short-ton-per-year plant in Pace

Junction. The Directory of Florida Industries also listed Jones Chemical Inc., Fort Lauderdale, as having anhydrous ammonia in its product line. Nitram Inc. reopened its nitric acid plant in Tampa early in 1985. The plant was closed late in 1984 for installation of a new energy-saving acid train. The single train produces as much as the two trains previously used to produce ammonium nitrate solutions and prilled ammonium nitrate.

Peat.—Florida ranked second in the Nation in peat sales in 1985. Reported sales decreased as unit values increased. Production of reed-sedge and humus peat was reported by 12 companies from 9 counties. Most of the peat was shipped in bulk for use as a potting soil and in nurseries. Of 11 companies nationwide with output over 25,000 short tons per year, 4 were in Florida.

Perlite (Expanded).—Four companies expanded perlite from crude ore shipped into Florida. Production increased to 26,400 short tons and value increased to about $4.8 million. Perlite was expanded at plants in Broward, Duval, Escambia, and Indian River Counties. Principal uses were as construction aggregate, horticultural purposes, insulation, and filler.

Phosphate Rock.—Florida ranked first in the Nation in output of phosphate rock and the industry continued as the principal mineral industry in the State. Production of marketable phosphate rock in 1985 increased nearly 7.4% in output and 9.5% in value over that of 1984, indicating an increase in unit values. Output picked up early in the year; but as stockpiles increased and sales remained low, reduced work schedules and temporary closures of operations occurred. At least five companies were for sale, with two operating under chapter 11 of the Federal Bankruptcy Code. Nearly all operating facilities were temporarily shut down, and by late in the year, all were operating shorter workweeks with associated plants operating at less than capacity. The year was one of the industry's most depressed since 1982, with employment dropping to 11,500 in 1985; in 1980, 14,600 were employed. Problems were caused to a certain degree by overcapacity, low prices, loss of export markets, less domestic consumption by farmers, and the high value of the dollar.

According to the Florida Phosphate Council, 1985 production was 39.0 million metric tons, an increase of 1.1 million tons over that reported for 1984. Output of major finished products was mixed, as shown in the following figures: phosphoric acid (-11.5%), triple superphosphate (+12.1%), diammonium phosphate (-8.7), monoammonium phosphate (-9.3%), and animal feed supplements (+1.7%). The council reported that the industry had invested an estimated $8.8 billion in Florida with nearly $124 million in expansion and construction in 1985. The industry paid over $100 million in severance taxes, over $24 million in various State taxes, and more than $28 million in county taxes. Nearly one-fourth of Florida's phosphate rock was exported along with phosphate fertilizer products. Major customers were Japan, Canada, the Republic of Korea, and Western Europe.

Land-pebble phosphate was produced at 20 mines by 12 companies in Hamilton, Hardee, Hillsborough, Manatee, and Polk Counties. Of the 12 companies with mining operations, 6 increased production in 1985, 5 decreased production, and 1 started operating. Two companies increased export tonnage in 1985, one remained at about the same level, six decreased exports, and three did not export. In 1985, agricultural uses accounted for nearly all production. Normal superphosphate, triple superphosphate, wet-process phosphoric acid, phosphate rock for direct application, and defluorinated phosphate rock were produced for agricultural purposes. Of the companies, 11 produced wet-process phosphoric acid, 4 produced triple superphosphate, 5 produced normal superphosphate, 2 produced direct-application material, 1 produced defluorinate rock, and 2 produced elemental phosphorus.

Sulfur prices remained relatively high, increasing the cost of some chemical plant operations. The Florida phosphate industry, the largest consumer of sulfur in the world, investigated the use of prilled sulfur rather than liquid sulfur to determine whether sulfur costs could be reduced. Guidelines for handling and storing were promulgated by the Environmental Regulation Commission.

Agrico Chemical Co. operated the Fort Green, Payne Creek, and Saddle Creek Mines during the year. The Payne Creek Mine was closed most of the year. Capacity of the mines is approximately 7 million metric tons per year. Agrico continued efforts to obtain authority to import prilled sulfur from Canada to replace liquid sulfur. Agrico proposed to import 600,000 short tons per year and save $6.4 million. The Environmental Regulation Commission set

down regulations for handling and storing solid and liquid sulfur. The regulations specify that sulfur must be stored in enclosed buildings equipped with sprinkler systems to control excessive airborne dust. The regulations include guidelines for minimizing spills in Tampa Bay. After permitting, Agrico planned to build a solid sulfur terminal in Tampa. Agrico received the 1985 Environmental Achievement Award from the National Wildlife Federation for wetland conservation. Late in the year, Agrico's operations reached the safety milestone of 1 million employee-hours worked without a serious injury.

AMAX Chemical Inc. maintained the Big Four Mine and the Piney Point fertilizer plant. The mine closed in 1984, and the Piney Point fertilizer plant closed in February 1985. The two operations were shut down indefinitely, and AMAX's facilities were put up for sale. Late in the year, AMAX announced it had reached agreement in principle to sell all of its Florida properties to FCS Energy Inc.; FCS is an affiliate of Florida Crushed Stone. The assets included AMAX's headquarters in Lakeland, the Big Four Mine, the Piney Point fertilizer plant, the Pine Level reserves, and the Plant City feed supplement plant. The agreement must be approved by regulatory agencies. AMAX reportedly had a book value of $42 million for the properties. FCS reportedly intends to process waste phosphogypsum by converting it into sulfuric acid and lime and to construct a cogeneration unit. High-sulfur petroleum coke will be used to dissociate the phosphogypsum.

Beker Phosphate Corp. operated the Wingate Creek Mine in Manatee County using floating dredges to remove overburden and recover matrix; Beker reportedly was seeking a buyer for its operation. In August, a circuit court allowed Beker to increase truck traffic to Port Manatee, allowing shipments of as much as 2 million metric tons per year. Phosphate rock was barged from Port Manatee to Beker's fertilizer plant in Taft, LA. In October, Beker filed for reorganization under chapter 11 of the Federal Bankruptcy Code. Shipments of rock to Beker's plant in Taft, LA, were stopped. In November, Beker received financing of $2.3 million enabling the company to operate through 1985.

Brewster Phosphates, a partnership between American Cyanamid Co. and Kerr-McGee Corp., operated the Haynsworth and Lonesome Mines at various work schedules; the mines have a total capacity of over 5.5 million metric tons per year. During the year, Kerr-McGee reiterated its position that its portion of the partnership was for sale. Late in the year, International Minerals & Chemical Corp. (IMC) reportedly reached agreement with Brewster to lease the operations and acquire the reserves on a royalty basis.

CF Industries Inc. operated the Hardee Complex No. 1 Mine at less than capacity during 1985. CF reopened its 1.5-million-ton-per-year phosphoric acid facility at Bartow in January after a 2-year shut down and operated at one-third of its capacity. In July, the plant was closed indefinitely. CF continued to operate its Plant City chemical plant at capacity; the plant is capable of producing 600,000 tons per year of diammonium phosphate. The closure of the Bartow facility did not affect output at the Hardee Complex No. 1 Mine because IMC had been supplying phosphate rock to the facility.

Estech Inc. operated the Watson Mine but kept the Silver City Mine closed. Estech indicated its Florida phosphate operations were for sale. After nearly a decade of attempts to obtain permits to develop the Duette deposit, Estech sold the 10,500-acre site to Manatee County for a reported $26 million. Environmental concerns delayed the project with concerns centered on the Lake Manatee watershed. Manatee County purchased the property to protect the watershed, which supplies Manatee and Sarasota Counties with drinking water.

Farmland Industries Inc. purchased phosphate rock for its Green Bay chemical plant. The plant operated at reduced levels, at times below 50% of capacity.

Gardinier operated under chapter 11 provisions of the Federal Bankruptcy Code beginning in February. Its Fort Meade Mine and phosphoric acid plant south of Tampa operated at reduced levels of capacity with periodic shutdowns. The Fort Meade Mine was closed in November and the phosphoric acid plant was reduced to 50% of its 800,000-ton-per-year capacity; the plant shut down late in the year for about 6 weeks. Late in the year, Cargill purchased 80% of the company's stock or about $80 million, with the remaining 20% held by Gardinier's major creditors. The purchase included all properties and part of the reserves. Florida Crushed Stone attempted to purchase Gardinier, but was not successful.

W. R. Grace operated its Hooker Prairie

and Four Corners Mines during the year. The $650 million Four Corners Mine, a joint venture with IMC, started operations early in the year. The mines operated on reduced schedules and were down for a month at midyear. In December, W. R. Grace announced that its Four Corners Mine would close for a period of up to 2 years. The Mulberry plant was closed late in the year for at least 1 month. W. R. Grace, early in the year, idled one of three phosphoric acid trains at its 200,000-ton-per-year phosphoric acid plant at Bartow. W. R. Grace also announced plans to install a 36-megawatt cogeneration unit at its Bartow facility.

Hopewell Land, a subsidiary of Noranda Inc., started up the new 550,000-ton-per-year Lithia Mine in Hillsborough County early in the year. The mine originally was scheduled to be operational in mid-1982. A portion of the output is dedicated to a Noranda facility in Canada. The mine's wet-rock product was shipped to Mobil Mining and Minerals Co.'s drying plant at Nichols and to the Port of Tampa for export.

IMC, the world's largest private producer of phosphate rock and phosphate chemical products, operated the Clear Springs, Kingsford, and Noralyn-Phosphoria Mines. Early in the year, IMC put on-line a 58.5-megawatt cogenerator unit at its Lake Wales chemical plant with plans to install $5 million more in heat recovery equipment. This was the third phase of a $35 million project announced in 1983 to make the facility more self-sufficient in generating its own electricity. Reduced operation schedules were in effect in the second half of the year to reduce growing inventories. The mines experienced a mid-summer shutdown and a 4-week shutdown at yearend. Late in the year, IMC reached an agreement to lease the operations of Brewster and its phosphate rock reserves. The Governor and cabinet adopted a resolution commending IMC for demonstrating a positive influence in promoting the acceptance and feasibility of creating functional wetlands on phosphate mined lands and advancing the degree of wetlands reclamation technology.

Mobil operated the Fort Meade and Nichols Mines at reduced levels during the year. With large inventories, the mines operated at times at 50% of capacity. Both mines were to be phased out when Mobil's proposed South Fort Meade Mine was developed. Mobil has no plans to develop the South Fort Meade deposit but will if it can economically justify pumping matrix or flotation feed to the mine. Mobil received approval of the reclamation plan for the South Fort Meade Mine, with only minor permitting yet to be received.

Occidental produced phosphate rock from its Suwanee River and Swift Creek Mines in 1985. Occidental exported superphosphoric acid and phosphate rock through the Jacksonville Bulk Terminal. The company planned to install a $15 million, 24-megawatt cogeneration system at its White Springs plant with completion scheduled for late 1986. At midyear, Occidental cut output at the Suwanee River chemical complex to 75% of capacity, citing low prices for product and high prices for sulfur; the curtailment was expected to last well into 1986. Occidental was one of several companies involved in testing byproduct phosphogypsum in road construction.

Royster Co., a subsidiary of Superfos N/A, closed its Mulberry plant for several months while an $18 million, 21-megawatt congeneration unit was installed. Further delays in getting back on-stream were caused by an electrical fire in the motor control center of the cogeneration unit. Royster was spending an additional $10 million to modify its phosphoric acid plant to produce a higher concentration acid.

U.S.S. Agri-Chemicals Inc. was another company whose phosphate assets in Florida were for sale. The company reduced output at its Rockland Mine and its Fort Meade and Bartow plants. Late in the year, the company temporarily closed its operations.

Sand and Gravel.—Florida produced both construction and industrial sand and gravel in 1985. Together they were the fourth leading commodity in value among nonfuel minerals produced in Florida. Total sand and gravel production and value were estimated to have increased over those of 1984; the increase was due in large part to increased construction activities.

Construction.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Output of construction sand and gravel was estimated to have increased because of the high level of activity in the construction sector in the State. During 1984, 30 companies produced construction sand and gravel with 4 producing in excess of 1 million short

tons.

Industrial.—Six companies produced industrial sand and gravel, one as a byproduct of kaolin operations. Florida ranked fifth nationally in output of industrial sand and gravel as production increased more than 38%. Major markets were in glass manufacture and for foundry sands; the market area was the Southeastern United States.

Staurolite.—Florida was the only State with a recorded production of staurolite, an iron-aluminum silicate low in free silica. Staurolite was recovered as a byproduct of ilmenite processing by Associated Minerals (USA) Ltd. Inc. and by E. I. duPont de Nemours & Co. Inc., both in Clay County. Associated Minerals shut down its production unit in midyear. Estimated capacity of both companies prior to shutdown was 135,000 short tons per year. The staurolite was recovered by electrical and magnetic separation from heavy minerals concentrates. Production and value decreased about 41% and 34%, respectively, from those of 1984. Staurolite was used mainly in foundry applications, for sandblasting, and in cement manufacture where it was used as a fluxing agent.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend. In 1985, the Bureau of Mines began compiling crushed stone production statistics by districts for some States.

Table 4.—Florida: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	33	153
Filter stone	454	2,498
Coarse aggregate, graded:		
Concrete aggregate, coarse	16,611	101,890
Bituminous aggregate, coarse	2,549	12,774
Bituminous surface-treatment aggregate	832	4,244
Railroad ballast	413	2,205
Fine aggregate (-3/8 inch):		
Stone sand, concrete	4,438	20,144
Stone sand, bituminous mix or seal	1,762	8,120
Screening, undesignated	1,781	8,457
Combined coarse and fine aggregates:		
Graded road base or subbase	13,528	36,241
Crusher run, fill, or waste	4,421	13,793
Other construction[2]	5,100	16,474
Agricultural:		
Agricultural limestone	3,340	7,811
Poultry grit and mineral food	W	1,829
Chemical and metallurgical: Cement manufacture	2,225	8,175
Special:		
Mine dusting or acid water treatment	W	339
Asphalt filler or extenders	W	628
Other fillers or extenders	W	162
Roofing granules	1,187	7,893
Other miscellaneous[3]	10,592	33,408
Other unspecified	(4)	(4)
Total	69,266	[5]287,237

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

[1]Includes dolomite, limestone, marl, and shell.

[2]Includes stone used in macadam, drain fields, coarse aggregate (large), fine aggregate, unpaved road surfacing, and stone used for other construction and maintenance purposes.

[3]Includes stone used in agricultural marl and other soil conditioners, sulfur oxide removal, and data indicated by symbol W.

[4]Includes products reported without a breakdown by end use and estimates for nonrespondents; included with "Other miscellaneous."

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

Table 5.—Florida: Crushed stone sold or used by producers in 1985, by use and district

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3		District 4	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	[1]	[1]	[1]	[1]	[1]	[1]	483	2,628
Coarse aggregate, graded	[1]	[1]	[1]	[1]	8,011	57,289	11,461	57,466
Fine aggregate (-3/8 inch)	[1]	[1]	[1]	[1]	1,913	8,385	6,164	28,685
Combined coarse and fine aggregates	[1]	[1]	[1]	[1]	7,983	20,750	7,202	22,324
Other construction	763	3,474	6,683	21,796	516	2,045	746	2,152
Agricultural limestone	[2]	[2]	[2]	[2]	394	1,641	[2]	[2]
Cement manufacture	--	--	--	--	[2]	[2]	[2]	[2]
Sulfur oxide removal	--	--	--	--	[2]	[2]	--	--
Mine dusting or acid water treatment	--	--	[2]	339				
Asphalt fillers or extenders	--	--	[2]	628	--	--	--	--
Other fillers or extenders	--	--	[2]	162	--	--	--	--
Roofing granules	--	--	--	--	1,187	7,893	--	--
Other miscellaneous	619	2,484	2,549	6,858	2,183	5,980	10,409	34,260
Other unspecified	--	--	[3]	[3]	--	--	--	--
Total[4]	1,382	5,958	9,232	29,783	22,187	103,983	36,466	147,514

[1]Withheld to avoid disclosing company proprietary data; included with "Other construction."
[2]Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."
[3]Includes products reported without a breakdown by end use and estimates for nonrespondents; included with "Other miscellaneous."
[4]Data may not add to totals shown because of independent rounding.

Florida ranked second nationally in output of crushed stone. Of the Nation's top 150 producing quarries, Florida had 14, 3 of which were in the top 10. Stone produced included limestone, dolomite, marl, and oyster shell. Output increased for the third straight year, reflecting activities in the construction sector; unit prices decreased. Crushed stone was produced by 77 companies at 107 quarries in 23 counties. Leading counties were Dade, Hernando, and Broward, which supplied nearly 63% of the State's output. Seventeen companies produced over 1 million short tons each and accounted for 77% of the State's production. Crushed stone was transported mainly by truck and railroad and was used for dense-graded road base, concrete and bituminous aggregates, and cement manufacture. Seven companies processed oyster shell for roadbed material. Most markets were in close proximity to quarries and were served by truck, but unit trains transport stone from the Miami area to market areas in the northern part of the State. Harper Bros. Inc., Fort Myers, with modifications to its plant, planned to double present output of 1 million tons per year at its underwater quarry. The company installed a new primary crusher and increased silo storage capacity during the year, allowing the increased output.

Sulfur (Recovered).—Output from Exxon Corp.'s natural gas desulfurization plant in Santa Rosa County decreased for the seventh straight year as oil and gas production decreased. Florida ranked 10th in the Nation in the recovery of byproduct elemental sulfur; unit prices increased slightly.

Vermiculite (Exfoliated).—Crude vermiculite ore shipped into Florida was exfoliated by two companies at four plants in Broward, Duval, and Hillsborough Counties. Florida ranked third in the Nation in output of exfoliated vermiculite. Production and value increased 6% and 1%, respectively, over those of 1984, indicating a decrease in unit prices. Principal uses were for concrete aggregate, horticulture, and insulation.

METALS

Iron and Steel.—Florida Steel Corp., one of the top 15 steelmakers nationally, operated minimills at Jacksonville and Tampa in 1985. The company has five plants nationwide and was one of the Nation's largest minimill operators. Florida Steel sold its Miami Structural Div., a structural steel fabricator, to Tampa Tank & Welding Inc. This was the final stage of the company's plan to divest itself of operations not directly related to the production and fabrication of merchant and reinforcing bars. Florida Steel was conducting a feasibility study to determine the location of a replacement mill for its Tampa operations. The Tampa mill produced reinforcing bar, which accounted for about 70% of the output of the company's five minimills. The Tampa fa-

cility has two electric arc furnaces with a combined annual tonnage of 280,000 short tons, along with two continuous billet casting machines, a reheat furnace, and an integrated eight-strand bar rolling mill. Late in the year, the company purchased a direct current arc furnace for installation at its Tampa mill because of the expectation that it would use one-half of the electrodes used in a traditional alternating current arc furnace. Installation began in 1985 with completion scheduled for early 1986. Florida Steel was also spending $8 million to install a rod finishing mill at its Jacksonville plant, which will produce coiled reinforcing bar as well as coiled wire rod. The mill was operational by late 1985.

According to the Directory of Florida Industries, 10 gray iron foundries and 9 steel foundries operated in Florida. The majority of these foundries were relatively small.

Ferroalloys.—Two companies produced ferroalloys in the State with output increasing and unit prices decreasing. Electro-Phos Corp., Pierce, and Stauffer Chemical Co., Tarpon Springs, produced ferrophosphorus in 1985.

Mineral Sands.—*Rare-Earth Minerals.*—Florida remained the only State with production of rare earths from mineral sands mining. Associated Minerals recovered monazite concentrate as a byproduct of its operation in Clay County. Output increased while unit prices decreased. Associated Minerals installed a bucket wheel excavator on its floating dredge, which was expected to increase output.

Titanium Concentrates.—DuPont and Associated Minerals produced concentrate from their heavy minerals operations in Clay County. The Trail Ridge deposit in Florida is probably the most important source of detrital heavy minerals in the Nation. Both rutile and ilmenite shipments increased over those of 1984; unit prices of ilmenite decreased, while those of rutile increased. Florida was the only producer of rutile and ilmenite. Associated Minerals, with an annual capacity of about 30,000 short tons, was the only producer of natural rutile concentrate. Exploration by both companies continued and the construction of a synthetic rutile plant in the area was still under consideration. Output of mineral sands was shipped primarily to users in the Southeast.

Zircon.—DuPont and Associated Minerals recovered zircon concentrate from their operations in Clay County. Output increased slightly while unit prices decreased. Florida remained the only State with a recorded production of zircon, which was recovered as a byproduct of mineral sands operations. Principal markets were in the foundry, refractory, and ceramic industries. The combined zircon capacity of the two plants was estimated to be 125,000 short tons per year.

[1]State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.
[2]State geologist, Florida Bureau of Geology, Tallahassee, FL.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
General Portland Inc	Box 22348 Tampa, FL 3362	Plants	Hillsborough.
Lonestar Florida Pennsuco Inc	Box 122035 Hialeah, FL 33012	Plant	Dade.
Moore McCormack Resources Inc.	Box 23965 Tampa, FL 33630	do	Hernando.
National Portland Cement Co	Route 1 Port Manatee, FL 33561	do	Manatee.
Rinker Portland Cement Corp	Drawer K Palm Beach, FL 33402	do	Dade.
Clays:			
Engelhard Minerals & Chemical Corp.	Menlo Park Edison, NJ 08817	Open pit mines and plant.	Brevard.
The Feldspar Corp., EPK Div.[1]	Box 8 Edgar, FL 32049	do	Putnam.
Florida Solite, Solite Corp	Box 297 Green Cove Springs, FL 32043	do	Clay.
Mid-Florida Mining Co	Box 68-F Lowell, FL 32663	do	Marion.
Pennsylvania Glass Sand Corp	Berkeley Springs, WV 25411	do	Gadsden.
Gypsum (calcined):			
Jim Walter Corp	Box 135 Jacksonville, FL 32226	Plant	Duval.
National Gypsum Co	4100 First International Bldg. Dallas, TX 57270	do	Hillsborough.
USG Corp	101 South Wacker Dr. Chicago, IL 60606	do	Duval.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lime:			
Basic Magnesia Inc.[2]	Box 160 Port St. Joe, FL 32456	Plant	Gulf.
Chemical Lime Inc	Box 317 Leesburg, FL 32748	do	Hernando.
Dixie Lime & Stone Co.[3]	Drawer 217 Sumterville, FL 33585	do	Sumter.
Peat:			
Atlas Peat & Soil Inc	Box 867 Boynton Beach, FL 33435	Bog	Palm Beach.
Superior Peat & Soil Co	Box 1688 Sebring, FL 33870	Bog	Highlands.
Perlite (expanded):			
Airlite Processing Corp. of Florida.	Route 2, Box 740 Vero Beach, FL 32960	Plant	Indian River.
Armstrong Cork Co	Box 1991 Pensacola, FL 35289	do	Escambia.
Chemrock Corp	End of Osage St. Nashville, TN 37208	do	Duval.
W. R. Grace & Co.[4]	62 Whittemore Ave. Cambridge, MA 02140	do	Broward.
Phosphate rock:			
Agrico Chemical Co	Box 1110 Mulberry, FL 33860	Open pit mines and plants.	Polk.
AMAX Chemical Inc	402 South Kentucky Ave. Lakeland, FL 33801	Open pit mine and plant.	Hillsborough.
Beker Phosphate Corp	Box 9034 Bradenton, FL 33506	do	Manatee.
Brewster Phosphates	Bradley, FL 33835	Open pit mines and plant.	Hillsborough and Polk.
CF Industries Inc	Box 790 Plant City, FL 33566	Open pit mine and plant.	Hardee.
Estech Inc	Box 208 Bartow, FL 33830	Open pit mines	Polk.
Gardinier Inc	Box 3269 Tampa, FL 33601	Open pit mine and plant.	Do.
W. R. Grace & Co	Box 471 Bartow, FL 33830	Open pit mines and plant.	Do.
International Minerals & Chemical Corp.	Box 867 Bartow, FL 33830	do	Do.
Mobil Mining and Minerals Co.	Box 311 Nichols, FL 33863	do	Do.
Occidental Chemical Co	White Springs, FL 32096	do	Hamilton.
U.S.S. Agri-Chemicals Inc	Box 867 Fort Meade, FL 33841	Open pit mine and plant.	Polk.
Sand and gravel (1984):			
Florida Rock Industries Inc., Shands & Baker.	Box 4667 Jacksonville, FL 32201	Pits	Clay, Glades, Lake, Marion, Polk, Putnam.
General Development Corp	1111 South Bayshore Dr. Miami, FL 33131	do	Hendry, St. Lucie, Sarasota.
E. R. Jahna Industries Inc., Ortona Sand Co. Div.	102 East Tillman Ave. Lake Wales, FL 33853	do	Glades, Lake, Polk.
Silver Sand Co. of Clermont Inc.	Route 1, Box US1 Clermont, FL 32711	Pit	Lake.
Staurolite:			
Associated Minerals (USA) Ltd. Inc.[5]	Green Cove Springs, FL 32043	Mine and plant	Clay.
E. I. duPont de Nemours & Co. Inc.[5]	DuPont Bldg. D-10084 Wilmington, DE 19898	Mines and plants	Do.
Stone:			
Florida Crushed Stone Co	Box 317 Leesburg, FL 32748	Quarries	Hernando and Sumter.
Florida Rock Industries Inc	Box 4667 Jacksonville, FL 32201	do	Alachua, Collier, Hernando, Lee, Levy, St. Lucie, Taylor.
Rinker Southeastern Materials Inc.	Box 5230 Hialeah, FL 33014	do	Dade.
Tarmac Florida Inc	Box 8648 Deerfield Beach, FL 33441	Quarry	Do.
Vulcan Materials Co	Box 660097 Miami Springs, FL 33166	Quarries	Broward and Dade.

[1]Also construction and industrial sand and gravel.
[2]Also magnesia.
[3]Also crushed stone.
[4]Also exfoliated vermiculite.
[5]Also titanium concentrates.

The Mineral Industry of Georgia

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources, for collecting information on all nonfuel minerals.

By Doss H. White, Jr.,[1] and Bruce J. O'Connor[2]

In 1985, Georgia mineral sales established a new record, almost $6 million over the previous one established in 1984. Increased value of nearly $36.6 million for crushed stone was the principal reason for the new record. Sales of other mineral commodities mined in the State fell $31 million below the 1984 level.

Nationally, the State ranked fourth in industrial mineral production and seventh in total mineral output. Georgia continued to lead the Nation in the production of clays, crushed and dimension granite, and dimension marble. The State ranked second in crude iron oxide pigments, kyanite, and crushed marble, and third in feldspar production.

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

Mineral		1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
Clays	thousand short tons	8,679	$600,029	8,671	$575,097
Gem stones		NA	20	NA	20
Sand and gravel:					
Construction	thousand short tons	5,347	13,623	e5,000	e13,400
Industrial	do	478	6,795	571	6,675
Stone:					
Crushed	do	e45,900	e220,000	52,062	256,588
Dimension	do	e202	e20,007	185	19,466
Talc	do	15	104	16	111
Combined value of barite, bauxite (1984), cement, feldspar, iron oxide pigments (crude), kyanite, mica (scrap), and peat		XX	79,914	XX	74,718
Total		XX	940,492	XX	946,075

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

Table 2.—Nonfuel minerals produced in Georgia in 1984, by county[1]

County	Minerals produced in order of value
Baldwin	Sand and gravel.
Bartow	Barite, iron oxide pigments, clays.
Bibb	Clays, sand and gravel.
Brantley	Sand and gravel.
Carroll	Do.
Chatham	Do.
Cherokee	Do.
Cobb	Do.
Columbia	Clays.
Columbus (city)	Do.
Cook	Sand and gravel, peat.
Crawford	Sand and gravel.
Decatur	Clays, sand and gravel.
De Kalb	Sand and gravel.
Dougherty	Do.
Douglas	Clays, sand and gravel.
Effingham	Sand and gravel.
Elbert	Do.
Floyd	Clays.
Forsyth	Sand and gravel.
Fulton	Cement, clays, sand and gravel.
Glynn	Sand and gravel.
Greene	Do.
Gwinnett	Do.
Hart	Mica.
Houston	Cement, clays.
Jackson	Sand and gravel.
Jasper	Feldspar.
Jefferson	Clays.
Lee	Sand and gravel.
Lincoln	Kyanite.
Long	Sand and gravel.
Lowndes	Do.
Marion	Do.
Montgomery	Do.
Murray	Talc.
Richmond	Clays, sand and gravel.
Screven	Peat.
Sumter	Clays, bauxite, sand and gravel.
Talbot	Sand and gravel.
Taylor	Do.
Thomas	Clays, sand and gravel.
Twiggs	Clays.
Warren	Do.
Washington	Do.
Wheeler	Sand and gravel.
Wilkinson	Clays.
Undistributed[2]	Stone (crushed and dimension), clays, gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Trends and Developments.—Although Georgia's economy continued to grow, the rate lagged behind that of 1984 and slowed considerably during the latter part of the year. This slowdown impeded activity in the construction industry, the principal market for the State's construction mineral production, which historically accounts for approximately 25% of Georgia's mineral value. While aggregate producers continued to experience a demand buoyed by a vigorous State road building and maintenance program, this demand lessened during the latter part of 1985.

Kaolin sales, which in the past several years accounted for about 60% to 70% of Georgia's mineral value, also experienced a downturn after midyear. J. M. Huber Co., one of the Nation's leading kaolin producers, was operating at 20% to 30% below capacity at yearend. Engelhard Corp., another leader in kaolin production, experienced a 5% decline in domestic sales and a 7% decline in exports. The former was attributed to inroads into traditional kaolin markets by calcium carbonate substitutes and the latter to the strong U.S. dollar. In addition, large imports of paper, primarily from the Federal Republic of Germany and Sweden, cut into the U.S. paper production, the principal market for the kaolin producers.

Both Australia and Brazil plan to increase kaolin production and exports, which will affect both the foreign and domestic market for Georgia production.

A decreasing share of the world market was not the only problem faced by the State's kaolin industry. In the past 3 years, approximately a dozen lawsuits have been filed against the companies by heirs of former property owners in the kaolin belt who sold their mineral rights to the kaolin companies in the 1920's through 1950's. The suits contend that the sellers were not informed as to the value of the minerals under their land and ask that the leases-sales be declared void.

In February, a teenage boy fell to his death in an abandoned copper mine in the Dahlonega area. The mine and two others were sealed with concrete caps to prevent a recurrence; however, approximately 200 abandoned mines, some dating to the 19th century, dot the Lumpkin County countryside, and funds are not available to cap all of the hazardous areas.

The Georgia Mining Association (GMA) continued as the spokesorganization for the State's mining industry. During the year, GMA sponsored several seminars and conferences; among these were the "Environmental Conference," the "Environmental Institute for Teachers," the "Tax Seminar," and the "Drug Awareness Workshop." GMA was instrumental in the preparation of several newspaper articles promoting the positive benefits of mining.

The Georgia Crushed Stone Association (GCSA), which represents the major aggregate producers in the State, continued its programs to educate the public and legislative sectors on the basic role that crushed stone plays in the State's economic well-being. The association's Marketing and

Table 3.—Indicators of Georgia business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	5,733	5,842	5,976
Total civilian labor force	do.	2,685	2,761	2,865
Unemployment	percent	7.5	6.0	6.5
Employment (nonagricultural):				
Mining total	thousands	7.3	7.8	8.0
Manufacturing total	do.	511.1	546.5	554.3
Primary metal industries	do.	15.0	16.2	16.5
Stone, clay, and glass products	do.	17.7	18.8	19.7
Chemicals and allied products	do.	17.9	18.9	19.3
Construction	do.	108.8	131.5	145.6
Transportation and public utilities	do.	147.7	156.5	162.4
Wholesale and retail trade	do.	547.6	602.4	648.0
Finance, insurance, real estate	do.	121.8	128.3	137.1
Services	do.	397.6	433.7	463.1
Government and government enterprises	do.	437.6	442.0	447.3
Total	do.	2,279.5	2,448.7	2,565.8
Personal income:				
Total	millions	$61,263	$68,910	$74,960
Per capita		$10,685	$11,796	$12,543
Hours and earnings:				
Total average weekly hours, production workers		41.1	41.0	40.6
Total average hourly earnings, production workers		$7.1	$7.6	$8.0
Earnings by industry:				
Farm income	millions	$693	$1,244	$833
Nonfarm	do.	$46,023	$52,163	$57,613
Mining total	do.	$234	$279	$286
Manufacturing total	do.	$10,020	$11,271	$12,072
Primary metal industries	do.	$385	$448	$481
Stone, clay, and glass products	do.	$379	$425	$465
Chemicals and allied products	do.	$446	$511	$545
Construction	do.	$2,754	$3,475	$3,876
Transportation and public utilities	do.	$4,632	$5,033	$5,477
Wholesale and retail trade	do.	$8,903	$10,282	$11,562
Finance, insurance, real estate	do.	$2,710	$3,045	$3,592
Services	do.	$7,987	$9,359	$10,603
Government and government enterprises	do.	$8,573	$9,191	$9,889
Construction activity:				
Number of private and public residential units authorized[1]		66,417	70,289	73,141
Value of nonresidential construction[1]	millions	$1,469.9	$1,996.0	$2,484.9
Value of State road contract awards	do.	$292.6	$452.0	$560.0
Shipments of portland and masonry cement to and within the State	thousand short tons	2,445	2,984	3,103
Nonfuel mineral production value:				
Total crude mineral value	millions	$849.6	$940.5	$946.1
Value per capita		$148	$161	$158

[p]Preliminary. [r]Revised.
[1]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

Technical Committees published over 5,000 copies of the "Crushed Product Guide" and the "Crushed Stone Information Directory." During the year, GCSA held a management workshop, at which time a $6,000 grant was made to the Georgia Institute of Technology School of Civil Engineering. The association worked closely with the Georgia Department of Transportation to determine the cause and solution to a rutting problem observed in some sectors of the State's asphaltic concrete highways.

The China Clay Producers Association, representing seven of the State's leading kaolin producers, funded a study on the economic contributions of kaolin mining and processing. The association held several press briefings to publicize the findings, which document the $350 million annually added to the State's economy by kaolin-related activity.

Legislation and Government Programs.—During the 1985 session of the Georgia General Assembly, a Surface Mining Bond Bill was passed and signed by the Governor. The act requires companies planning to extract mineral commodities by surface methods to post a bond of up to $2,500 per acre prior to initiating mining. Formerly, a bond of up to $1,000 per acre was required. A second act with impact on the mining industry was the Water Well Standards Act of 1985. A section of the act addresses drilling associated with mineral exploration and/or mine development. Holes must be drilled and/or plugged under the supervision of a registered geologist or engineer.

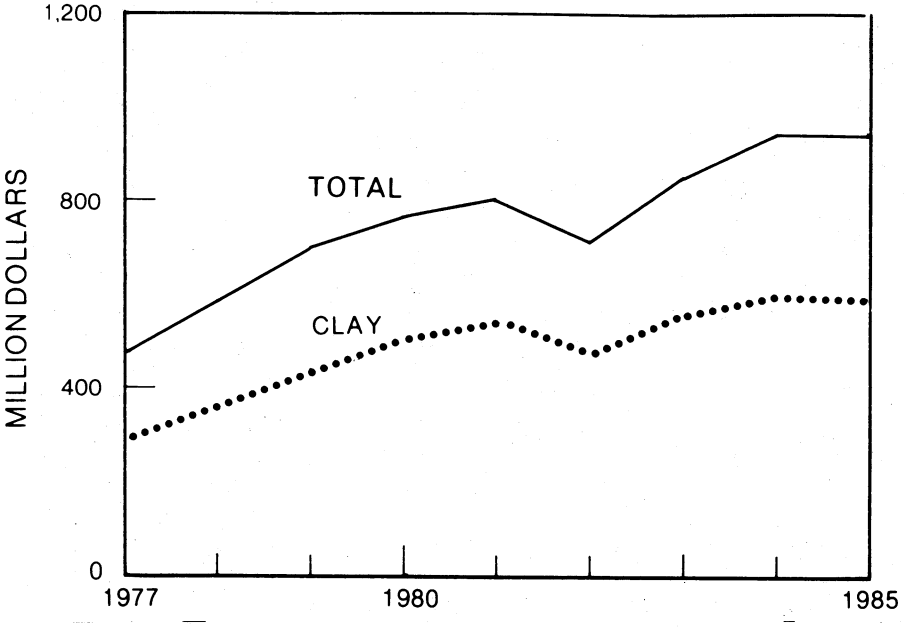

Figure 1.—Value of clays and total value of nonfuel mineral production in Georgia.

A panel sponsored by the General Assembly's Surface Mining Subcommittee completed a study on mined land reclamation and the effectiveness of Georgia's 1968 Reclamation Act. The panel's findings and recommendations will be presented to the Natural Resources and Environment Committee early in 1986.

A number of Federal and State government agencies had programs ongoing that impacted Georgia's mineral industry. Notably among these were the U.S. Department of the Interior's Bureau of Mines, Geological Survey, and Office of Surface Mining, and the Georgia Geologic Survey (GGS).

U.S Bureau of Mines engineers and scientists at the Tuscaloosa Research Center worked with several of Georgia's mineral producers to develop improved methods of mineral recovery. Bureau geologists in the Intermountain Field Operations Center, Denver, CO, completed mineral land assessment reports on the Brasstown-Wolf Pen, Worley Ridge, Rabun Bald-Rand Mountain, Board Camp-Raven Cliff, and Southern Nantahala areas. The Bureau contracted with the Georgia Department of Health and Human Services to do research on the health effects of silica dust and on particle characterization to improve silica dust control, and with Morehouse College to investigate the use of cyanobacteria in the recovery of metals from mineral processing water and waste water.

Geologists with the U.S. Geological Survey (USGS), working from the Doraville office, continued the geological mapping of the Athens 1° and Barnwell 1° topographic areas to better define the State's geological and mineral resources. USGS geologists aboard the USGS research vessel, *J. W. Powell,* identified several mineral-rich areas off Georgia's coast. Two vibracore and three grab samples taken from an area about 12 miles square contained 5% to 30% heavy minerals, primarily ilmenite and zircon. Initial exploration indicated that the mineral-rich areas had a vertical depth of at least 10 feet.

GGS, an agency of the Department of Natural Resources (DNR), is the principal State organization responsible for the investigation of Georgia's geologic, hydrologic, and mineral resources. GGS personnel pro-

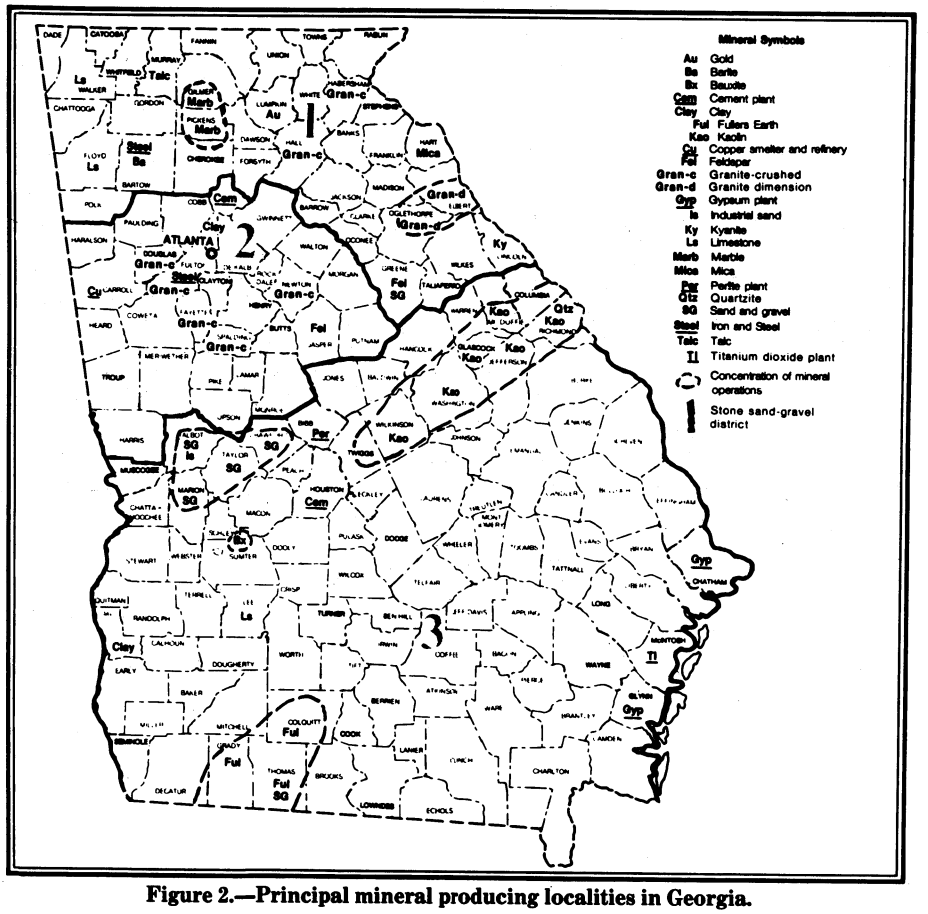

Figure 2.—Principal mineral producing localities in Georgia.

vide technical expertise to other groups in the DNR and other State agencies promoting industrial development. GGS is charged with the regulation of petroleum and natural gas exploration and Classes IV and V injection wells, oversees compliance with the Water Well Standards Act, and administers the State's ground water management plan. From July 1, 1984, to June 30, 1985 (the State's fiscal year), GGS published 18 reports and responded to approximately 2,600 information requests on the geology, hydrology, and mineral resources of the State.

The GGS geology program emphasizes economic geology and the Accelerated Minerals Program. This program includes investigations into (1) construction sand and gravel potential of the Coastal Plain, (2) the massive sulfide deposits of the State, (3) the gold resources of the State, (4) mafic and ultramafic rock bodies, and (5) ceramic clays and shales of the Valley and Ridge Province. Additionally, GGS provides technical assistance and information to mining companies including the publication of a mining and geoscience facilities directory. Other activities included a major revision of the Cenozoic stratigraphy of the Coastal Plain and participation in the U.S. Department of Energy's Crystalline Rock Repository Study for high-level radioactive waste. With a grant from the Minerals Management Service, GGS also continued evaluating offshore phosphate-bearing strata.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Barite.—New Riverside Ochre Co. and Paga Mining Co. mined barite by surface methods in the Cartersville area of northwestern Georgia. Both companies recovered a barite concentrate by flotation methods. Paga produced three filler grades of barite for the paint, paper, plastic, and rubber markets. New Riverside Ochre's barite concentrates were used by Chemical Products Corp., an associated company, for the production of barium chemicals.

New Riverside Ochre, which has operated a surface mine inside the city limits of Cartersville for 20 years, is scheduled to complete mining and reclamation by 1988 and will transfer mining operations to the Emerson area south of Cartersville. During 1985, New Riverside Ochre and Paga officials met with the Emerson land use planning commission to discuss mineral rights within the city limits owned by the two companies. Company drilling and reserve data were made available to the commission as an aid in zoning certain areas for mining.

Beryl.—Approximately 10 short tons of beryl was recovered by B&B Minerals Co. Inc. during mica mining at the Cochran pegmatite in Cherokee County. The beryl was shipped to the Brush Wellman plant near Delta, UT, for processing into beryllium hydroxide.

Cement.—During the year, Lehigh Portland Cement Co. purchased a cement distribution terminal near Atlanta. The terminal will handle cement produced at a Lehigh plant in Leeds, AL, near Birmingham.

Clays.—Historically, Georgia has led the Nation in the production and sales of clays, and this was again true in 1985. In the decade of the 1980's, the State's clay producers sold over $2.75 billion worth of clay products. Kaolin was the leading clay commodity produced in terms of value (93%), followed by fuller's earth (6%), and common clay (1%).

Table 4.—Georgia: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Kaolin		Fuller's earth		Common clay	
	Quantity	Value	Quantity	Value	Quantity	Value
1981	6,236	519,497	584	30,173	1,209	4,156
1982	5,268	445,389	534	27,558	970	2,821
1983	5,886	523,407	692	32,826	1,281	3,773
1984	6,508	562,697	569	32,415	1,601	4,918
1985	6,345	534,980	593	34,628	1,733	5,489

Kaolin.—In 1985, Georgia's kaolin production came from 25 mines in a 10-county area in the east-central part of the State. Kaolin production and value (see table 4) fell below the 1984 figures by 163,000 short tons and nearly $28 million, respectively.

The decline was due in part to increased use of calcium carbonate in the paper industry, the strong U.S. dollar during much of the year, and imports of foreign paper products. Kaolin activity within Georgia during 1985 is noted in the following table:

Company	Location	Remarks
Engelhard Corp	Attapulgus	Began operation of its kaolin-based catalyst plant.
Do	Gordon	Donated technical reference valued at $100,000 to Mercer University School of Engineering.
Do	do	Purchased Freeport Kaolin Co. for $100 million.
J. M. Huber Co	Wrens	Contracted with Eriez Magnetics to construct the world's first super conducting high gradient magnetic separator.
United Catalysts Inc	Hephzibah	Purchased Albion Kaolin Co. from Babcock and Wilcox Inc.

In other kaolin-related activity, Georgia Kaolin Co. and Anglo-American Clays Corp. agreed to pay Engelhard in excess of $4 million royalty for the right to use a patented method refining nonpaper-grade kaolin, and Evans Clay Co. signed a 6-year labor contract with its employees. The contract is believed to be the longest of its kind in the industry and will allow the company to expand its McIntyre operation without worry about labor problems.

A bauxitic kaolin was mined by C-E Minerals Inc. at Andersonville in west-central Georgia. After blending, the clay was extruded into pellets, dried, and calcined. Three grades of material were marketed, with 47%, 60%, and 70% alumina content. The company also imports bauxite from China. Approximately one-half of the facility's output is sold for domestic use, and the remainder is shipped to overseas customers.

American Cyanamid Co. mined kaolin in the Andersonville area as a raw material in the production of alum. The kaolin was semicalcined prior to shipping to chemical plants.

Table 5.—Georgia: Kaolin producers in 1985[1]

Company	Location	Capacity[2] (thousand short tons)	Primary use
Albion Kaolin Co	Hephzibah	200	Refractories, ceramics, fiberglass.
American Industrial Clay Co	Sandersville	[3]NA	NA.
	Wrens		
Anglo-American Clays Corp	Sandersville	350	Paper coating and filler.
Buffalo China Clay Co	do	55	Paper.
Cyprus Industrial Minerals Co	do	200	Paper and refractories.
Engelhard Corp., Specialty Chemicals Div	do		
	Irwinton		
	McIntyre	[3]1,000	Paper.
	Gardner		
Evans Clay Co	Irwinton	120	Rubber, paint, insecticide.
Freeport Kaolin Co	Sandersville	[3]450	Paper (80%).
	Gordon		
Georgia Kaolin Co	Dry Branch	1,600	NA.
J. M. Huber Co	Wrens	[3]900	Paper, rubber, plastics, paint, adhesives.
	Huber		
M & M Clays Inc	Irwinton	80	Rubber.
Nord Kaolin Co	Jeffersonville	140	Paper.
Thiele Kaolin Co	Sandersville	[3]600	Paper coating and filler.
	Wrens		
Wilkinson Kaolin Associates Ltd	Gordon	120	Ceramics and fiberglass.

NA Not available.
[1]Excludes Andersonville District and kaolin used in cement manufacture.
[2]Industrial Minerals (London). Dec. 1979, pp. 31-33.
[3]All pits.

Table 6.—Georgia: Kaolin sold or used by producers, by county

County	1984			1985		
	Number of mines	Quantity (thousand short tons)	Value (thousands)	Number of mines	Quantity (thousand short tons)	Value (thousands)
Jefferson	1	W	W	1	W	W
Richmond[1]	2	269	$16,014	2	352	$13,144
Twiggs	6	1,191	102,794	6	1,266	112,270
Washington	6	2,268	199,224	5	2,330	211,131
Wilkinson	6	1,164	123,105	4	778	88,157
Other[2]	7	1,616	121,560	7	1,619	110,278
Total	28	6,508	562,697	25	6,345	534,980

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes Jefferson County.
[2]Includes Columbia, Houston, Macon, Sumter, and Warren Counties and data indicated by symbol W.

Table 7.—Georgia: Kaolin sold or used by producers, by kind

Kind	1984		1985	
	Short tons	Value	Short tons	Value
Air-float	591,869	$27,989,083	739,563	$31,824,375
Calcined[1]	850,372	129,410,496	945,106	100,875,939
Delaminated	764,566	72,529,476	735,503	72,075,882
Unprocessed	395,094	9,799,483	196,312	5,594,126
Water-washed	3,906,418	322,968,236	3,728,721	324,609,679
Total	6,508,319	562,696,774	6,345,205	534,980,001

[1]Includes both low-temperature filler and high-temperature refractory grades.

Fuller's Earth.—Georgia's fuller's earth industry is composed of five companies with operations in the southwestern part of the State and a sixth company in the central part.

Sales of fuller's earth increased $2.2 million and established a new record high. During the year, Oil-Dri Corp. purchased the mines and plant formerly operated by Anschutz Mining Co. adjacent to Oil-Dri's current plant. The $1.75 million transaction expands Oil-Dri's reserves by 40%.

Common Clay.—The output and value of common clay and shale products increased for the third consecutive year because of the continued demand by the southeastern construction industry. Georgia's common clay and shale industry is situated in four counties in the northwestern part of the State and in two counties in central and east-central areas of Georgia. Historically, over 80% of clay and shale production has been used in brick and tile manufacture. Other uses include cement and aluminum sulfate manufacture.

Table 8.—Georgia: Fuller's earth producers in 1985

Company	Location	Product
Engelhard Corp., Specialty Chemicals Div	Attapulgus	Catalysts and absorbents.
Georgia-Tennessee Mining and Chemical Co	Wrens	Absorbents (animal and industrial wastes) and agricultural carriers.
Milwhite Co. Inc	Attapulgus	Absorbents, fillers, joint compounds.
Oil-Dri Corp	Ocklocknee	Absorbents (animal and industrial wastes).
Thor Mining Co	Meigs	Do.
Waverly Mineral Products Co	do	Do.

Feldspar.—The Feldspar Corp. produced both high potash and soda feldspar ore from surface mines in Greene and Jasper Counties. The company operated a beneficiation plant at Monticello where the ore from the two mines was crushed and ground and a concentrate was obtained by flotation.

Feldspar production decreased slightly in 1985 compared with that of 1984. Instate feldspar use has risen from 64,700 short tons in 1980 to 95,300 tons in 1985 with Atlanta-area glass producers providing

the major market. Compared with that of 1984, there was a decrease of 700 tons.

Gypsum.—Canadian gypsum was imported by three companies and byproduct gypsum was produced by a fourth. The Canadian ore was used to produce gypsum board, plasters, fillers, and agricultural products. Kemira Inc. produced byproduct gypsum during titanium dioxide production at a plant in Savannah. The byproduct material was purchased by Lemco Gypsum Inc. to manufacture briquets for the cement industry. Georgia's gypsum industry is summarized in the following table:

Company	County	Source
Genstar Gypsum Products Co.	Chatham	Newfoundland.
Georgia-Pacific Corp., Gypsum Div.	Glynn	Nova Scotia.
Lemco Gypsum Inc	Chatham	Kemira Inc.
National Gypsum Co	do	Nova Scotia.

Iron Oxide Pigments.—New Riverside Ochre continued as the only natural pigment producer in the Southeast. The Cartersville-based company mined crude pigments for processing into coloring agents for cement and construction materials.

Kyanite-Mullite.—Georgia and Virginia were the only States reporting the production of kyanite, an aluminum silicate used by the ceramic industry and as a raw material in the production of mullite for refractory applications. Pasco Mining Inc. operated an open pit kyanite mine and beneficiation plant at Graves Mountain in Lincoln County. The beneficiation facility utilizes grinding, two-stage flotation, and magnetic separation to produce a kyanite concentrate. The dried concentrate was trucked approximately 20 miles to the company's Little River plant and ground and/or calcined for use in refractories or other high-temperature ceramic use.

Synthetic mullite produced by sintering an aluminous and siliceous mix was produced by the Mulcoa Div. of C-E Minerals at a plant in Sumter County. This operation is discussed in the "Clays" section.

Lime.—Brunswick Pulp and Paper Co., Brunswick, began operating the world's largest lime kiln in December. The $15 million kiln, imported from Finland, will replace three existing kilns; the new unit will reduce fuel requirements as well as solid waste output.

Mica.—Franklin Mineral Products Co. Inc., a subsidiary of the Mearl Corp., operated an open pit mine and beneficiation plant in Hart County in northeastern Georgia. The company produced a wet-ground product and also shipped crude mica to a wet grinding plant in Franklin, NC. Much of the production is used by the parent company in the manufacture of pearlescent pigments.

B&B Minerals recovered both sheet and scrap mica at the Cochran Mine in Cherokee County. Sheet mica was sold to Spruce Pine Mica Co., Spruce Pine, NC, and the scrap mica was purchased by Franklin Mineral Products.

Perlite.—Crude perlite was imported from Greece by Armstrong World Industries Inc. and expanded at a plant in Macon. Sales, principally for insulation applications, increased over those of 1984 according to an industry spokesperson.

Pyrite.—A pyrite concentrate, recovered during kyanite beneficiation, was marketed by Pasco Mining, Graves Mountain, for a coloring agent in bottle manufacture.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend. The 1985 estimate was 347,000 short tons less than that reported in 1984, which reflects the slowdown in construction.

Industrial.—Georgia's industrial sand companies produced 571,000 short tons of industrial sand valued at nearly $6.7 million. Although tonnage increased 93,000 tons, value decreased $120,000.

Silica (Fused).—Harbison-Walker Refractories in Calhoun and Leco Corp. in Lawrenceville, comprising the State's fused silica industry, produce silica grains and powder for the refractory, foundry, filler, and extender markets. The bulk of Harbison-Walker's grain production is used in an on-site company refractory products plant. Harbison-Walker exports to both Europe and Japan. Much of Leco's output is used in the company's refractory and investment casting products.

Silicon Carbide.—Silicon Metal Products Inc., near Elberton, operated the country's only plant to recover silicon carbide from sludge produced during granite cutting. Plant feed, recovered from holding ponds, was processed and a concentrate recovered by flotation.

Slag—Iron and Steel.—Atlantic Steel

Co., operating plants in Atlanta and Cartersville, sold byproduct slag from the two minimills to a farm that marketed the material for aggregate uses.

Sodium Bicarbonate.—Riverside Products Co. of Cartersville operated the only sodium bicarbonate plant in the Southeast. Plant feed was soda ash, produced from trona mined in Wyoming. Principal markets were the pharmaceutical, food, and animal feed industries.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone production increased more than 6 million short tons over the 1984 estimate and value increased nearly $36.6 million.

In 1985, the Bureau of Mines began compiling crushed stone production statistics by districts for some States. Table 10 presents end-use data for crushed stone produced in the three Georgia districts that are outlined in figure 2.

Table 9.—Georgia: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	193	1,355
Coarse aggregate, graded:		
Concrete aggregate, coarse	13,643	73,380
Bituminous aggregate, coarse	2,848	15,628
Railroad ballast	2,568	10,902
Fine aggregate (-3/8 inch):		
Stone sand, concrete	2,042	11,273
Stone sand, bituminous mix or seal	1,046	4,943
Screening, undesignated	3,518	17,049
Combined coarse and fine aggregates:		
Graded road base or subbase	9,792	46,337
Unpaved road surfacing	491	1,971
Crusher run, fill, or waste	8,870	41,806
Other construction[2]	2,413	12,232
Agricultural: Agricultural limestone	1,304	6,590
Special:		
Other miscellaneous[3]	2,015	7,567
Other unspecified[4]	1,319	5,557
Total	52,062	[5]256,588

[1]Includes dolomite, granite, limestone, marble, quartzite, and slate.
[2]Includes bituminous surface-treatment aggregate, filter stone, and other construction and maintenance uses.
[3]Includes cement manufacture, other fillers or extenders, and waste material.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data do not add to total shown because of independent rounding.

Table 10.—Crushed stone sold or used by producers in Georgia in 1985, by use and district

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	[1]	[1]	[1]	[1]	[1]	[1]
Coarse aggregate, graded	4,188	21,407	10,412	55,687	4,958	25,400
Fine aggregate (-3/8 inch)	[1]	[1]	4,590	23,435	[1]	[1]
Combined coarse and fine aggregates	4,836	21,516	10,549	51,905	3,768	16,693
Other construction	2,178	10,976	486	3,370	1,458	6,486
Agricultural limestone	[2]	[2]	--	--	[3]	[3]
Cement manufacture	[2]	[2]	--	--	[3]	[3]
Other fillers or extenders	[2]	[2]	--	--	--	--
Other miscellaneous	2,385	11,952	--	--	--	--
Other unspecified[4]	391	1,810	928	3,747	--	--
Total[5]	13,979	67,659	26,965	138,144	11,118	50,784

[1]Withheld to avoid disclosing company proprietary data; included with "Other construction."
[2]Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."
[3]Withheld to avoid disclosing company proprietary data; included in "Total."
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Talc.—Southern Talc Co. mined talc underground in Murray County in north-central Georgia. Run-of-mine material was trucked to Chatsworth where it was dried, crushed, and ground for use by the insecticide, paper, roofing, and plastic industries.

Titanium Dioxide.—Kemira Oy, Helsinki, Finland, purchased the American Cyanamid titanium dioxide (TiO_2) plant in Savannah for approximately $100 million. With the acquisition, Kemira owned approximately 8% of the Western World's TiO_2 capacity. The Savannah plant, which employed 600 workers, produced material used for whitening in paint, bleached paper, plastics, and other products.

METALS

Arsenic.—Two companies, Koppers Co. Inc. in Conley and Mineral Research Development Corp. in Valdosta, processed low-grade Canadian arsenic trioxide into arsenic acid for the production of chromated copper arsenate wood preservatives.

Bauxite.—The Mulcoa Div. of C-E Minerals mined bauxite and bauxitic kaolin in the Anderson area. The operation is described in the "Clays" section; however, there was no bauxite production reported during 1985.

Copper.—Southwire Co. operated a copper smelter, a continuous cast copper rod plant, and a copper wire facility at Carrollton, west of Atlanta.

Gold.—Several companies continued to recover gold with sand and gravel as a coproduct in the Lumpkin and White County areas of northern Georgia.

Iron and Steel.—Atlantic Steel operated minimills in Atlanta and Cartersville. The Atlanta plant was equipped with two 90-short-ton furnaces, and the Cartersvile plant housed a single 100-ton unit.

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

[2]Senior economic geologist, Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
New Riverside Ochre Co.[1]	Box 387 Cartersville, GA 30120	Open pit mine and mill.	Bartow.
Paga Mining Co	Box 130 Cartersville, GA 30120	----do----	Do.
Bauxite:			
Mullite Co. of America	Box 37 Andersonville, GA 31711	----do----	Macon and Sumter.
Cement:			
Blue Circle Inc	2520 Paul Ave., NW. Atlanta, GA 30318	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 Corp., Specialty Chemicals Div.	Menlo Park Edison, NJ 08817	----do----	Decatur, Washington, Wilkinson.
J. M. Huber Co	Thornall St. Edison, NJ 08817	----do----	Twiggs and Warren.
Thiele Kaolin Co	Box 1056 Sandersville, GA 31082	----do----	Warren and Washington.
Feldspar:			
The Feldspar Corp	Box 99 Spruce Pine, NC 28777	Open pit mines and plant.	Greene and Jasper.
Gypsum (calcined):			
Genstar Gypsum Products Co	Box 2580 Irving, TX 75061	Plant	Chatham.
Georgia-Pacific Corp	133 Peachtree St., NE. Atlanta, GA 30303	----do----	Glynn.
National Gypsum Co	4500 Lincoln Plaza Dallas, TX 75201	----do----	Chatham.
Kyanite:			
Pasco Mining Inc	Box 649 Washington, GA 30673	Open pit mine and plant.	Lincoln.
Mica:			
Franklin Mineral Products Co. Inc	Box 0 Wilmington, MA 01887	----do----	Hart.
Perlite (expanded):			
Armstrong World Industries Inc	1010 Concord Lancaster, PA 17604	Plant	Bibb.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Construction (1984):			
Atlanta Sand & Supply Co	Route 1 Roberta, GA 31078	Open pit mine	Crawford.
Brown Bros. Sand Co	Box 82 Howard, GA 31039	Open pit mines	Talbot.
Howard Sand Co	Box 118 Butler, GA 31006	____do____	Talbot and Taylor.
Industrial (1985):			
Montgomery Sand Co., a subsidiary of Florida Crushed Stone Co.	Box 2117 Thomasville, GA 31792	Open pit mine	Thomas.
The Morie Co. Inc	1201 North High St. Millville, NJ 08332	____do____	Marion.
Stone:			
Crushed:			
Florida Rock Industries Inc	Box 4667 Jacksonville, FL 32201	Quarries	Clayton, Fayette, Floyd, Monroe, Spalding.
Georgia Marble Co	3460 Cumberland Parkway NW. Atlanta, GA 30303	____do____	De Kalb, Douglas, Forsyth, Gilmer, Hall, Newton, Pickens.
Martin Marietta Aggregates	Box 30013 Raleigh, NC 27612	____do____	Jones, Lee, Richmond, Warren.
North Georgia Crushed Stone Co., a division of Koppers Co. Inc.	Box 458 Lithonia, GA 30058	____do____	Clarke, De Kalb, Fayette, Fulton, Habersham, Hall, Stephens, Walker.
Vulcan Materials Co	Box 80730 Atlanta, GA 30366	____do____	Carroll, Cobb, Coweta, Douglas, Fulton, Gwinnett, Henry, Troup.
Dimension:			
Bennie & Harvey Inc	Box 958 Elberton, GA 30635	Quarry and finishing plant.	Oglethorpe.
Coggings Granite Industries Inc	Box 250 Elberton, GA 30635	____do____	Madison.
Georgia Marble Co	Box 238 Tate, GA 30117	____do____	Pickens.
Granite Panewall Co., a division of Florida Crushed Stone Co.	Box 898 Elberton, GA 30635	____do____	Elbert.
Talc:			
Southern Talc Co	Box F Chatsworth, GA 30705	Mines and mill.	Murray.

[1]Also produced crude iron oxide pigments.

The Mineral Industry of Hawaii

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

By Leon E. Esparza[1]

Hawaii's nonfuel mineral production value in 1985 was $53 million, an increase of about 4% over the value recorded in 1984. The State's nonfuel mineral industry is largely dependent on construction, which according to the Bank of Hawaii, was up 16.5% in value in 1985 compared with that of 1984. The rising level of construction activity was due to settlement of industry strikes and the decline of long-term interest rates.

Industrial minerals accounted for the total mineral value. All industrial minerals except gem stones and lime were used by the construction industry. Hawaii ranked 44th in the Nation in value of nonfuel minerals produced in 1985, identical to the ranking attained in 1984.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	5	$792	7	$588
Portland do.	186	18,282	215	16,050
Sand and gravel (construction) do.	436	2,031	e500	e2,100
Stone (crushed) do.	e5,400	e29,700	5,627	34,183
Combined value of other industrial minerals	XX	442	XX	351
Total	XX	51,247	XX	53,272

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

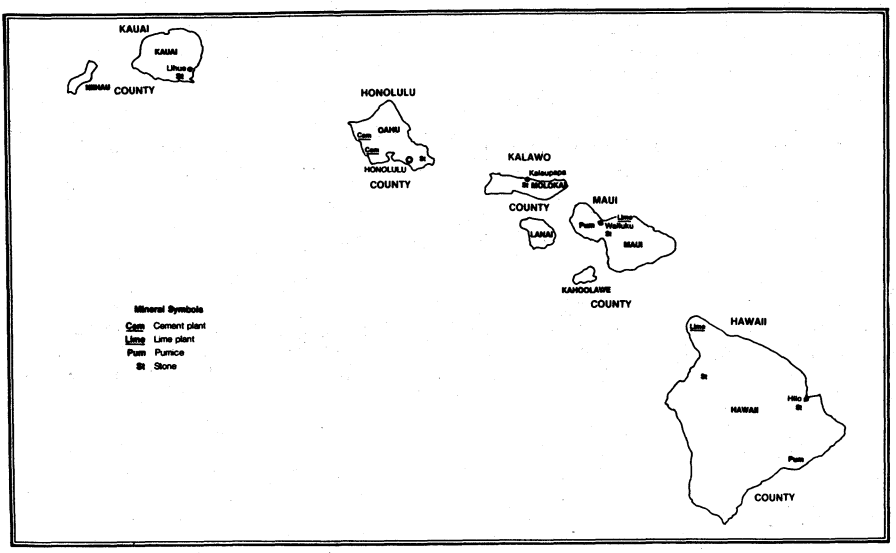

Figure 1.—Principal mineral producing localities in Hawaii.

Table 2.—Nonfuel minerals produced in Hawaii in 1984, by county[1]

County	Minerals produced in order of value
Hawaii	Sand and gravel, pumice.
Honolulu	Cement.
Kauai	Sand and gravel.
Maui	Sand and gravel, lime, pumice.
Undistributed[2]	Stone (crushed), gem stones.

[1]No production of nonfuel mineral commodities was reported for county not listed.
[2]Data not available by county for minerals listed.

Trends and Developments.—Research continued on the occurrence of cobalt-rich manganese crust by private and State and Federal Government organizations. The Hawaii Department of Planning and Economic Development published a plan that the State feels will direct the conservation, use, and development of its seabed resources. The State government was seeking a shared responsibility with the Federal Government for seabed resources within the 200-mile offshore Exclusive Economic Zone (EEZ). The EEZ could directly affect Hawaii's economy and environment if seabed mining becomes a reality. A Federal-State task force, formed in 1984 under a cooperative agreement between the U.S. Department of the Interior's Minerals Management Service (MMS) and the State of Hawaii, continued discussions on these matters. Meetings of the task force during 1985 focused on overseeing preparation of an environmental impact statement for a proposed lease sale.

University of Hawaii scientists under MMS sponsorship explored the Cross Seamounts west of the Island of Hawaii. Dredge and core samples were collected to assess the resources and potential for minesites in that area. This study and others sponsored by MMS are part of a program to encourage exploration, development, and production of nonenergy minerals in the Outer Continental Shelf and EEZ. Included with this program are intensified studies by the U.S. Bureau of Mines to analyze the characteristics of seafloor minerals and to test mineral processing methods. During fiscal year 1985, 185 cobalt crust samples were analyzed for 24 elements, and bulk samples of cobalt-rich manganese crusts were tested metallurgically. Also part of the program are U.S. Geological Survey efforts to map the EEZ and compile data on cobalt-rich manganese crusts and polymetallic sulfides.

Involvement in ocean mining enterprises from the private sector has indicated interest, by an unnamed company, in leasing about 4,000 acres north of Pahoa on the Island of Hawaii. The site would be used for a mill location and for tailings disposal. Water for the milling operation also would be obtained from the site. The West German

firm Preussag AG was conducting detailed investigations of cobalt-manganese crusts in the Hawaiian Archipelago.

Construction on the deep-draft harbor at Barbers Point, which began in 1982, was completed in 1985. Construction involved the dredging of a 38-foot-deep harbor and a 450-foot-wide, 42-foot-deep channel. About 9 million cubic yards of coral have been dredged by the U.S. Army Corps of Engineers contractor, Peter Kiewit Sons Co. of Vancouver, WA. The coral is stockpiled, for periodic sales, at the Campbell Industrial Park on the Island of Oahu and is used in road construction aggregate, concrete aggregate, and as a soil conditioner.

Table 3.—Indicators of Hawaii business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	1,019	1,037	1,054
Total civilian labor force	do	472	472	481
Unemployment	percent	6.5	5.6	5.6
Employment (nonagricultural):				
Mining total	thousands	0.1	0.1	0.1
Nonmetallic minerals except fuels	do	.1	.1	.1
Manufacturing total	do	22.4	21.9	21.8
Primary metal industries[1]	do	(2)	(2)	(2)
Stone, clay, and glass products	do	1.1	1.0	1.0
Petroleum and coal products[1]	do	.5	.5	.5
Construction	do	17.8	15.8	17.0
Transportation and public utilities	do	31.1	32.0	33.3
Wholesale and retail trade	do	106.8	111.4	115.5
Finance, insurance, real estate	do	31.9	31.9	32.0
Services	do	104.9	107.9	110.2
Government and government enterprises	do	91.3	91.8	93.3
Total[3]	do	406.2	412.7	423.1
Personal income:				
Total	millions	$12,862	$13,690	$14,558
Per capita		$12,616	$13,199	$13,814
Hours and earnings:				
Total average weekly hours, production workers		38.6	38.1	37.4
Total average hourly earnings, production workers		$8.2	$8.3	$8.6
Earnings by industry:				
Farm income	millions	$339	$284	$268
Nonfarm	do	$9,414	$10,041	$10,760
Mining total	do	$16	$19	$17
Nonmetallic minerals except fuels	do	$2	$1	$1
Oil and gas extraction	do	$14	$18	$16
Manufacturing total	do	$498	$485	$505
Primary metal industries	do	$2	$1	$1
Stone, clay, and glass products	do	$35	$31	$35
Petroleum and coal products	do	$24	$24	$25
Construction	do	$637	$606	$669
Transportation and public utilities	do	$800	$865	$909
Wholesale and retail trade	do	$1,469	$1,586	$1,704
Finance, insurance, real estate	do	$661	$678	$742
Services	do	$2,220	$2,493	$2,695
Government and government enterprises	do	$3,069	$3,265	$3,473
Construction activity:				
Number of private and public residential units authorized[4]		4,760	5,449	7,262
Value of nonresidential construction[4]	millions	$117.8	$139.4	$309.3
Value of State road contract awards	do	$77.3	$45.9	$45.1
Shipments of portland and masonry cement to and within the State	thousand short tons	222	191	221
Nonfuel mineral production value:				
Total crude mineral value	millions	$52.4	$51.2	$53.3
Value per capita		$51	$49	$51

[p]Preliminary. [r]Revised.
[1]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2]Less than 50 employees.
[3]Data may not add to totals shown because of independent rounding.
[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

INDUSTRIAL MINERALS

Cement.—Kaiser Cement Corp. at Waianae and Lone Star Hawaiian Cement Corp. at the Campbell Industrial Park continued to operate the two cement plants in Honolulu County (Oahu). Combined annual capacity for both plants was about 600,000 short tons of cement. Together, the plants produced at about 35% of capacity in 1985, compared with 32% in 1984. Masonry cement sold during the year was 6,577 short tons, an increase of nearly 20% over that sold in 1984.

Of the total portland cement sold, 70% was used in ready-mixed concrete, 14% by concrete product manufacturers, 7% by building material dealers, 6% by highway and other contractors, 2% by miscellaneous customers, and 1% by government agencies.

Raw materials consumed in portland and masonry cement manufacture included coral, gypsum, limestone, pyrite, sand, sandstone, and volcanic cinders. The coral, limestone, and volcanic cinders were mined at nearby quarries on Oahu; the other raw materials were imported from Australia or Mexico. Kilns at both plants were fired with coal and fuel oil, and electricity was purchased for both. Coal was imported from Australia.

Lime.—Quicklime and hydrated lime were produced by the Hawaiian Commercial & Sugar Co. Ltd. from its calcining operations near Paia, in Maui County. Reported 1985 lime production in Hawaii decreased in quantity and value from that reported in 1984.

Pumice and Pumicite.—Pumice and pumicite production in Hawaii increased nearly 39% in quantity and 28% in value over that of 1984. Pumicite (volcanic ash) was mined by the Puna Sugar Co. Ltd. at Keeau, and pumice was mined in Hawaii County by Volcanite Ltd. at Kailua Kona. In Maui County at Lahaina, pumicite was mined by Maui Pineapple Co. Ltd. Principal uses were for concrete aggregate and in road construction and maintenance; lesser uses were for landscaping and insulation.

Sand and Gravel (Construction).—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Production of crushed stone in 1985 increased approximately 4% in quantity over the estimated production in 1984, and value increased about 15%.

[1]State Mineral Officer, Bureau of Mines, Spokane, WA.

Table 4.—Hawaii: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Macadam	W	125
Coarse aggregate, graded:		
Concrete aggregate, coarse	911	6,466
Bituminous aggregate, coarse	609	3,474
Railroad ballast	6	15
Fine aggregate (-3/8 inch):		
Stone sand, concrete	707	6,943
Stone sand, bituminous mix or seal	433	3,205
Combined coarse and fine aggregates:		
Graded road base or subbase	1,263	6,739
Unpaved road surfacing	612	1,910
Crusher run or fill or waste	333	1,345
Other construction materials[2]	248	1,849
Agricultural: Poultry grit and mineral food	3	22
Special: Other[3]	502	2,090
Total	5,627	34,183

W Withheld to avoid disclosing company proprietary data; included with "Special: Other."
[1]Includes limestone, traprock, volcanic cinders, scoria, and miscellaneous stone.
[2]Includes agricultural limestone, riprap and jetty stone, filter stone, fine aggregate screen, and other construction and maintenance uses.
[3]Includes cement manufacture, other fillers or extenders, roofing granules, waste material, and use indicated by symbol W.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Lone Star Hawaiian Cement Corp	Barber's Point Plant 220 SiKing St., Suite 1700 Honolulu, HI 96813	Cement plant	Honolulu.
Lime:			
Hawaiian Commercial & Sugar Co. Ltd.	Box 266 Puunene, HI 96784	Rotary kiln and continuous hydrator.	Maui.
Pumice:			
Maui Pineapple Co. Ltd	Box 445-C Lahaina, HI 96761	Surface mine	Do.
Puna Sugar Co. Ltd	Box 120 Keaau, HI 96749	do	Hawaii.
Volcanite Ltd	Box 3000 Kailua Kona, HI 96740	do	Do.
Sand and gravel (construction, 1984):			
Amelco Corp., Maui Concrete	Box 488 Kahului, HI 96732	Plant and pit	Maui.
Kauai Sand & Gravel Inc	4247 Kapaia Rd. Lihue, HI 96766	do	Kauai.
Stone:			
Ameron Honolulu Construction & Drayage Ltd.	Box 29968 Honolulu, HI 96820	Quarries	Honolulu and Maui.
Grace Pacific Corp., Concrete and Rock Div.	91-920 Farrington Hwy. Ewa Beach, HI 96707	do	Do.
Grove Farm Rock Co. Inc	Puhi Rural Station Lihue, HI 96776	do	Kauai.
Herbert Tanaka Co	87-1748 Farrington Hwy. Waianae, HI 96792	Quarry	Honolulu.
Kuwaye Bros. Inc	160 Keaa St. Hilo, HI 96720	do	Hawaii.
Lone Star Hawaii Rock Products	11555 Dublin Canyon Rd. Pleasanton, CA 94566	do	Honolulu.

The Mineral Industry of Idaho

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

By W. L. Rice,[1] E. H. Bennett,[2] and M. M. Miller[3]

Idaho's nonfuel mineral production value decreased in 1985 to $348 million, down about 16% from the $412 million recorded in 1984. Decreases in the value of silver and phosphate rock production more than offset a substantial increase in molybdenum production value for 1985.

Silver continued to be the leading commodity in terms of value, followed by phosphate rock, molybdenum, lead, and gold. Metallic minerals accounted for 59% of total nonfuel mineral value for the year; silver accounted for 57% of that total. Idaho ranked 22d in the Nation in value of nonfuel minerals produced in 1985, down from the 21st ranking gained in 1984. The State achieved the 32d ranking in value for production of industrial minerals in 1985.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate, antimony content short tons	557	W	W	W
Clays[2] thousand short tons	1	W	2	W
Copper (recoverable content of ores, etc.) metric tons	3,701	$5,455	3,551	$5,242
Gem stones	NA	150	NA	175
Gold (recoverable content of ores, etc.) troy ounces	W	W	44,306	14,074
Lead (recoverable content of ores, etc.) metric tons	W	W	33,707	14,169
Lime thousand short tons	87	5,616	93	5,803
Phosphate rock thousand metric tons	4,722	126,586	3,784	102,430
Sand and gravel (construction) thousand short tons	4,725	13,509	e4,000	e11,400
Silver (recoverable content of ores, etc.) thousand troy ounces	18,869	153,608	18,828	115,645
Stone (crushed) thousand short tons	e1,800	e7,100	2,019	6,977
Combined value of cement, clays (bentonite and fire clay; fuller's earth, 1985), garnet (abrasive), gypsum (1984), molybdenum, perlite, pumice, sand and gravel (industrial), stone (dimension), vanadium, zinc, and values indicated by symbol W	XX	r100,326	XX	72,239
Total	XX	r412,350	XX	348,154

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

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

[2]Excludes bentonite, fire clay, and fuller's earth; value included with "Combined value" figure.

Table 2.—Nonfuel minerals produced in Idaho in 1984, by county[1]

County	Minerals produced in order of value
Ada	Sand and gravel.
Bannock	Cement, sand and gravel.
Benewah	Garnet (abrasive).
Bingham	Phosphate rock, sand and gravel.
Blaine	Sand and gravel.
Bonner	Do.
Bonneville	Pumice.
Boundary	Sand and gravel.
Camas	Silver, gold.
Canyon	Sand and gravel, lime.
Caribou	Phosphate rock, vanadium.
Cassia	Sand and gravel.
Clark	Clays.
Custer	Molybdenum, silver, lead, gold, copper.
Elmore	Sand and gravel.
Franklin	Do.
Fremont	Do.
Gem	Do.
Gooding	Do.
Idaho	Gold, sand and gravel, silver, copper, lead.
Kootenai	Sand and gravel.
Latah	Clays.
Lemhi	Sand and gravel.
Madison	Do.
Minidoka	Lime, sand and gravel.
Nez Perce	Sand and gravel.
Oneida	Perlite, pumice.
Owyhee	Silver, gold.
Power	Sand and gravel.
Shoshone	Silver, lead, copper, gold, antimony, zinc.
Teton	Sand and gravel.
Twin Falls	Lime, sand and gravel.
Valley	Gold, silver, sand and gravel.
Washington	Sand and gravel, gypsum.
Undistributed[2]	Sand and gravel, stone (crushed), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Idaho business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	988	999	1,005
Total civilian labor force	do	458	463	471
Unemployment	percent	9.8	7.2	7.9
Employment (nonagricultural):				
Mining total[1]	thousands	4.1	4.2	3.9
Metal mining	do	2.6	2.8	2.6
Nonmetallic minerals except fuels[2]	do	1.3	1.3	1.2
Oil and gas extraction[2]	do	.1	.1	.1
Manufacturing total	do	51.4	54.8	55.2
Primary metal industries[2]	do	.1	.1	--
Stone, clay, and glass products	do	1.0	.9	.9
Chemicals and allied products	do	3.3	3.5	3.5
Construction	do	13.2	14.6	15.6
Transportation and public utilities	do	19.1	19.1	19.3
Wholesale and retail trade	do	79.4	83.0	84.6
Finance, insurance, real estate	do	23.0	23.5	23.7
Services	do	59.9	62.5	65.8
Government and government enterprises	do	67.8	68.9	70.3
Total[3]	do	317.9	330.5	338.3
Personal income:				
Total	millions	$9,882	$10,520	$11,173
Per capita		$10,004	$10,530	$11,120
Hours and earnings:				
Total average weekly hours, production workers		37.4	37.6	37.8
Mining		41.5	41.1	40.9
Total average hourly earnings, production workers		$9.0	$9.3	$9.4
Mining		$13.4	$14.3	$14.6

See footnotes at end of table.

Table 3.—Indicators of Idaho business activity —Continued

		1983[r]	1984	1985[p]
Earnings by industry:				
Farm income	millions	$556	$526	$591
Nonfarm	do	$5,523	$7,073	$7,484
Mining total[1]	do	$145	$157	$151
Metal mining	do	$94	$102	$96
Nonmetallic minerals except fuels	do	$38	$42	$44
Oil and gas extraction	do	$12	$13	$12
Manufacturing total	do	$1,158	$1,299	$1,356
Primary metal industries	do	$3	$4	$3
Stone, clay, and glass products	do	$19	$21	$20
Chemicals and allied products	do	$64	$112	$124
Construction	do	$654	$788	$812
Transportation and public utilities	do	$543	$577	$614
Wholesale and retail trade	do	$1,136	$1,202	$1,233
Finance, insurance, real estate	do	$300	$322	$351
Services	do	$1,294	$1,366	$1,511
Government and government enterprises	do	$1,203	$1,276	$1,363
Construction activity:				
Number of private and public residential units authorized[4]		4,225	4,308	4,307
Value of nonresidential construction[4]	millions	$17.5	$205.3	$251.90
Value of State road contract awards	do	$80.2	$87.4	$90.5
Shipments of portland and masonry cement to and within the State	thousand short tons	269	277	237
Nonfuel mineral production value:				
Total crude mineral value	millions	$415.2	$412.4	$348.2
Value per capita		$420	$413	$346

[p]Preliminary. [r]Revised.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]Data may not add to totals shown because of independent rounding.
[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

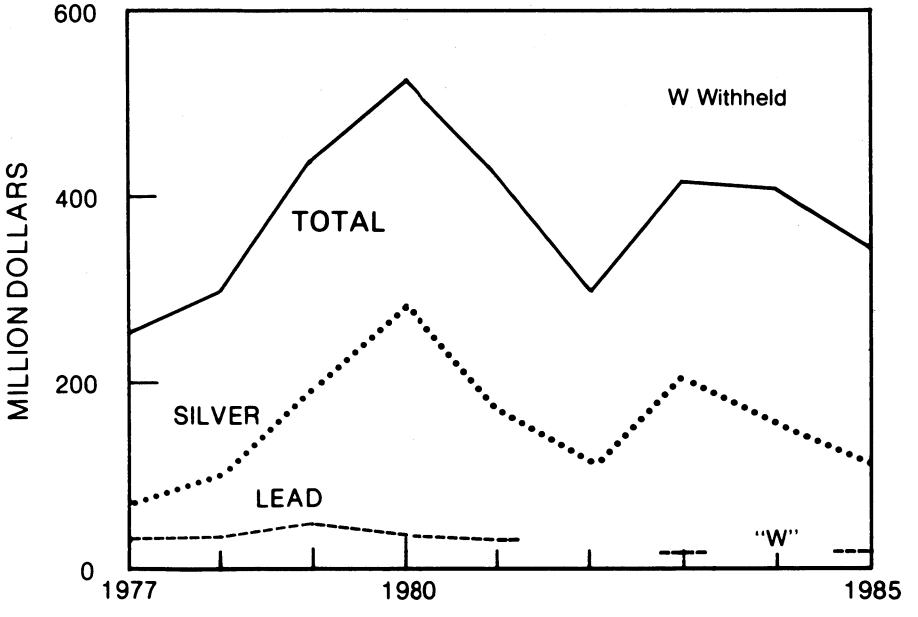

Figure 1.—Value of silver and lead and total value of nonfuel mineral production in Idaho.

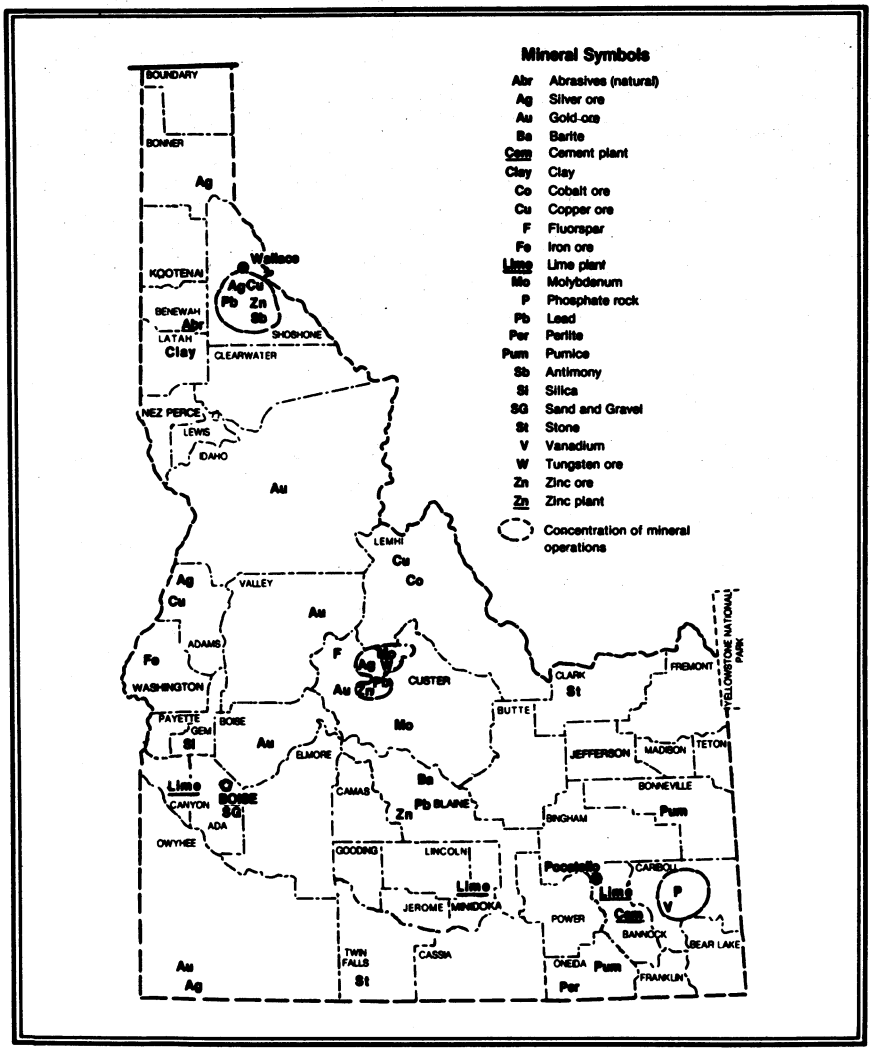

Figure 2.—Principal mineral producing localities in Idaho.

The production of the 1 billionth ounce of silver from 101 years of lode mining in the Coeur d'Alene District occurred early in the year and was commemorated by a banquet and presentation of a silver plaque on August 4. By yearend 1985, the district's mines had produced nearly 1.2 billion troy ounces of silver, 518,000 troy ounces of gold, 8.44 million tons of lead, 3.2 million tons of zinc, and 173,700 tons of copper. The total value of all ore mined in the Coeur d'Alene District for the 101-year period is estimated at more than $4.7 billion.

Trends and Developments.—Despite a yearlong decline in metals prices, most of Idaho's major silver mines maintained full-scale production throughout 1985. Exploration and mine development activity generally tapered off toward yearend, and cost-cutting measures, including personnel reductions, pay cuts for salaried employees, and closing down of lower grade stopes, were implemented at some operations. The yearend market silver price of $5.83 per ounce was below the break-even point for some of the State's largest silver mines. The strength of the U.S. dollar, low domestic inflation rates, and steadily decreasing world oil prices combined to dampen speculation in precious metals. In 1985, Idaho mines produced nearly 48% of the Nation's new silver, compared with more than 42% in 1984.

The limited recovery in the southeastern Idaho phosphate industry during 1983 and 1984 did not continue throughout 1985. A weak domestic fertilizer market and declining prices were factors leading to declining phosphate production and bankruptcy of one fertilizer manufacturer in the State.

Idaho's molybdenum production rose substantially in 1985, although prices, which had risen to $4.50 per pound early in the year, collapsed to the $2.60 per pound range by yearend. Production economies at Cyprus Minerals Co.'s Thompson Creek Mine, achieved by work force reductions, a cessation of preproduction stripping, and a reduction in electric power rates, were sufficient to keep the operation going in 1985.

Continued low lead-zinc prices and a projected cost of more than $50 million for additional federally mandated lead emission controls led to a decision by Bunker Limited Partnership to auction off rolling stock, tools, operating supplies, and bulk metals at the Bunker Hill lead-zinc smelter complex. Although none of the basic smelting plant equipment was sold in 1985, the owners indicated that offers for the smelting plants would be entertained. By yearend, the outlook was extremely bleak for an eventual reopening of the smelter.

Exploration Activities.—Reflecting lower metals prices and a general mood of uncertainty prevalent in the silver mining industry, 1985 exploration activity in the Coeur d'Alene region was down substantially from levels reached in the past few years.

Coeur Explorations Inc., the exploration subsidiary of Coeur d'Alene Mines Corp., continued work on properties held by Royal Apex Silver Inc. and Capitol Silver Mines Inc. Diamond drilling was done on the Capitol Silver Mines property, and the old Coeur d'Alene Mines mill near Osburn was used during the year for test work.

The Anaconda Minerals Co. discontinued its exploration program in 1985 on a 25,000-acre land package in the eastern end of the Coeur d'Alene District between the Placer Creek and Osburn Faults. The area, which extends south of the Caladay property eastward into Montana, is owned by several small mining companies. A deep drill hole on Helena Silver Mines' Wonderful Creek property near Stevens Peak was bottomed at 4,500 feet when a series of faults frustrated completion to the target vein. A 3,500-foot-deep hole was completed underground at the Reindeer Queen Mine; the deep holes were drilled using a directional technique new to the Coeur d'Alenes area. About 25,000 feet of core generated by Anaconda Minerals' $2 million drilling program was donated to the Idaho Geological Survey (IGS) and operating companies in the district. The core was moved to local storage quarters provided by Coeur d'Alene Mines; it is available for study by contacting the IGS or the Coeur Explorations office in Wallace.

Cominco American Incorporated ended a 5-year study of the Pine Creek area and dropped all its agreements early in the year. Companies affected by the termination were Epic Silver Consolidation Group, Sidney Mining Co., Nabob Silver Lead Co., the old Constitution and Hypotheek Mines, and several other Pine Creek properties. Cominco, in its ongoing exploration program in the Prichard Formation, staked 138 claims south of the Saint Joe River between Blackdome and Crescendo Peaks.

Pacific Coast Mines, a subsidiary of United States Borax & Chemical Corp., began a drilling program on its properties in the Murray-Prichard area north of the main Coeur d'Alene District. Pacific Coast con-

trols an area from Prichard south along Beaver Creek, and has a large claim block north of the West Fork of Eagle Creek.

Mines Management Inc. continued exploration on the 6,100-acre Janstan property on the Idaho-Montana border. Testing of stratiform copper-silver mineralization discovered during the year gave assays as high as 0.7% copper and 3.7 ounces of silver.

Exploration activity, largely oriented toward low-grade, heap leachable gold deposits, accelerated in the Elk City region of Idaho County. United Gold Corp. (Ager, Beretta, and Ellis) continued work at the Ericson Reef gold property north of Elk City; encouraging drilling results in 1984 resulted in more drilling and evaluation in 1985.

Normine Resources Ltd. completed a seven-hole reverse circulation drilling program on the Friday gold property near Elk City. Encouraging results led the company to schedule additional detailed drilling in conjunction with heap leach testing. Normine intends to make a production decision on the Friday property in 1986.

Nevex Gold Co. Inc. acquired the contiguous Robinson Dike and Dixie gold properties near Dixie in Idaho County. Twelve holes drilled at the Robinson Dike property in 1985 led the company to plan 4,000 feet of additional drilling in 1986, and to complete the permitting process for a heap-leaching recovery facility.

Tundra Gold Mines Ltd. evaluated the Golden Eagle, Madre D-Oro, and Mineral Zone properties near Elk City. Plans for 1986 include 10,000 feet of drilling.

Development work to enlarge and firm up ore reserves continued at the old Center Star Gold underground mine near Elk City. A 75-ton-per-day mill and tailings ponds were completed at the site.

Canu Resources Ltd. and Ican Resources Ltd. signed an agreement with Homestake Mining Co. on the Almaden project near Weiser, in Washington County. A drilling program has identified a mass-minable, hot-springs-type gold deposit at the old Idaho-Almaden mercury mine; more drilling was planned for 1986.

Shoshone Silver Mining Co. continued development work and mill construction at the Weber silver mine in the Lakeview District, Bonner County. Diamond drilling from the No. 2 Level at the Iron Mask Mine in the Talache District, Bonner County, discovered mineralization assaying up to 83 ounces of silver per ton; no mining was done during the year.

Atlanta Gold Corp. continued drilling and evaluation of a potential mass-minable gold deposit near Atlanta in Elmore County. The exploration program was to continue in 1986, and applications for operating permits for a 300,000- to 400,000-ton-per-year heap leach operation also were to be filed in 1986.

Golden Express Corp. continued evaluating its holdings near Gibbonsville in Lemhi County; activities were centered on the old Clara Morris Mine, a producer in the late 1800's and early 1900's.

Four Seasons Resources carried out a geological and geochemical survey on the Lidy Hot Springs gold property near Dubois, Clark County. Arsenic, gold, and mercury anomalies were detected and were being evaluated.

Silver Bar Mines did bulldozing, surface sampling and mapping, and drove two adits on veins thought to be extensions of structures mined at the old Banner Mine northeast of Idaho City, Boise County.

Orsina Resources Ltd. evaluated the Packer John silver property in Boise County. The 820-acre claim block was to be examined in more detail in 1986.

Employment.—A combination of declining metals prices, a decreased demand in the phosphate fertilizer industry, and early seasonal shutdowns in phosphate mining during late 1985 contributed to a decrease in Idaho's mineral sector employment for the year. Metal mining employment declined to 2,600 workers, a decrease of slightly more than 7.1% from the 1984 employment figure; overall mining employment declined by about 7.1% to 3,900 workers.

Average weekly earnings in 1985 for Idaho's mineral industry production workers was $597.14 for a workweek averaging 40.9 hours. Mineral industry wages remained the highest for any production workers' group in the State; average weekly earnings were up $9.41 from those in 1984.

Average yearly wages for mineral industry production workers in Shoshone County (largely representing the Coeur d'Alene region) decreased slightly to $33,459.70 in 1985, compared with an average wage of $33,676.99 for 1984.

Legislation and Government Programs.—The Idaho Land Board implemented new environmental regulations on placer and dredge mining, as mandated in 1984 by the 47th Idaho Legislature, second regular session. Significant provisions included (1) regulation of any placer or dredge min-

ing or exploration disturbing more than one-half acre; (2) imposing a maximum $1,000 application fee for a dredge mining permit; (3) requiring miners to obtain a stream alteration permit before being issued a dredge mining permit; (4) new bonding requirements calculated by estimating mining reclamation costs and adding 10% to those costs; (5) allowing the Idaho State Lands Department to recognize and honor valid bonds for mining projects on Federal lands; (6) revocation of permits for nonpayment of fees or noncompliance with State regulations; and (7) levying of State mine inspection fees on an hourly rate.

A memorandum of understanding designed to simplify surface mining applications in the State was ratified by the Idaho Department of Lands and the U.S. Bureau of Land Management (BLM). The memorandum, covering surface mining application, notification, and bonding processes, provides for bond posting and a common plan of operations to be filed with only one of the agencies. Both agencies will share inspection responsibilities, and each must be notified prior to the start of exploration work or mining on Federal lands.

Two Idaho wilderness bills, one proposing the addition of 3.5 million acres and the other nearly 5 million acres to the State's existing 3.8 million acres of designated wilderness, were introduced into Congress in 1985. The bills were written to include most of the remaining roadless areas in Idaho's national forests. Both bills died in Congress as a result of opposition by the State's congressional delegation. No Idaho-sponsored wilderness legislation was introduced in 1985.

Interagency plans for a large-scale land exchange between the BLM and U.S. Forest Service were released during the year. The proposed exchange of management responsibility, advanced as a means to improve efficiency and cut costs, would affect 4.1 million acres of Federal land in Idaho. Enabling legislation to implement the land exchange had not been introduced by yearend.

A proposal by the Greater Yellowstone Coalition of environmentalist groups to establish a 4-million-acre Greater Yellowstone Ecosystem buffer zone surrounding Yellowstone National Park was made in 1985. All human activities, including mining, would be either severely restricted or eliminated within the proposed federally managed ecosystem zone. The Idaho portion of the ecosystem was drawn to cover large parts of the Caribou and Targhee National Forests and would include most of the southeastern Idaho phosphate district. The coalition currently is pushing for congressional action on the proposal.

The proposed cleanup of mining-related harzardous wastes in a 21-square-mile area, including the dormant Bunker Hill mining and smelting complex, was started in 1985. Federally funded under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund), this action was being cooperatively implemented by the Environmental Protection Agency and the Idaho Division of Environment. Activity in 1985 was confined to a community relations program and the initiation of a remedial investigation and feasibility study. The remedial cleanup operations are projected to begin in 1987.

The State of Idaho continued to press an environmental damage lawsuit against Gulf Resources & Chemical Corp., former owner of the Bunker Hill Mine and smelter complex. The lawsuit, filed under the Superfund law, would require responsible parties to either resolve environmental problems arising from past operations or pay the State to do so.

The IGS—formerly the Idaho Bureau of Mines and Geology—completed its first full year under special program status at the University of Idaho. The IGS worked in cooperation with the U.S. Geological Survey (USGS) on a project to evaluate the geology and mineral potential of a 375-square-mile tract of BLM land proposed for wilderness status. The IGS also participated with the USGS in the first year of a 4-year Conterminous United States Mineral Appraisal Program study of the Hailey 2° Quadrangle. Two new geologic maps in the phosphate series and a new 1:500,000-scale gravity map of the State were finished in cooperation with the USGS.

Progress on preparation of a 1:100,000-scale surficial geologic map of the State was made in 1985 by the IGS. A compilation of isotopic data was completed, and eight thesis maps were released as special reports. Publications under way at yearend included the IGS's first annual report, which will contain a yearly summary of mining activity in the State, a collection of papers on the 1983 Borah Peak earthquake, and the Idaho portion of several 1:100,000-scale surficial geological maps.

The Mining and Mineral Resources Institute of the University of Idaho received an allotment of $147,000 from the U.S. Bureau of Mines in 1985. The University of Idaho assisted the Virginia Polytechnic Institute in work on the Mine Systems Design and Ground Control generic project areas. University of Idaho metallurgists accomplished significant research work in the areas of plasma smelting and the acoustical monitoring of crushing and grinding operations in ore processing.

The Idaho State University School of Vocational Technical Education received a $65,000 grant as part of a special Mine Safety and Health Administration program to help train employees and operators of small mines.

The U.S. Department of Energy's Idaho National Engineering Laboratory was funded at $4.93 million by the U.S. Bureau of Mines to continue a multiyear extractive metallurgy and materials technology research and development program in strategic and critical minerals. The 1985 effort addressed the areas of (1) biologically assisted minerals processing, (2) joining silicon nitride-based ceramics, (3) metal-gas reactions and thermal plasmas, (4) joining rapidly solidified alloys, (5) nondestructive testing of ceramic and rapidly solidified alloy joints and materials, and (6) dehydration of aluminum chlorate hexahydrate.

Idaho received $3.2 million in 1985 from the BLM as receipts from the Mineral Leasing Act.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Antimony.—Idaho was the only State in the Nation reporting antimony production in 1985. Production for the year was down slightly from that reported in 1984. Sunshine Mining Co. recovered antimony as a byproduct from the treatment of tetrahedrite, the principal silver-bearing ore mineral at the Sunshine Mine. Development work was carried out at the Antimony Rainbow Mine in Valley County, and at the Scorpion Extension property in Blaine County.

Copper.—Copper production, reported from 10 Idaho mines in 1985, was down about 4% in quantity and value from that reported in 1984. More than 3,500 metric tons was produced at a value of about $5.2 million, ranking Idaho seventh nationally in copper output for 1985. The largest producers, all from the Coeur d'Alene District, Shoshone County, were the Galena, Coeur, Sunshine, Lucky Friday, and Crescent Mines. Nearly 99% of total State production came from Coeur d'Alene District mines, where copper was a byproduct of silver recovery. The additional small production was reported from Camas, Custer, and Idaho Counties.

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
1983, total	24	2	2,104,344	W	W	17,684,278	$202,308,141
1984, total	13	2	r1,627,020	W	W	18,869,186	153,607,626
1985:							
Boise	1	--	W	W	W	W	W
Camas	1	--	100	447	$141,994	11,000	67,564
Custer	1	--	W	W	W	W	W
Idaho	1	--	W	W	W	W	W
Owyhee	1	--	W	W	W	W	W
Shoshone	7	--	834,031	W	W	16,786,333	103,105,015
Valley	1	--	32,329	2,689	854,185	1,133	6,959
Total	13	--	3 1,716,722	3 44,306	3 14,074,200	3 18,827,948	3 115,645,022

See footnotes at end of table.

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

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1983, total	3,556	$5,999,880	25,893	$12,375,857	W	W	$247,678,621
1984, total	3,701	5,454,689	W	W	W	W	r192,393,340
1985:							
Boise	--	--	--	--	--	--	W
Camas	5	6,858	W	W	--	--	W
Custer	W	W	W	W	--	--	W
Idaho	W	W	W	W	--	--	W
Owyhee	--	--	--	--	--	--	W
Shoshone	W	W	W	W	W	W	126,667,942
Valley	--	--	--	--	--	--	861,144
Total	[3]3,551	[3]5,241,792	[3]33,707	[3]14,168,756	W	W	W

rRevised. W Withheld to avoid disclosing company proprietary data.
[1]An operation at which metals are recovered as byproducts of molybdenum ore is not counted as a producing mine.
[2]Does not include gravel washed.
[3]Includes items indicated by symbol W.

Table 5.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1985, 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]	3	W	W	W	W	W	--
Gold-silver	2	W	W	W	5	W	--
Silver	7	952,042	W	17,041,542	W	W	W
Total	12	W	W	W	W	W	W
Lead-zinc	1	W	--	W	--	W	W
Other lode material:							
Molybdenum	--	--	W	W	W	W	--
Grand total	13	[3]1,716,722	[3]44,306	[3]18,827,948	[3]3,551	[3]33,707	W

W Withheld to avoid disclosing company proprietary data.
[1]An operation at which metals are recovered as byproducts from molybdenum ore is not counted as a producing mine.
[2]Includes material that was leached.
[3]Includes items indicated by symbol W.

Table 6.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1985, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:					
Cyanidation	W	W	--	--	--
Smelting of concentrates	W	17,058,959	W	W	W
Direct smelting of ore	W	W	W	W	W
Total	[1]44,306	[1]18,827,948	[1]3,551	[1]33,707	W

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

Gold.—Idaho gold production decreased in both quantity and value from that recorded in 1984, reflecting decreased gold prices prevalent during 1985. The State dropped in national ranking to 10th for the amount and value of gold produced in 1985. Production was reported from 11 lode mines in 1985, compared with 13 mines reporting production in 1984. NERCO Minerals Co.'s DeLamar silver-gold mine in Owyhee County was the State's largest producer.

Idaho's largest heap leach operation, Superior Mining Co.'s West End Mine at Stibnite, Valley County, treated previously mined material in 1985. Mobil Corp. acquired Superior Mining in 1984, and was negotiating at yearend with T.R.V. Minerals Corp., a 25% interest holder, to purchase Mobil's 75% interest in the property. The West End Mine came on-stream in late 1982, and has produced about 500,000 tons of ore per year; total production has been approximately 62,000 ounces of gold and 30,000 ounces of silver.

Coeur d'Alene Mines completed construction of surface facilities at its Thunder Mountain gold-silver project in Valley County; production at the open pit, heap leach operation was slated to begin in July 1986. The company had expended approximately $10.7 million of the anticipated $14.5 million total cost of the operation by yearend 1985. Ore reserves are estimated at 1.788 million tons averaging 0.095 ounce of gold and 0.077 ounce of silver per ton; the production rate was projected to be 25,000 ounces of gold annually. The project, which will be seasonally restricted from 4 to 6 months of operation per year, should employ about 80 people and is expected to mine about 2,000 tons of ore per day. Exploration drilling on the adjoining Lightening Peak area indicated gold mineralization; further work is planned to determine if minable reserves exist on the property.

Production was deferred for at least a year at Geodome Resources Ltd.'s proposed Sunbeam Mine on Jordan Creek, Custer County. Detailed exploration work and mine-mill planning were accomplished in 1985; the company hopes to begin construction in late 1986. Annual production from the open pit, vat leach operation is planned at about 29,000 ounces of gold over a 10-year mine life.

U.S. Antimony Corp. began production from the Estes Mountain gold-silver mine on Jordan Creek, and from the Red Bird silver-lead mine about 25 miles east of the Yankee Fork Salmon River, in Custer County. Ore from both mines was processed at the company's 300-ton-per-day flotation mill and 100-ton-per-day vat leach plant at Preacher's Cove on the Yankee Fork.

Golden Maple Mining and Leaching Co. received preliminary approval from the U.S. Forest Service to operate an open pit, heap-leaching operation at the old Valley Creek gold mine north of Stanley, Custer County. The proposed operation, which would include 2 years of open pit mining and 3 years of underground mining, was expected to mine at the rate of 10,000 tons of ore per year.

A heap leach operation of old mine dumps at the Comeback Mine north of Idaho City, Boise County, by the Diamond Hill Mining Co.-Goldsill Resources Ltd. partnership got under way in 1985. An estimated 100,000 tons of dump material grading 0.065 ounce of gold and 6.0 ounces of silver per ton are available for leaching.

No placer gold production data was reported from Idaho in 1985; however, a number of small placer mining operations were reported to have been active along various Idaho waterways.

A total of 612 stream alteration permits were issued by the Idaho Department of Water Resources in 1985. These permits covered placer mines and all sizes and types of dredges, although most of the permits were for small suction dredges operated as a hobby-type activity.

Lead.—Idaho retained its second ranking in lead production for 1985, although the quantity produced was only a small fraction of the production in Missouri, the major producing State. Although 10 mines reported lead production for 1985, the bulk came from the Lucky Friday Mine in Shoshone County.

Molybdenum.—Despite a worldwide oversupply of molybdenum and a consequent decrease in price from $4.50 per pound to about $2.60 by December, the second-year production at Cyprus Minerals' Thompson Creek Mine near Clayton, Custer County, was sufficient to retain Idaho's ranking as third nationally in 1985. Production increased nearly 47% in quantity and about 31% in value from that of 1984.

Operational economies at Thompson Creek were achieved by (1) a 75-worker permanent cutback in the 490 employee work force, (2) a reduction in interruptible electric power costs by Bonneville Power

Administration (BPA), and (3) a cessation of preproduction stripping by yearend. Production in 1985 was at about 85% of capacity. Future plans call for a 2-1/2- to 3-year operation; the mine could then shut down unless market conditions improve.

Silver.—Idaho was again the top domestic silver producing State, accounting for nearly 48% of total 1985 production. Although silver prices declined from $6.30 per ounce in January to $5.83 per ounce at yearend, the State's production decreased only slightly from the 1984 level. Five mines in the Coeur d'Alene District of Shoshone County accounted for almost 89% of the total output reported from 13 mines in the State.

Hecla Mining Co.'s Lucky Friday Unit regained its position as the Nation's leading silver mine in 1985, producing more than 4.74 million ounces of silver from a record 276,817 tons of ore. Improved operating efficiency, contributed by the new Silver Shaft, improvements to the pumping system, cooling plant, and mill, and a 20% increase in labor productivity, resulted in decreased operating costs from those in 1984. A novel electrical generating system using free-falling water was installed at the Lucky Friday Mine in cooperation with the U.S. Bureau of Mines. The system, which is part of a Bureau research program to help industry cut operating costs, will save Hecla $40,000 per year in energy costs.

Hecla's 3-year underground exploration drilling program on adjacent Allied Silver-Lead Co. ground from the 5100 level of the Lucky Friday Mine was suspended in mid-July and not resumed until late in the year. Primary targets are not expected to be reached until 1986.

Hecla continued work on the $17 million Consolidated Silver Project, a joint venture between Hecla and Coeur d'Alene Mines at the Silver Summit Mine near Osburn. Exploration in 1985 consisted of 2,788 feet of drifting on the 5400 level of the downward projection of the Silver Summit No. 4 vein discovered in 1984.

Early in January, Hecla announced the termination of its 1982 lease and exploration agreement at the Atlas Mine south of the Lucky Friday Mine at Mullan. The company completed 2,000 feet of drifting and 2,900 feet of diamond drilling at a total cost of $1.3 million; no ore-grade material was encountered in the target Boulder Creek vein system.

On June 1, Hecla broke ground for construction of a $6 million corporate headquarters on 13 acres of a 60-acre tract purchased in the city of Coeur d'Alene. The company intends the new headquarters to be the nucleus of an office park complex.

Production at Sunshine's Sunshine Mine at Big Creek was down slightly from that of 1984. The mine ranked second in the Nation for silver production in 1985, producing more than 4.71 million ounces from 218,509 tons of ore containing an average of 22.15 ounces of silver per ton. Development work in 1985 was confined to areas near the four active shafts. Work near the No. 12 shaft was directed toward the Copper and Syndicate veins between the 4200 and 5000 levels; a 10-foot-wide ore shoot was discovered in the Copper vein on the 4200 level. Development from the other shafts was concentrated in the East and West Rambo areas and along the Sunshine-Polaris vein system. A new high-grade vein, discovered between the Sunshine and Syndicate veins, was mined from three stopes off the 3400 level. The new discovery is close to the Jewell Shaft and can be mined at a lower cost than more deep-seated ores. In May, high-grade silver ore was discovered in the Silver Surprise property (part of the Yankee Girl vein).

The first full year of operation for Sunshine's $17 million hydrometallurgical silver-copper refinery was achieved in 1985. The refinery, which was 17 years in construction, can process 8 million ounces of silver per year at full capacity. By August, the plant was refining 20 tons of silver-copper concentrates per day, yielding 30,000 ounces of 999.5-fine silver and 8 tons of cathode copper per day. Presently, all the feed is supplied by the Sunshine Mine and the company-owned Sixteen-to-One Mine in Nevada; the refinery has sufficient capacity to process custom concentrates from other silver producers. By yearend, operational problems had been overcome and the refinery was operating at capacity; over 3 million ounces of silver was recovered in 1985. The United Steelworkers of America sued Sunshine to force arbitration over union jurisdiction at the silver refinery; the company maintained that the control did not include the refinery operation. An amended agreement incorporating union employees at the refinery was signed in June and the suit was dropped. In late October, Sunshine announced the acquisition of Tentex Inc., a precious metal reclamation and custom minting firm in Chino, CA. Sunshine plans to move the plant to Coeur d'Alene and will manufacture finished silver products. The new plant will employ up to 30 people.

ASARCO Incorporated's Galena Mine near Wallace was the third-ranked domes-

tic silver producer, while its Coeur Mine ranked fifth. Production from the Galena Mine decreased slightly from the 1984 level; about 4.1 million ounces of silver and 1,180 tons of copper were recovered from 200,176 tons of ore milled. Supplementing improvements to the main shaft, hoist, and mill carried out in 1984, a new pumping system was installed in the mine in 1985. Production in 1985 came from the 3200, 3400, 3700, 4000, 4300, 4600, and 4900 levels.

Production from the Coeur Mine for 1985 was increased by about 8% from the 1984 total, to slightly over 2.6 million ounces of silver and 1,166 tons of copper recovered from 151,224 tons of ore. During the year, Asarco completed a major rehabilitation of the 4,428-foot-deep Coeur shaft.

Asarco continued exploration at the American Silver project, joint ventured with Callahan Mining Corp., Hecla, and Coeur d'Alene Mines. American Silver ground was being investigated west from the 3400 level of the Coeur Mine; the long exploration drive had reached 4,957 feet by yearend. This drift was only 540 feet short of the projected target, the Wire Silver vein mined in the past from the old Coeur d'Alene Mine.

Bunker Limited completed the second year of production from its reopened Crescent Mine. The mine produced 418,020 ounces of silver from 28,376 tons of ore in 1985. An early result of Bunker Limited's long-range exploration and development plans for the mine was the discovery of a vein on the 4300 level that contained high-grade silver ore assaying 350 to 380 ounces per ton. A crosscut was completed and raises for stopes were started during the year.

Callahan Mining's Caladay Shaft, east of the Galena Mine, was completed to a depth of 5,100 feet on January 30. A crosscut to connect the 4900 level of the Caladay to the Galena Shaft was started in April, and underground diamond drilling was begun in June. On October 10, a 6-1/2-foot-wide siderite-tetrahedrite vein was encountered about 1,300 feet from the Caladay Shaft; the company withheld all assay data on this initial discovery. The structure was drifted on, lost on a fault, and soon rediscovered; the vein was still being evaluated at yearend. To date, $24 million has been expended out of a total budget of $26.6 million.

NERCO purchased Superior Oil Co.'s 47.5% interest in the DeLamar silver-gold mine in Owyhee County; the purchase gave NERCO sole ownership of the open pit, vat leach operation. Major operational improvements, including widening haul roads, replacing 35-ton trucks with 85-ton-capacity vehicles, and economies in the leaching process, have cut costs and improved efficiency. Some ore was mined from the North DeLamar pit, although most of the production came from the Glen Silver pit started in 1984. The DeLamar Mine produced about 3,300 tons of ore per day, and was again Idaho's largest silver producer outside the Coeur d'Alene District. The mine, which has about 12 years of reserves at present production rates, ranked fifth in silver production in the State in 1985.

Clayton Silver Mines Inc. celebrated 50 years of operation in midyear at its Clayton Silver Mine in Custer County. Since 1935, the mine has produced nearly 6.7 million ounces of silver, and 83.5 million pounds of lead from 2.2 million tons of ore. Cost-cutting measures implemented in 1985 to compensate for low metals prices included stopping all exploration work, wage cuts for miners and office staff, and adoption of a BPA pilot program that provided reduced electric power rates. In 1985, the mine produced between 325 and 350 tons of ore per day with a work force of about 40 people.

Vanadium.—Idaho ranked second in the Nation in vanadium production in 1985. Permanent closure or shutdown of 26 uranium-vanadium mines on the Colorado Plateau increased the market for Idaho vanadium; the State's vanadium production increased substantially over that of 1984. Ferrophosphorus slag from two Idaho elemental phosphorus plants was processed for vanadium pentoxide and ammonium metavanadate by Kerr-McGee Chemical Corp. at Soda Springs in Caribou County.

Zinc.—Zinc production in Idaho, although minimal compared to pre-1983 years, doubled in quantity and value over that recorded in 1984. The only major zinc producers in the State were Hecla's Lucky Friday Mine and Star-Morning Mining Co.'s Star-Morning Mine, operating under a lease from Hecla. A substantial decrease in zinc prices, however, forced closure of the Star-Morning operation in October, putting 50 employees out of work. Star-Morning had been mining zinc-rich areas left by previous operators in upper levels of the mine.

INDUSTRIAL MINERALS

Cement.—Idaho's cement production was up slightly for 1985; sales were assisted by cement use for two large highway paving projects. Portland cement production increased nearly 8% in quantity and about 7% in value over that recorded in 1984; a small amount of masonry cement was also

produced. Ash Grove Cement West Inc., at Inkom in Bannock County, was the State's only cement producer. Portland cement was used by ready-mixed concrete companies (52%); highway contractors (34%); concrete products manufacturers (8%); and others, including other contractors, building materials dealers, miscellaneous customers, and government agencies (6%). Ash Grove Cement's two-kiln, wet-process plant used natural gas and coal for fuel and purchased electricity for energy. Raw materials used in cement manufacture were locally mined gypsum, limestone, and quartzite; iron ore was shipped in from out-of-State.

Clays.—Idaho's 1985 clay production increased slightly in quantity and value over that reported in 1984. Bentonite, fire clay, and kaolin were mined from three pits in Latah and Clark Counties. The State's largest volume clay producer was A. P. Green Refractories Co. in Latah County.

Garnet.—In 1985, Idaho ranked first in the Nation in garnet production. Garnet production at the Emerald Creek Garnet Milling Co. operation at Fernwood, Benewah County, increased nearly 21% in quantity and value from that of 1984. The company dredged garnet sands from the State's largest placer operation on Emerald and Carpenter Creeks; the garnet was recovered by jigging and then trucked to the Fernwood plant for drying, crushing, sizing, and packaging. The company was the largest domestic producer of garnet for abrasives and as a filtering medium.

Gem Stones.—The value of 1985 gem stone production in Idaho was estimated at $175,000, compared with a figure of $150,000 for 1984. Precious opals, jasper, aquamarine, topaz, gem quartz, and star garnets were mined in the State. In 1985, there were a number of dig-for-fee operations.

Gypsum.—The Consumer Coop Association Inc. in Weiser, for several years Idaho's only gypsum producer, dropped its lease on the Iron Mountain Mine in Washington County, and did not mine gypsum in 1985.

Lime.—Amalgamated Sugar Co.'s three lime plants in Canyon, Minidoka, and Twin Falls Counties accounted for all of the State's 1985 lime production. Quicklime production for sugar manufacture increased in quantity and value from that reported in 1984.

Perlite.—Oneida Perlite Corp. mined perlite from a mine on Wrights Creek; the material was processed at the Malad City plant in Oneida County. The company manufactured expanded perlite under the trade name Perlcor Products; the perlite was used for industrial fillers, in fireproofing, and as a filtering medium. Reported production and value for 1985 were the same as those for 1984.

Phosphate Rock.—Idaho retained its third ranking in the Nation for the quantity of marketable phosphate rock produced, and rose to second for the product value in 1985. The State accounted for more than 7% of the total domestic phosphate output in 1985, although Idaho's production decreased by nearly 20% in quantity and about 19% in value from that reported in 1984.

The primary products processed from Idaho phosphate rock were phosphoric acid used in fertilizer manufacture and elemental phosphorus used in fertilizers and for industrial phosphate products. A major factor in the decline was reduced demand for agricultural purposes. A ban on phosphate-based detergents in some Eastern and Midwestern States also affected domestic phosphate producers. Beker Industries Corp., which mined phosphate at the Conda Partnership's Champ Lease Mine in Caribou County and operated a fertilizer plant near Soda Springs, filed for chapter 11 bankruptcy in October. Reasons cited were decreased fertilizer sales and product prices depressed below the break-even point.

Six open pit phosphate mines in the southeastern Idaho phosphate field in Bingham and Caribou Counties produced in 1985.

The J. R. Simplot Co. completed its first year of production from the $40 million Smoky Canyon Mine near the Idaho-Wyoming border in Caribou County, and operated the Gay Mine on the Fort Hall Indian Reservation in Bingham County. Simplot completed a $50 million modernization and expansion program at its Pocatello phosphate fertilizer plant in 1985. The program, which involved construction of a new sulfuric acid plant and a 1,200-ton-per-day phosphoric acid plant that will allow a 30% expansion in production, also included environmental control equipment designed to substantially decrease sulfur dioxide emissions. Construction of a 145-megawatt cogeneration electric powerplant was scheduled for completion in early 1986.

After 2-1/2 years of negotiations, FMC Corp. and the Shoshone-Bannock Indian Tribes agreed to lease terms covering a 2,300-acre expansion of the FMC-Simplot jointly operated Gay Mine on the Fort Hall Indian Reservation. The expansion will allow mining to continue at the site for at least 10 years. FMC continued development

drilling at its Dry Valley deposit in Caribou County; mine development at this deposit is not scheduled to commence until reserves at the Gay Mine are depleted. FMC installed scrubbers for environmental control purposes and rebuilt an electric reduction furnace at its Pocatello elemental phosphorus plant.

Monsanto Co. announced closure of its elemental phosphorus plant at Columbia, TN, leaving its Soda Springs operation in Caribou County the company's only phosphorus producer. Monsanto mined phosphate at the Henry Mine in 1985.

Stauffer Chemical Co. shipped ore from the Wooley Valley Mine to its elemental phosphorus plant at Silver Bow, MT.

Pumice.—Idaho retained its fourth rank for pumice production in the Nation, although the 1985 production decreased by nearly 24% in quantity and about 7% in value from that reported in 1984.

Two operations in Bonneville County and one in Oneida County accounted for the State's production.

Hess Pumice Products, the State's largest pumice producer, operated a mine on Wrights Creek near Malad in Oneida County. The processed pumice was used in lightweight building blocks, as an abrasive in soaps and cleaners, and for industrial abrasive applications. Hess completed construction of a new $1.7 million automated, state-of-the-art pumice processing plant at Malad during 1985. The company, which is one of the Nation's major producers of ground pumice products, has ore reserves in excess of 10 million tons of crude pumice.

The second largest producer was Amcor Inc. from its Fan Creek claims near Idaho Falls in Bonneville County; the product was used as lightweight concrete aggregate. Producers Pumice mined pumice from the Rock Hollow Mine near Ammon; the material was used in lighweight concrete block manufacture.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Unimin Corp. produced industrial sand and gravel at its operation in Emmett, Gem County. The industrial silica sand uses were for glass containers, for sandblasting sand, filtration-medium sand, in fiberglass manufacture, for roofing granules, and for other applications.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Table 7.—Idaho: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	6	18
Other coarse aggregate	222	626
Coarse aggregate, graded:		
Concrete aggregate, coarse	55	122
Bituminous aggregate, coarse	130	280
Bituminous surface-treatment aggregate	20	100
Fine aggregate (-3/8 inch):		
Stone sand, concrete	10	35
Screening, undesignated	2	5
Combined coarse and fine aggregates:		
Graded road base or subbase	521	1,514
Unpaved road surfacing	311	1,407
Other construction materials	163	1,260
Agricultural:		
Poultry grit and mineral food	3	8
Other agricultural	24	72
Chemical and metallurgical:		
Lime manufacture	(2)	2
Chemical stone	154	154
Sulfur oxide removal	3	9
Special:		
Roofing granules	(2)	(2)
Other miscellaneous[3]	357	1,249
Other unspecified[4]	38	118
Total	2,019	[5]6,977

[1]Includes dolomite, granite, limestone, quartzite, sandstone, and traprock.
[2]Less than 1/2 unit; included with "Other miscellaneous."
[3]Includes cement manufacture and waste material.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data do not add to total shown because of independent rounding.

Crushed.—The 1985 output of crushed stone for Idaho increased in quantity but decreased in value from the levels estimated in 1984, and increased in quantity from the level reported in 1983. Increased activity in highway and secondary road construction and maintenance was largely responsible for the increased use of crushed stone. Six counties—Bannock, Benewah, Caribou, Clark, Idaho, and Twin Falls—accounted for 81% of the State total. The U.S. Forest Service (Region 4), Ash Grove Cement, and Seubert Excavators Inc. were the leading producers.

Dimension.—The Marble Shop Inc. quarried travertine at Fall Creek in Bonneville County. The company shipped facing stone for the Potter County courthouse in Amarillo, TX, during the year.

Idaho Quartzite Corp., at Oakley in Cassia County, entered into a joint venture agreement with the Bank of America World Trade Corp. to import and export stone and slate. Idaho Quartzite will be the North American marketing agent for the import of slate roofing, marble, granite, and slate tiles from China.

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[1]State Mineral Officer, Bureau of Mines, Spokane, WA.
[2]Associate director, Idaho Geological Survey, Moscow, ID.
[3]Director, Idaho Geological Survey, Moscow, ID.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Antimony:			
Sunshine Mining Co	815 Park Blvd., Suite 100 Boise, ID 83702	Mine, mill, plant	Shoshone.
Cement:			
Ash Grove Cement West Inc	5550 SW. Macadam Ave. Suite 300 Portland, OR 97201	Surface mine and plant.	Bannock.
Clays:			
Clayburn Industries Ltd	3202 Beta Burnaby, BC, Canada	Surface mine	Latah.
A. P. Green Refractories Co., a subsidiary of USG Corp.	Box 158 Troy, ID 83871	do	Do.
Copper:			
ASARCO Incorporated	Box 440 Wallace, ID 83873	Mine and mill	Shoshone.
Hecla Mining Co	6500 Mineral Dr. Box C-8000 Coeur d'Alene, ID 83814	do	Do.
Sunshine Mining Co	815 Park Blvd., Suite 100 Boise, ID 83702	do	Do.
Gold:			
Hecla Mining Co	6500 Mineral Dr. Box C-8000 Coeur d'Alene, ID 83814	do	Do.
NERCO Minerals Co	3230 Airport Way Fairbanks, AK 99701	Surface mine and mill.	Owyhee.
Lead:			
Clayton Silver Mines Inc	Box 890 Wallace, ID 83873	Mine and mill	Custer.
Hecla Mining Co	6500 Mineral Dr. Box C-8000 Coeur d'Alene, ID 83814	do	Shoshone.
Lime:			
Amalgamated Sugar Co	First Security Bank Bldg. Ogden, UT 84402	Plants	Various.
Molybdenum:			
Cyprus Minerals Co	7200 South Alton Way Englewood, CO 80110	Surface mine and mill.	Custer.
Perlite:			
Oneida Perlite Corp	Box 162 Malad City, ID 83252	Surface mine and plant.	Oneida.
Phosphate rock:			
Conda Partnership	Box 37 Conda, ID 83230	do	Caribou.
Monsanto Co	Box 816 Soda Springs, ID 83276	Surface mine	Do.
J. R. Simplot Co	Box 912 Pocatello, ID 83201	Surface mine and plant.	Bingham and Caribou.
Pumice:			
Amcor Inc	Box 1141 Idaho Falls, ID 83401	Quarry and plant	Bonneville.
Hess Pumice Products	Box 209 Malad City, ID 83252	do	Oneida.
Producers Pumice	6001 Fairview Ave. Boise, ID 83704	Quarry	Bonneville.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel (industrial):			
Unimin Corp	50 Locust Ave. New Canaan, CT 06840	Pit	Gem.
Silver:			
ASARCO Incorporated	Box 440 Wallace, ID 83873	Mine and mill	Shoshone.
Bunker Limited Partnership	Box 29 Kellogg, ID 83837	do	Do.
Clayton Silver Mines Inc	Box 890 Wallace, ID 83873	do	Custer.
Hecla Mining Co	6500 Mineral Dr. Box C-8000 Coeur d'Alene, ID 83814	do	Shoshone.
NERCO Minerals Co	3230 Airport Way Fairbanks, AK 99701	Surface mine and mill.	Owyhee.
Sunshine Mining Co	815 Park Blvd., Suite 100 Boise, ID 83702	Mine, mill, plant	Shoshone.
Stone:			
Crushed:			
Ash Grove Cement West Inc	5550 SW. Macadam Ave. Suite 300 Portland, OR 97201	Quarry	Bannock.
Monsanto Co	Box 816 Soda Springs, ID 83276	do	Caribou.
Seubert Excavators Inc	Box 57 Cottonwood, ID 83522	do	Idaho.
U.S. Forest Service, Region 4	324 25th St. Ogden, UT 84401	Quarries	Various.
Dimension:			
The Marble Shop Inc	3935 North Yellowstone Hwy. Idaho Falls, ID 83401	Quarry and plant	Bonneville.
Vanadium:			
Kerr-McGee Chemical Corp	Box 478 Soda Springs, ID 83276	Plant	Caribou.
Zinc:			
Hecla Mining Co	6500 Mineral Dr. Box C-8000 Coeur d'Alene, ID 83814	do	Shoshone.
Star-Morning Mining Co	Box 1086 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] and Wanda J. West[2]

Illinois nonfuel mineral production was valued at $459.9 million, a slight decrease compared with that of 1984, as the State's mineral economy leveled off after rebounding from the 1982 recession. Nationally, the State ranked 17th in nonfuel production value. Illinois led the Nation in output of fluorspar, industrial sand, and tripoli and in the manufacture of iron oxide pigments, and ranked fourth in the production of peat. Crushed stone production contributed the greatest amount to the State's nonfuel mineral value, followed in descending order by cement, construction sand and gravel, industrial sand, and lime. Production declined for barite, masonry cement, fluorspar, lead, industrial sand, crushed stone, and zinc. All other nonfuel mineral commodities produced in the State registered gains, with byproduct silver output increasing the greatest percent.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement (portland) thousand short tons	1,997	$82,622	2,101	$86,211
Clays[2] do.	253	940	265	876
Gem stones	NA	15	NA	15
Peat thousand short tons	49	W	W	W
Sand and gravel:				
Construction do.	25,969	72,477	e26,600	e77,000
Industrial do.	4,100	52,197	4,056	56,915
Stone:				
Crushed do.	e48,500	e191,600	41,044	164,117
Dimension do.	--	--	2	107
Combined value of barite, cement (masonry), clays (fuller's earth), copper (1985), fluorspar, lead, lime, silver, tripoli, zinc, and values indicated by symbol W	XX	72,010	XX	74,679
Total	XX	471,861	XX	459,920

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

Table 2.—Nonfuel minerals produced in Illinois in 1984, by county[1]

County	Minerals produced in order of value
Adams	Sand and gravel (construction).
Alexander	Sand and gravel (construction), tripoli.
Bond	Sand and gravel (construction), clays.
Boone	Sand and gravel (construction).
Bureau	Do.
Champaign	Do.
Clinton	Do.
Coles	Do.
Cook	Lime, sand and gravel (construction), peat.
Crawford	Sand and gravel (construction).
Cumberland	Do.
De Kalb	Do.
De Witt	Do.
Du Page	Do.
Effingham	Do.
Fayette	Do.
Ford	Do.
Fulton	Do.
Gallatin	Do.
Grundy	Do.
Hardin	Fluorspar, zinc, barite, lead, silver.
Henderson	Sand and gravel (construction).
Henry	Do.
Jackson	Do.
Jo Daviess	Do.
Kane	Do.
Kankakee	Sand and gravel (construction), clays.
Kendall	Sand and gravel (construction).
Knox	Do.
Lake	Sand and gravel (construction), peat.
La Salle	Sand (industrial), cement, sand and gravel (construction), clays.
Lawrence	Sand and gravel (construction).
Lee	Cement.
Livingston	Clays, sand and gravel (construction).
Logan	Sand and gravel (construction).
McDonough	Clays.
McHenry	Sand and gravel (construction).
McLean	Do.
Macon	Do.
Madison	Do.
Marshall	Do.
Mason	Sand (industrial), sand and gravel (construction).
Massac	Cement, sand and gravel (construction).
Morgan	Sand and gravel (construction).
Moultrie	Do.
Ogle	Sand (industrial), sand and gravel (construction).
Peoria	Sand and gravel (construction).
Piatt	Do.
Pike	Do.
Pulaski	Clays, sand and gravel (construction).
Putnam	Sand and gravel (construction).
Randolph	Do.
Rock Island	Do.
St. Clair	Do.
Sangamon	Do.
Stephenson	Do.
Tazewell	Do.
Vermilion	Do.
Wabash	Do.
White	Do.
Whiteside	Peat, sand and gravel (construction).
Will	Sand and gravel (construction).
Winnebago	Do.
Woodford	Do.
Undistributed[2]	Stone (crushed), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Employment.—Records compiled by the Illinois Department of Employment Security showed that average monthly employment in mining and quarrying, excluding coal mining and oil and gas extraction, was about 5,200 persons in 1985, about 400 workers more than reported in 1984. Average hourly wages increased by $0.06 to $10.88 per hour. Average hours worked per week dropped to 46.3 from 48.4 hours reported in 1984.

Table 3.—Indicators of Illinois business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	11,491	11,522	11,535
Total civilian labor force	do.	5,594	5,608	5,673
Unemployment	percent	11.4	9.1	9.0
Employment (nonagricultural):				
Mining total[1]	thousands	24.6	26.5	28.6
Coal mining	do.	14.1	15.6	16.7
Oil and gas extraction	do.	5.9	6.1	6.7
Manufacturing total	do.	955.8	997.0	981.1
Primary metal industries	do.	58.8	61.1	57.9
Stone, clay, and glass products	do.	24.6	25.6	24.8
Chemicals and allied products	do.	59.4	58.4	58.5
Petroleum and coal products	do.	9.2	9.3	8.8
Construction	do.	144.2	154.7	181.4
Transportation and public utilities	do.	264.5	278.3	277.0
Wholesale and retail trade	do.	1,097.5	1,148.1	1,168.1
Finance, insurance, real estate	do.	320.1	322.2	337.8
Services	do.	1,022.5	1,057.6	1,100.4
Government and government enterprises	do.	701.6	687.9	692.6
Total[2]	do.	4,530.6	4,672.3	4,767.1
Personal income:				
Total	millions	$147,215	$161,118	$169,999
Per capita		$12,811	$13,984	$14,738
Hours and earnings:				
Total average weekly hours, production workers		40.6	40.6	40.6
Mining		42.9	43.9	41.3
Total average hourly earnings, production workers		$9.7	$10.1	$10.4
Mining		$13.6	$14.1	$14.3
Earnings by industry:				
Farm income	millions	-$431	$1,500	$1,572
Nonfarm	do.	$105,568	$115,832	$122,626
Mining total	do.	$1,202	$1,331	$1,278
Nonmetallic minerals except fuels	do.	$153	$164	$180
Coal mining	do.	W	$702	$690
Oil and gas extraction	do.	$412	$464	$408
Manufacturing total	do.	$25,515	$28,100	$28,635
Primary metal industries	do.	$1,759	$2,055	$2,009
Stone, clay, and glass products	do.	$667	$721	$723
Chemicals and allied products	do.	$1,834	$1,988	$2,079
Petroleum and coal products	do.	$426	$420	$443
Construction	do.	$5,700	$6,676	$7,111
Transportation and public utilities	do.	$8,399	$9,228	$9,842
Wholesale and retail trade	do.	$18,320	$20,014	$21,223
Finance, insurance, real estate	do.	$8,203	$8,953	$10,080
Services	do.	$23,505	$25,972	$28,141
Government and government enterprises	do.	$14,309	$15,142	$15,885
Construction activity:				
Number of private and public residential units authorized[3]		30,230	30,180	38,719
Value of nonresidential construction[3]	millions	$1,788.1	$2,326.6	$2,696.6
Value of State road contract awards	do.	$782.0	$1,052.5	$783.5
Shipments of portland and masonry cement to and within the State	thousand short tons	2,305	2,686	2,797
Nonfuel mineral production value:				
Total crude mineral value	millions	$406.9	$471.9	$459.9
Value per capita		$35	$41	$40

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Data may not add to totals shown because of independent rounding.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

Sources: U.S. Department of Commerce, Highway and Heavy Construction Magazine, Illinois Department of Employment Security in cooperation with the Bureau of Labor Statistics, U.S. Department of Labor, and U.S. Bureau of Mines.

Employment in the basic steel industry dropped to about 24,500 persons in 1985, compared with 25,000 workers in 1984. Average hourly wages increased $0.47 to $13.42 per hour. Average hours worked per week declined about 0.3 hour, to 41.4 hours.

Only one strike was reported in the nonfuel minerals industry. Workers at Material Service Corp.'s Fairmont Quarry in Fairmont were on strike from April 22 to May 4.

Exploration Activities.—At the end of fiscal year (FY) 1985, U.S. Forest Service records showed that in the Shawnee National Forest there were 22 active prospecting permits for fluorspar on 16,624 acres, 4 active fluorspar leases on 2,554 acres, and 6 active oil and gas leases on 648 acres. Leasing proposals pending at that time

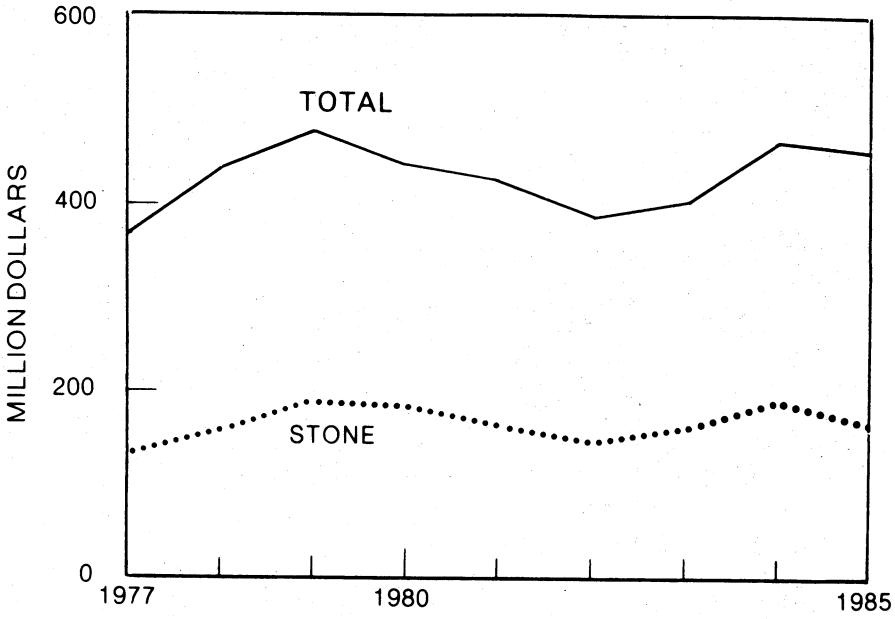

Figure 1.—Value of stone and total value of nonfuel mineral production in Illinois.

were 5 prospecting permits for fluorspar, 2 prospecting permits for silica, and 113 oil and gas leases. Execution of the oil and gas leases had been put on administrative hold for several years because of legislative action initiated by an Illinois Congressman.

Ozark-Mahoning Co., the State's largest fluorspar producer, had maintained an aggressive exploration program for the past several years, exploring for fluorspar deposits on both Federal and private lands. In August, the firm pared its exploration program in half because of increasing production costs and a shrinking market caused by low-priced foreign imports. In November, Ozark-Mahoning further reduced its exploration activity to one drill and terminated several salaried and hourly personnel.

Legislation and Government Programs.—Several mining industry-related bills were enacted into law during 1985. Public Act 84-0585 amended the Environmental Protection Act to authorize the Pollution Control Board to require the use of Illinois coal as a condition to granting an alternative emission standard of variance for sulfur dioxide emissions from a coal-burning stationary source. The board was also required to consider the availability and price of the coal, the cost of pollution control equipment, and the economic impact on the coal mining industry.

Public Act 84-0597 amended an act that authorized transfer of certain lands to the Chicago Park District, city of Chicago, and Madison County. It authorized the city of Alton to sell and convey the limestone and other minerals underlying the real property it received from the State under the act and required the proceeds from the sale to be used for public park and recreation purposes, including the development and maintenance of the land received from the State.

Public Act 84-0661 amended the Revenue Act of 1939. It provided that in counties that do not classify real property for tax purposes, coal, gas, oil, or other mineral rights shall be assessed separately only when the rights had been conveyed to a person other than the landowner or when the value of such rights was readily ascertainable because of ongoing production or severance of the coal, gas, oil, or other minerals. It validated assessments made before the effective date of the act that did not correctly assess such rights separately and provided that coal, gas, oil, or other mineral rights shall be assessed separately only on or after January 1, 1987.

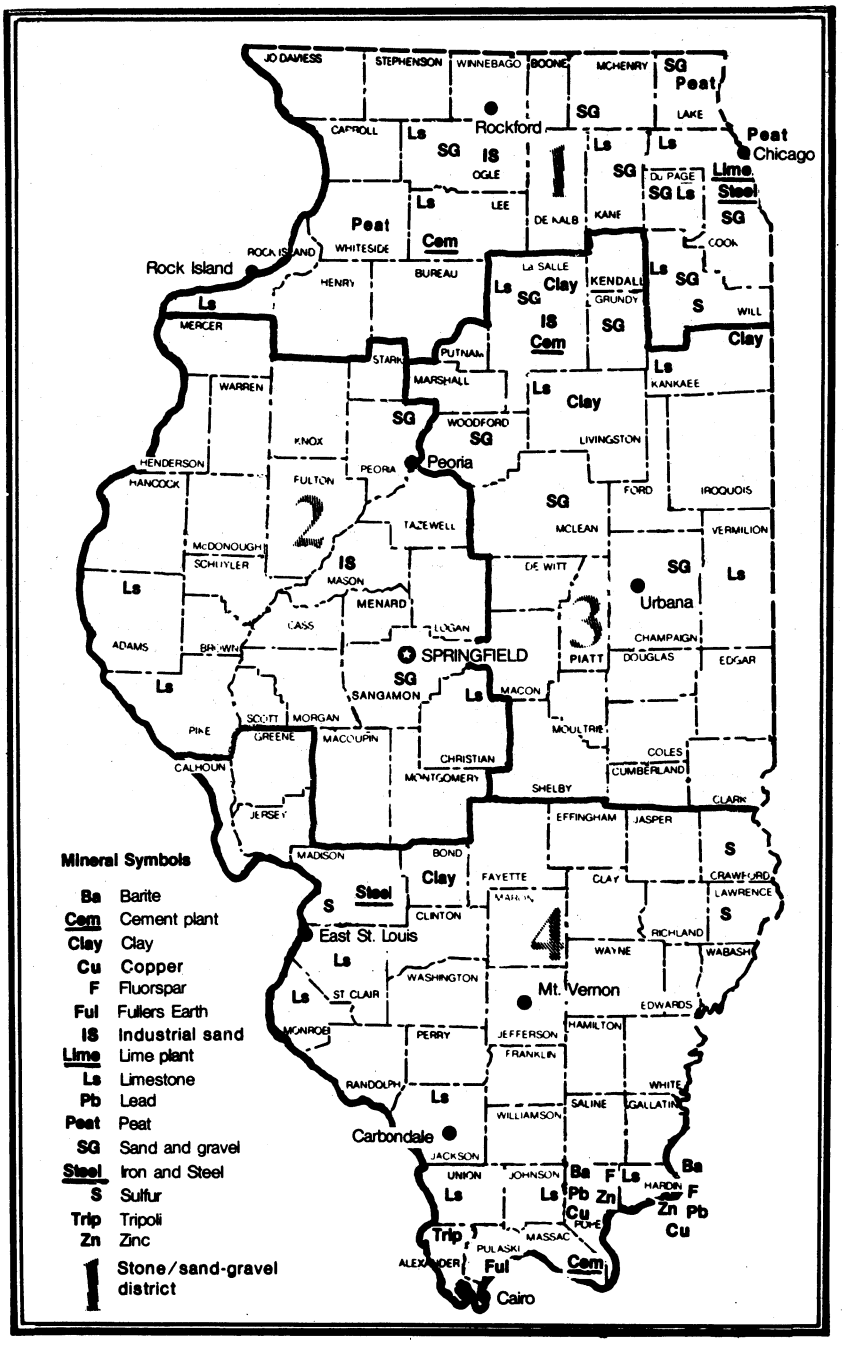

Figure 2.—Principal mineral producing localities in Illinois.

Public Act 84-0872 amended the Explosives Act and the Conservation of Oil and Gas Act. The act raised the fees for a magazine owner's annual permit and explosives possession licenses, which would be valid for 3 years. It also raised the fee for drilling permits and the bond requirements for persons who test drill for coal, gas, and oil. It provided that brine transporting permits would be valid for 2 years rather than 1 year and that proceeds from the sale of gas or oil production must be paid to the payee (royalty owner) on or before 150 days after the end of the month of first purchase by a payor.

Public Act 84-1098 amended the Abandoned Mined Lands and Water Reclamation Act by removing the Abandoned Mined Lands Reclamation Council and its duties from the purview of the Department of Mines and Minerals.

The Illinois Department of Mines and Minerals finalized rules of the State's Surface Coal Mining Land Conservation and Reclamation Act requiring the training, examination, and certification of all persons responsible for the use of explosives in a surface coal mining operation. The rules required all coal operators, beginning 1 year following the effective date, to employ certified blasters to supervise blasting operations in their mines. Training was to be conducted by the operator or his representative and must include design and layout of blasts; ground vibration, flyrock, and air blast control and monitoring; preparing and firing blasts; explosive properties; regulatory requirements such as a blasting plan, preblast, and condition surveys; and reporting of blasts and blasting notices. A written examination was to be administered at least semiannually by the department, with certification valid for a maximum of 5 years. Limited interstate reciprocation was included. The rules also addressed the denial of an application for blaster certification or the suspension of a certificate.[3]

The Illinois Geological Survey (IGS) continued its research program in basic geology, minerals resource evaluation, engineering and environmental geology, geochemistry, hydrology, and mineral economics. At an April workshop for the Deep Observation and Sampling of the Earth's Crust Program, IGS personnel presented a proposal for a super-deep drill hole in the Illinois Basin. The proposed 30,000-foot hole would provide scientists with a better understanding of the Illinois Basin and the Earth's crust and would provide the means to study magnetic and electrical forces at work, would provide details on the New Madrid Fault Zone, and could lead to the discovery of potential gas, oil, and other mineral resources. Funding for the proposed hole was expected to come from the National Science Foundation and other sources.

The IGS continued its research on coal desulfurization and conducted geotechnical and environmental feasibility studies on the State's proposal to locate the Superconducting Super Collider at Batavia. In cooperation with the U.S. Bureau of Mines, the IGS was conducting a program to develop guidelines that would maximize the efficiency of underground coal extraction while minimizing the impacts of subsidence on prime farmland. Another ongoing study concerned urban encroachment on the dolomite resources of the Chicago area.

The Federal Office of Surface Mining, in cooperation with the American Society for Surface Mining and Reclamation and Southern Illinois University—Carbondale, began a permanent register of research and demonstration areas on lands surface mined for coal. The register would document all types of reclamation studies in agronomy, forestry, soils, and related disciplines in the United States to avoid duplication of efforts in planting plots to assess reclamation success. In some cases, tree plantings are over 40 years old, and research information available could not be duplicated in one person's productive lifetime.

The U.S. Bureau of Land Management began a program to determine the eventual management or disposition of Federal lands and minerals in Illinois. About 5,200 acres of "split-estate minerals" in 28 counties were involved, as well as three tracts of surface administered land totaling about 2 acres. The planning effort was to evaluate the development potential of the Federal mineral ownership and to determine guidelines for the management of the minerals according to that potential.

The U.S. Bureau of Mines awarded $270,136 for operations and research to Southern Illinois University—Carbondale, the State's Mining and Mineral Resources and Research Institute created under title III of Public Law 95-87. The Bureau of Mines also distributed about $470,700 in contracts and grants to Illinois firms and consultants for equipment, research, and services in FY 1985.

Research by the U.S. Bureau of Mines to eliminate subsidence damage to prime farmland in Illinois would be coordinated with the Illinois Coal Association, the Illinois Farm Bureau, and the Illinois Department of Agriculture, according to a Memorandum of Agreement signed with the State in May. Research results would be used to develop strategies to preserve the productivity of prime farmland while maximizing recovery of the State's coal resources.

The Federal Government distributed $96,500 to the State as its 25% share of revenues for grazing rights, mineral leases, recreation, timber sales, and other uses on the Shawnee National Forest in FY 1985. This compared with $109,126 distributed in FY 1984. Illinois also received $274,979 "in lieu of tax" payments from the Federal Government in FY 1985.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Abrasives (Manufactured).—Exolon-ESK Co. continued to manufacture two grades of silicon carbide at its plant near Hennepin, Putnam County. Metallurgical silicon carbide was used in manufacturing cast iron and steel. Abrasive silicon carbide was used in grinding and polishing wheels, as a refractory lining for blast furnaces, and as a cutting agent for wire sawing. Production dropped about 6% during the year.

Barite.—Ozark-Mahoning recovered barite as a byproduct at its fluorspar operations in Hardin County. Slack demand and competition from foreign imports forced the company to shut down its barite circuit for part of the year. Production dropped significantly in 1985.

Cement.—Nationally, Illinois ranked 10th and 24th in sales of portland and masonry cement, respectively. Sales increased about 5% for portland cement and dropped about 36% for masonry cement. The average value for portland cement sales dropped $0.34 per short ton; whereas masonry cement averaged $0.99 per ton higher compared with 1984 figures.

Table 4.—Illinois: Portland cement salient statistics

(Short tons unless otherwise specified)

	1984	1985
Number of active plants	4	4
Production	1,876,231	2,073,069
Shipments from mills:		
Quantity	1,996,658	2,100,724
Value	$82,621,878	$86,210,707
Stocks at mills, Dec. 31	118,540	127,830

The Illinois cement industry was comprised of four companies having a total of eight kilns. All the companies operated dry-process plants fueled mainly with natural gas. Plants were operated by Illinois Cement Co., a subsidiary of Centex Corp., and Lone Star Industries Inc. in La Salle County; Dixon-Marquette Cement Inc., a subsidiary of Prairie Materials Sales Inc., in Lee County; and Missouri Portland Cement Co., a division of H. K. Porter Co. Inc. in Massac County. All companies produced Types I and II—general use and moderate heat portland cement, and all except Lone Star produced Type III—high-early-strength portland cement. Sales of masonry cement were reported by Dixon-Marquette and Lone Star. Dixon-Marquette operated only three of its four kilns during the year. Overall, Illinois cement producers operated at about 72% of capacity during 1985.

Over 78% of the portland cement sales were to ready-mixed concrete companies. The next largest users were concrete product manufacturers, highway contractors, and building material dealers. Most of the portland cement was shipped to consumers by truck in bulk form.

Approximately 2.8 million tons of limestone, 169,000 tons of clay and shale, and 93,000 tons of gypsum were used in cement manufacturing, along with lesser quantities of domestic clinker, fly ash, sand, and slag. Total tonnage of raw materials consumed was 3.4 million. Cement shipments to and within Illinois during 1985 included 2.7 million tons of portland cement and 73,000 tons of masonry cement.

During 1985, Illinois Cement made modifications to its finishing mill that included installation of a cement separator. Capacity was expected to increase 10% to 20%.

In December, H. K. Porter sold its cement division, Missouri Portland Cement, to MPC Holdings Inc., a European partnership incorporated in Delaware. The sale included the Joppa cement plant and a quarry near Cave in Rock, as well as the firm's Sugar Creek, MO, plant and 11 river terminals.

Clays.—Common clay was produced by seven companies with operations in four counties. La Salle County, whose output

was used in cement manufacturing, led in production, followed by Livingston, Bond, and Kankakee. Common clay was also used in manufacturing drain tile, face brick, and sewer pipe. Production increased about 5% during the year.

Fuller's earth was produced by two companies—Absorbent Clay Products Co. and Lowe's Southern Clay Inc.—both in Pulaski County. Output increased slightly compared with 1984 figures. Most of the fuller's earth was sold as pet litter; lesser quantities were used as an oil and grease absorbent.

Early in 1985, Thrall Enterprises Inc. agreed to give its Western Stoneware plant and clay mine to the city of Monmouth. The company had announced in December 1984 that it would close the plant in early 1985. City officials hoped to obtain funds from the State and other sources to renovate the plant and continue the operation, saving the jobs of the 50 persons employed there.

Fluorspar.—Illinois led the Nation in the production of fluorspar. Ozark-Mahoning was the State's largest producer, shipping both acid and metallurgical grades to consumers. Hastie Mining Co. also reported shipping some metallurgical-grade fluorspar from stockpile to consumers. Production dropped about 11% during the year, while average value per short ton increased about 7%.

In August, Ozark-Mahoning pared its exploration program in half and reduced output at its mines to one shift per day, resulting in the layoff of 22 employees. Reasons cited by the company for the cutbacks were increasing costs and market pressures from low-cost foreign imports. In November, the company cut its exploration program to one drill and laid off more hourly and salaried staff.

Gem Stones.—As in previous years, the value of mineral specimens hobbyists and dealers collected was estimated to be $15,000. Most of the State's mineral specimens were collected in the Illinois fluorspar district and included barite, calcite, fluorite, galena, and sphalerite.

Gypsum (Calcined).—Crude gypsum mined in nearby States was processed at the National Gypsum Co. plant in Waukegan. Production jumped 29% during 1985 because of the continued strong demand for wallboard by the construction industry.

Iron Oxide Pigments (Finished).—Four companies manufactured iron oxide pigments for use in paint and coatings. Manufacturers were Pfizer Inc., Minerals, Pigments & Metals Div., at East St. Louis in St. Clair County; Prince Manufacturing Co. at Quincy in Adams County; George B. Smith Color Co. at Maple Park in Kane County; and Solomon Grind-Chem Service Inc. at Springfield in Sangamon County. Shipments were nearly 28,600 short tons, valued at about $24.2 million.

Lime.—Nationally, Illinois ranked seventh of 36 States in lime production. Two companies operated plants in Cook County. Marblehead Lime Co. had operations at South Chicago and Thornton, and Vulcan Materials Co. had a plant at McCook. Production and value increased about 6% and 7%, respectively. Both companies produced quicklime and hydrated lime. Marblehead, headquartered in Chicago, was the second leading producer of lime in the United States, operating plants in Illinois, Indiana, Michigan, Pennsylvania, and Utah. Marblehead's South Chicago plant was the seventh largest producing lime plant in the United States in 1985.

Lime consumption in Illinois from all domestic sources totaled 655,000 short tons; 519,000 tons of quicklime and 137,000 tons of hydrated lime. The State ranked third in the consumption of hydrated lime.

Peat.—Illinois ranked fourth of 21 States in peat sales. Production increased slightly during 1985, with value climbing about 9%. Average value per short ton of peat increased $2.59 compared with 1984 figures. Production was by five companies harvesting bogs in the northern part of the State in Cook, Lake, and Whiteside Counties. Most of the peat was sold in packaged form. Reedsedge was the predominant type of peat mined, with lesser quantities of hypnum and humus. Most of the peat sales was for general soil improvement.

Perlite (Expanded).—Illinois ranked fifth of 31 States in sales of expanded perlite. Sales increased slightly during the year. Value per short ton increased $6.99 compared with 1984 figures.

Crude perlite mined in the Western United States was expanded by three companies: Silbrico Corp. in Cook County; Strong-Lite Products Corp. of Illinois in De Kalb County; and Manville Products Corp. in Will County. Expanded perlite was used for agricultural purposes, cavity fill insulation, concrete and plaster aggregates, fillers, low-temperature insulation, and roof insulation board.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985.

Data for odd-numbered years are based on annual company estimates made before yearend.

Sand and gravel mined for construction purposes was estimated to have increased about 2%, or to 26.6 million short tons in 1985. Average value per ton was estimated to have increased $0.10.

Industrial.—Illinois was the Nation's leader in industrial sand production. Six companies operated eight pits in La Salle, Mason, and Ogle Counties. Five were operated in La Salle County, which led the State's production. About 35% of the State's industrial sand was used in glassmaking. Other major uses were foundry applications and hydraulic fracturing. Industrial sand used in hydraulic fracturing commanded the highest average price per short ton, $24.39. The average f.o.b. price for all industrial sand produced in the State was $14.03. About 79% of the industrial sand was shipped to consumers by truck; the rest by rail and waterway.

Slag—Iron and Steel.—Illinois ranked 10th of 26 States in processed iron and steel slag sales. Three companies, Heckett Co., International Mill Service Co., and St. Louis Slag Products Co., processed slag from iron and steel furnaces in Alton, Chicago, Granite City, and Peoria. Sales and value of sales dropped about 3% and 24%, respectively.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Limestone and dolomite, the only rock types produced in Illinois during 1985, were quarried and crushed by 89 companies and government agencies at 160 quarries in 52 of the State's 102 counties. Cook County led in production, followed by Will, St. Clair, Hardin, La Salle, Lee, Kankakee, and Union Counties. Production from each of these counties was in excess of 1 million tons, and collectively they represented nearly two-thirds of the total State output. Nearly 91% of the crushed stone was shipped by truck; and railroads, waterways, and other unspecified methods represented the remainder.

In 1985, the U.S. Bureau of Mines began compiling crushed stone production statistics by districts for some States. Table 6 presents end-use data for crushed stone produced in the four Illinois districts that are outlined in figure 2.

Table 5.—Illinois: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	1,617	5,828
Riprap and jetty stone	887	3,471
Filter stone	8	44
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,371	14,772
Bituminous aggregate, coarse	3,103	14,180
Bituminous surface-treatment aggregate	1,120	4,379
Railroad ballast	980	3,924
Fine aggregate (-3/8 inch):		
Stone sand, concrete	48	W
Stone sand, bituminous mix or seal	50	232
Screening, undesignated	638	2,240
Combined coarse and fine aggregates:		
Graded road base or subbase	8,511	30,323
Unpaved road surfacing	2,276	7,748
Crusher run or fill or waste	308	1,069
Other construction[2]	595	2,181
Agricultural:		
Agricultural limestone	3,098	11,027
Poultry grit and mineral food	67	675
Chemical and metallurgical: Cement manufacture	2,577	6,551
Special:		
Whiting or whiting substitute	23	95
Other filler or extenders	434	11,553
Other miscellaneous[3]	684	3,687
Other unspecified[4]	10,648	40,138
Total	[5]41,044	164,117

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

[1]Includes dolomite and limestone.

[2]Includes stone used for terrazzo and exposed aggregate and other construction and maintenance purposes.

[3]Includes stone used for lime manufacture, flux stone, chemicals, roofing granules, waste material, sulfur oxide removal, other uses not listed, and value indicated by symbol W.

[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.

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

Table 6.—Illinois: Crushed stone sold or used by producers in 1985, by use and district

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3		District 4	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	1,394	4,989	196	694	446	1,981	476	1,679
Coarse aggregate, graded	5,145	20,917	395	3,907	1,191	5,332	1,842	7,099
Fine aggregate (-3/8 inch)	648	2,270	18	W	23	124	47	W
Combined coarse and fine aggregates	5,679	19,635	1,148	4,276	1,133	4,458	3,527	12,045
Other construction	17	82	7	21	38	61	142	744
Agricultural	544	1,703	443	1,989	687	3,625	1,491	4,385
Cement manufacture	W	W	--	--	W	W	W	W
Lime manufacture	--	--	W	W	--	--	W	W
Flux stone	W	W	--	--	--	--	W	W
Sulfur oxide removal	--	--	W	W	--	--	W	W
Whiting or whiting substitute	23	95	--	--	--	--	--	--
Other fillers or extenders	--	--	W	W	W	W	W	W
Roofing granules	--	--	W	W	--	--	W	W
Other miscellaneous	880	2,728	494	11,987	1,108	3,531	1,214	3,624
Other unspecified[1]	8,774	32,702	984	4,134	205	843	685	2,460
Total[2]	23,103	85,120	3,686	27,007	4,831	19,955	9,424	32,036

W Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."
[1]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[2]Data may not add to totals shown because of independent rounding.

Dimension.—The State's only dimension stone producer sold limestone in irregular shapes and blocks and cut stone for flagging and other construction uses from a quarry near South Elgin. The firm also produced crushed limestone for the construction industry.

Sulfur (Recovered).—Sulfur was recovered at petroleum refining operations of five companies in four counties—near Robinson in Crawford County, Lawrenceville in Lawrence County, Hartford in Madison County, and Chicago and Joliet in Will County. Sales totaled about 194,000 metric tons in 1985. Average value increased $15.24 per metric ton.

Tripoli.—Illinois ranked first of two States producing tripoli. Two companies, Illinois Minerals Co. and Tammsco Inc., had operations in Alexander County, the southernmost county in the State. Production increased very slightly during 1985. Prepared tripoli sales increased about 6%, but average value dropped $6.52 per short ton. Most tripoli sales were for fillers for the paint, plastics, and rubber industries. Lesser quantities were sold as abrasives for buffing and polishing compounds, soap, and toothpaste.

Since being purchased in 1984 by K & W Engineering Co. of Nashville, TN, Tammsco expanded its plant storage capacity, added a liquid petroleum backup system, and erected a new office building near the plant.

Vermiculite (Exfoliated).—W. R. Grace & Co. and Strong-Lite Products exfoliated vermiculite from out-of-State sources at their plants in Du Page and De Kalb Counties, respectively. Sales and value of sales dropped about 16% and 25%, respectively. Major sales were for loose-fill insulation and fireproofing. Other sales were for concrete and plaster aggregates, agricultural purposes, and block insulation, and as a texturizer. International Vermiculite Co. did not report any production from its Girard plant in Macoupin County in 1985.

METALS

Copper, Lead, Silver, and Zinc.—All of the State's base metal production came as byproducts from Ozark-Mahoning's fluorspar operation in Hardin and Pope Counties. Production of all commodities except silver decreased.

Iron and Steel.—Illinois ranked fifth of 11 States in pig iron shipments. Shipments dropped almost 4% and value nearly 8% in 1985. The State's steel industry continued to contract as it had in recent years as steel companies restructured operations to cut costs and remain competitive in a market affected by foreign imports.

National Steel Corp. began streamlining operations and announced it would reduce management and labor jobs by 2,500 employees by 1988. The work force at the Granite City plant would be reduced by 20%, or 780 jobs, through retirements and normal attrition. The other job losses would occur through attrition at the company's plants in the Detroit and Chicago areas. Although costs were to be reduced in several areas, the firm intended to remain competitive and continued its capital invest-

ment program. A new 250-short-ton ladle furnace and supporting equipment were ordered from Nippon Kokan K.K. for the Granite City mill, along with a molten-steel surface level control system for the continuous casting operation. Advanced computer technology was also to be applied to the hot-strip mill, basic oxygen furnaces, blast furnaces, and continuous caster.

Laclede Steel Co. planned to spend $8 to $9 million for electronic controls for its continuous caster at the Alton plant over the next 14 months. The improvements were expected to lower production costs and to expand its continuous casting ability by about 5%.

United States Steel Corp. began to expand the product line at its South Works plant in Chicago to include 19 intermediate and heavy, wide-flange structural steel shapes for the building and bridge construction industry. These products were formerly available only from foreign producers or had to be specially fabricated by domestic firms.

Dallas-based Keystone Consolidated Industries Inc. sold its steel division in Chicago Heights late in 1985 to a group of private investors. The new company was to be called Chicago Heights Steel, and the former Keystone plant was expected to reopen in early 1986.

Other Metals.—Olin Corp. completed the $25 million expansion program at its East Alton brass mill. Key equipment included in the expansion and modernization included a computer-controlled, highly automated mill, a horizontal annealing line utilizing a hydrogen atmosphere that was designed to produce an oxide and stain-free surface on the metal; two bell annealing facilities that utilize a hydrogen-nitrogen atmosphere, designed to produce metal free of stains and surface oxides with uniform metallurgical properties; and a full-width double loop slitter for improved winding capabilities. The expenditure was part of an ongoing investment program. In 1983 and 1984, the company spent $18.6 million and $32.8 million, respectively, to upgrade equipment.[4]

[1]State Mineral Officer, Bureau of Mines, Minneapolis, MN.
[2]Editorial assistant, Bureau of Mines, Minneapolis, MN.
[3]Interstate Mining Compact Commission Quarterly Newsletter. Illinois Blasting Certification. V. 3, No. 1, Feb. 1986, p. 4.
[4]American Metal Market. Olin Completes $25M Expansion at Brass Mill in East Alton, IL. May 9, 1985.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives (manufactured):			
Exolon-ESK Co	Box 412 Hennepin, IL 61327	Plant	Putnam.
Cement:			
Dixon-Marquette Cement Inc., a subsidiary of Prairie Materials Sales Inc.	6428 Joliet Rd. Countryside, IL 60525	Quarry and plant	Lee.
Illinois Cement Co., a subsidiary of Centex Corp.	Box 442 La Salle, IL 61301	Quarry, clay pit, plant.	La Salle.
Lone Star Industries Inc., Cement and Construction Materials Group.	Box 90765 Houston, TX 77290	----do	Do.
Missouri Portland Cement Co., a division of H. K. Porter Co. Inc.	7711 Carondelet Ave. St. Louis, MO 63105	Plant	Massac.
Do	----do	Quarry	Hardin.
Clays:			
Absorbent Clay Products Co	Box 120 Anna, IL 62906	Pit and plant	Pulaski.
Lowe's Southern Clay Inc	348 South Columbia South Bend, IN 46624	----do	Do.
Richards Brick Co	234 Springer Ave. Edwardsville, IL 62025	----do	Bond.
Streator Brick Systems Inc	West 9th St. Streator, IL 61364	----do	Livingston.
Fluorspar:			
Hastie Mining Co	Cave In Rock, IL 62919	Open pit	Hardin.
Ozark-Mahoning Co.[1]	Box 57 Rosiclare, IL 62982	Underground mines and plant.	Hardin and Pope.
Gypsum (calcined):			
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	Plant	Lake.
Iron oxide pigments (finished):			
Pfizer Inc., Minerals, Pigments & Metals Div.	235 East 42d St. New York, NY 10017	----do	St. Clair.
Prince Manufacturing Co	700 Lehigh St. Bowmanstown, PA 18030	----do	Adams.
Iron and steel:			
Granite City Steel Div. of National Steel Corp.	Box 365 Granite City, IL 62041	Iron and steel furnaces.	Madison.
Interlake Inc	13500 South Perry Ave. Riverdale, IL 60627	----do	Cook.
LTV Steel Co	1641 GH Republic Bldg. Cleveland, OH 44101	----do	Do.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lime:			
Marblehead Lime Co., a subsidiary of General Dynamics Corp.	300 West Washington St. Chicago, IL 60606	Plants	Cook.
Vulcan Materials Co	Joliet Rd. and 53d St. McCook, IL 60525	Plant	Do.
Peat:			
Hyponex Corp	2013 South Anthony Blvd. Fort Wayne, IN 46803	Bog and processing plant.	Whiteside.
Markman Peat Co	Route 3 Morrison, IL 61270	do	Do.
Perlite (expanded):			
Manville Products Corp	Box 864 Joliet, IL 60434	Plant	Will.
Silbrico Corp	6300 South River Rd. Hodgkins, IL 60525	do	Cook.
Sand and gravel:			
Construction (1984):			
R. A. Cullinan & Sons Inc	121 West Park St. Tremont, IL 61568	Pits and plants	Various.
Elmhurst-Chicago Stone Co	400 West 1st St. Elmhurst, IL 60126	do	Cook, Du Page, Kane.
General Dynamics Corp.: Material Service Corp	300 West Washington St. Chicago, IL 60606	do	Grundy, Kane, McHenry.
Yackley Material Service	1504 Ogden Ave. Lisle, IL 60532	Pit and plant	Will.
Meyer Materials Co	Route 2, Box 56 Algonquin, IL 60102	Pits and plants	Kane and McHenry.
Thelen Sand & Gravel	28955 West Route 173 Antioch, IL 60002	Pit and plant	Lake.
Vulcan Materials Co	Box 6 Countryside, IL 60525	Pits and plants	Champaign, Livingston, McHenry, Macon.
Industrial:			
Manley Bros. of Indiana Inc	Box 538 Chesterton, IN 46304	Pit and plant	La Salle.
Ottawa Silica Co	Box 577 Ottawa, IL 61350	do	Do.
Unimin Corp	258 Elm St. New Canaan, CT 06840	Pits and plants	La Salle and Ogle.
Wedron Silica Co	Box 167 Wedron, IL 60557	Pit and plant	La Salle.
Stone (limestone, crushed):			
Anna Quarries Inc	Box 180 Anna, IL 62906	Quarry and plant	Union.
Columbia Quarry Co	Box 128 Columbia, IL 62236	Underground mine, quarries, plants.	Johnson, Monroe, Pulaski, St. Clair, Union.
Material Service Corp., a subsidiary of General Dynamics Corp.	300 West Washington St. Chicago, IL 60606	do	Cook, Logan, Menard, Montgomery, St. Clair, Vermilion, Will.
Moline Consumers Co	313 16th St. Moline, IL 61265	Quarries and plants.	Adams, Hancock, Henry, La Salle, McDonough, Pike, Rock Island, Warren.
Vulcan Materials Co	Box 6 Countryside, IL 60525	do	Clark, Cook, Iroquois, Kankakee, Livingston, Will.
Sulfur (recovered):			
Mobil Oil Corp	Box 874 Joliet, IL 60434	Plant	Will.
Shell Oil Co	Box 262 Wood River, IL 62095	do	Madison.
UNOCAL Corp. (formerly Union Oil Co. of California).	1650 East Golf Rd. Schaumburg, IL 60196	do	Will.
Tripoli:			
Illinois Minerals Co., a subsidiary of Georgia Kaolin Co.	2035 Washington Ave. Cairo, IL 62914	Underground and open pit mines and plant.	Alexander.
Tammsco Inc	Box J Tamms, IL 62988	Underground mine and plant.	Do.
Vermiculite (exfoliated):			
W. R. Grace & Co	6051 West 65th St. Bedford Park, IL 60638	Plant	Du Page.
Strong-Lite Products Corp. of Illinois[2]	1120 Oak St. De Kalb, IL 60115	do	De Kalb.

[1]Also barite, copper, lead, silver, and zinc.
[2]Also expanded perlite.

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]

In 1985, Indiana's nonfuel mineral production, including large cement and lime shipments, was valued at nearly $303 million. Value increased 3.3% in 1985 over that of 1984, following 17% gains in both 1983 and 1984.

The State was ranked first nationally in building stone production and in masonry cement shipments. Indiana was also ranked third in peat and slag sales; seventh in gypsum production; and eighth in lime production. The State continued as the Nation's leading steelmaker and was ranked seventh among the 16 aluminum producing States.

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

Mineral		1984		1985	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	[2]653	[2]$2,085	740	$2,776
Gem stones		NA	1	NA	1
Peat	thousand short tons	61	1,358	54	W
Sand and gravel:					
Construction	do.	16,071	44,744	[e]18,600	[e]55,800
Industrial	do.	194	1,129	182	1,209
Stone:					
Crushed	do.	[e]26,700	[e]99,400	[3]23,384	[3]81,119
Dimension	do.	[e]159	[e]14,269	188	20,186
Combined value of abrasives (natural), cement, clays (fire clay, 1984), gypsum, lime, stone (crushed marl, 1985), and value indicated by symbol W		XX	130,250	XX	141,863
Total		XX	293,236	XX	302,954

[e]Estimated. NA Not available. W Withheld to avoid disclosing 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.

[3]Excludes marl; value included with "Combined value" figure.

Exploration Activities.—The final plan for future management of the Hoosier National Forest (HNF) was released. The plan addressed the increasing interest in exploration, particularly for oil and gas, in the HNF where 92% of the mineral rights were federally owned. Oil and gas lease applications had been received for more than 80% of HNF's 188,000 acres by 1982. In 1983, the U.S. Bureau of Land Management halted further lease applications pending completion of the forest management plan. According to the plan, "An analysis of the potential for mineral development determined that the forest has some potential for limited oil and gas production. The demand for other minerals is very low and will be handled on a case-by-case basis. Safeguarding standards and guidelines have been incorporated into all alternatives to protect resource values and yet provide minerals."[2] The highest probable level of surface disturbance from oil and gas development was estimated at 72 acres for drillsites and roads. Revenues generated from development, based on production of 112,000 barrels of oil per year and a small quantity of byproduct natural gas, were estimated at $278,000 for the U.S. Treasury and $107,000 for the counties. Areas expected to be affected by oil and gas development were the Dutch Ridge Dome (T7N R1E, T6N R1E) and the German Ridge (Section 21, T6S, R2W).

Legislation and Government Programs.—In December, legislation was prefiled on changing the land reclamation and permit system for mineral aggregate producers. In 1985 and previously, the only statewide regulation of mining applied to coal, clay, shale, and oil shale. Under the prefiled bill, sand and gravel and crushed stone producers will be required to obtain a permit from the State's Department of Natural Resources (DNR), Division of Reclamation. The stipulation will apply to both existing and new operations. In addition, a reclamation plan and performance bond will be required if the bill is enacted. Also in 1985, a bill (S.B. 300) appropriating $10 million for research and development in utilization of medium-sulfur-content coal (1.5% to 3%) was introduced. This bill died in committee. However, interest in research on cleaner burning coal continued, particularly by the State's coal producers, electric utilities, and industrial-commercial consumers. In a $6.2 million project, utility-flue-gas desulfurization was tested at the Stout Station of Indianapolis Power & Light

Table 2.—Nonfuel minerals produced in Indiana in 1984, by county[1]

County	Minerals produced in order of value
Adams	Sand and gravel.
Allen	Sand and gravel, peat.
Bartholomew	Sand and gravel.
Boone	Do.
Carroll	Do.
Cass	Cement, clays, sand and gravel.
Clark	Cement, sand and gravel, clays.
Clay	Clays.
Clinton	Sand and gravel.
Dearborn	Do.
De Kalb	Do.
Delaware	Do.
Dubois	Clays.
Elkhart	Sand and gravel.
Fayette	Do.
Floyd	Do.
Fountain	Sand and gravel, clays.
Franklin	Sand and gravel.
Fulton	Sand and gravel, peat.
Gibson	Sand and gravel.
Grant	Do.
Greene	Do.
Hamilton	Sand and gravel, peat.
Hancock	Sand and gravel.
Harrison	Do.
Henry	Do.
Howard	Do.
Huntington	Sand and gravel, clays.
Jackson	Do.
Jasper	Sand and gravel, peat.
Jay	Sand and gravel.
Johnson	Do.
Knox	Do.
Kosciusko	Do.
Lake	Lime.
La Porte	Sand and gravel, peat.
Lawrence	Cement.
Madison	Sand and gravel, peat.
Marion	Sand and gravel.
Marshall	Do.
Martin	Gypsum.
Miami	Sand and gravel.
Montgomery	Do.
Morgan	Sand and gravel, clays.
Noble	Sand and gravel.
Ohio	Do.
Orange	Abrasives.
Owen	Sand and gravel.
Parke	Do.
Porter	Do.
Putnam	Cement, clays, sand and gravel.
Randolph	Sand and gravel.
St. Joseph	Do.
Shelby	Do.
Starke	Do.
Steuben	Do.
Switzerland	Do.
Tippecanoe	Do.
Union	Do.
Vermillion	Sand and gravel, clays.
Vigo	Sand and gravel.
Wabash	Do.
Warren	Do.
Wayne	Do.
Wells	Peat.
Whitley	Sand and gravel.
Undistributed[2]	Stone (crushed and broken), stone (dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Indiana business activity

		1982[r]	1983	1984[p]
Employment and labor force, annual average:				
Population	thousands	5,474	5,492	5,499
Total civilian labor force	do.	2,578	2,621	2,735
Unemployment	percent	11.1	8.6	7.9
Employment (nonagricultural):				
Mining total	thousands	9.7	10.2	10.2
Nonmetallic minerals except fuels[1]	do.	2.7	2.8	2.9
Coal mining[1]	do.	6.1	6.6	W
Manufacturing total	do.	581.6	620.5	610.3
Primary metal industries	do.	82.4	80.2	74.5
Stone, clay, and glass products	do.	18.3	18.9	18.6
Chemicals and allied products	do.	29.0	29.7	29.6
Petroleum and coal products	do.	4.0	4.1	4.1
Construction	do.	74.8	79.4	89.1
Transportation and public utilities	do.	102.6	105.6	109.4
Wholesale and retail trade	do.	466.4	488.6	509.7
Finance, insurance, real estate	do.	101.4	103.3	105.9
Services	do.	366.1	386.6	408.6
Government and government enterprises	do.	327.0	328.1	333.6
Total	do.	[2]2,209.5	2,122.3	2,176.8
Personal income:				
Total	millions	$58,925	$65,234	$68,442
Per capita		$10,765	$11,878	$12,446
Hours and earnings:				
Total average weekly hours, production workers		41.0	41.7	40.9
Total average hourly earnings, production workers		$10.1	$10.4	$10.7
Earnings by industry:				
Farm income	millions	-$147	$932	$619
Nonfarm	do.	$42,447	$46,459	$49,278
Mining total	do.	$407	$473	$463
Nonmetallic minerals except fuels	do.	$58	$64	$71
Coal mining	do.	$264	$311	$307
Oil and gas extraction	do.	$85	$97	$86
Manufacturing total	do.	$15,510	$17,306	$17,841
Primary metal industries	do.	$2,805	$2,868	$2,821
Stone, clay, and glass products	do.	$452	$485	$495
Chemicals and allied products	do.	$964	$1,059	$1,116
Petroleum and coal products	do.	$175	$184	$192
Construction	do.	$2,396	$2,593	$2,830
Transportation and public utilities	do.	$3,143	$3,389	$3,603
Wholesale and retail trade	do.	$6,518	$6,997	$7,416
Finance, insurance, real estate	do.	$1,927	$2,042	$2,302
Services	do.	$6,850	$7,629	$8,353
Government and government enterprises	do.	$5,543	$5,881	$6,313
Construction activity:				
Number of private and public residential units authorized[3]		16,131	18,998	23,016
Value of nonresidential construction[3]	millions	$875.2	$1,122.7	$1,445.0
Value of State road contract awards	do.	$165.3	$309.3	$329.9
Shipments of portland and masonry cement to and within the State	thousand short tons	1,216	1,324	1,429
Nonfuel mineral production value:				
Total crude mineral value	millions	$250.5	$293.2	$303.0
Value per capita		$46	$53	$55

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2]Data do not add to total shown because of independent rounding.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

Co. in Indianapolis. The pilot-scale project used a process developed by Ebora International Corp., which simultaneously removed sulfur and nitrogen oxides from flue gases with electronbeam irradiation.

Research in industrial minerals by the Indiana Geological Survey (IGS) assisted K.P.T. Inc., Bloomfield, Greene County, in the development of a ceramic tile manufacturing plant; Yellow Banks Clay Products Inc., Huntingburg, Dubois County, in the expansion of its product line to include calcium carbonate fillers; and Calcium Products Inc., Swayzee, Grant County, in the startup and operation of a fine-grind limestone plant.

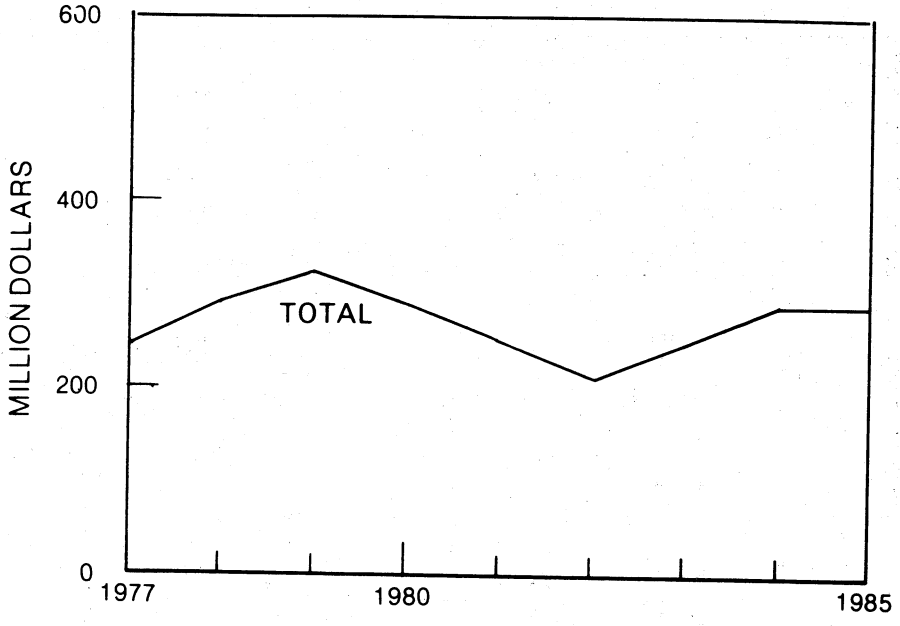

Figure 1.—Total value of nonfuel mineral production in Indiana.

Moreover, information on IGS research and file data was of particular interest to the industry during the year, especially brightness measurements on the limestone and dolomite of the State. IGS drilling of a reef in Grant County and examination of deep rock sections in limestone and dolomite quarries added to the basic knowledge of the State's limestone and dolomite resources. IGS physically tested rock samples, and had one of only three machines in the United States for testing dimension stone resistance to abrasion by foot traffic (ASTM C-241). The Elliott Stone Co. Inc. at Bedford quarried and cut all the limestone stair treads produced in the world-famous Indiana Building Stone District—the Bloomington-Bedford District of southern Indiana in Monroe and Lawrence Counties.

For the coal sector, IGS reports on coal resources and mining in Gibson, Sullivan, and Vigo Counties were completed or published during 1985, and mapping of surface and underground coal mines of Indiana, cooperatively with the Division of Reclamation and the DNR, continued. The IGS core-drilling program continued gathering information on the quality, thickness, and extent of deep coalbeds and yielded considerable information about the complex stratigraphy of Pennsylvania rocks.

The Indiana DNR, Division of Reclamation, contracted Indiana State University to inventory abandoned mine lands. The inventory would yield information used in determining each State's share of Federal funds for abandoned mine lands reclamation.

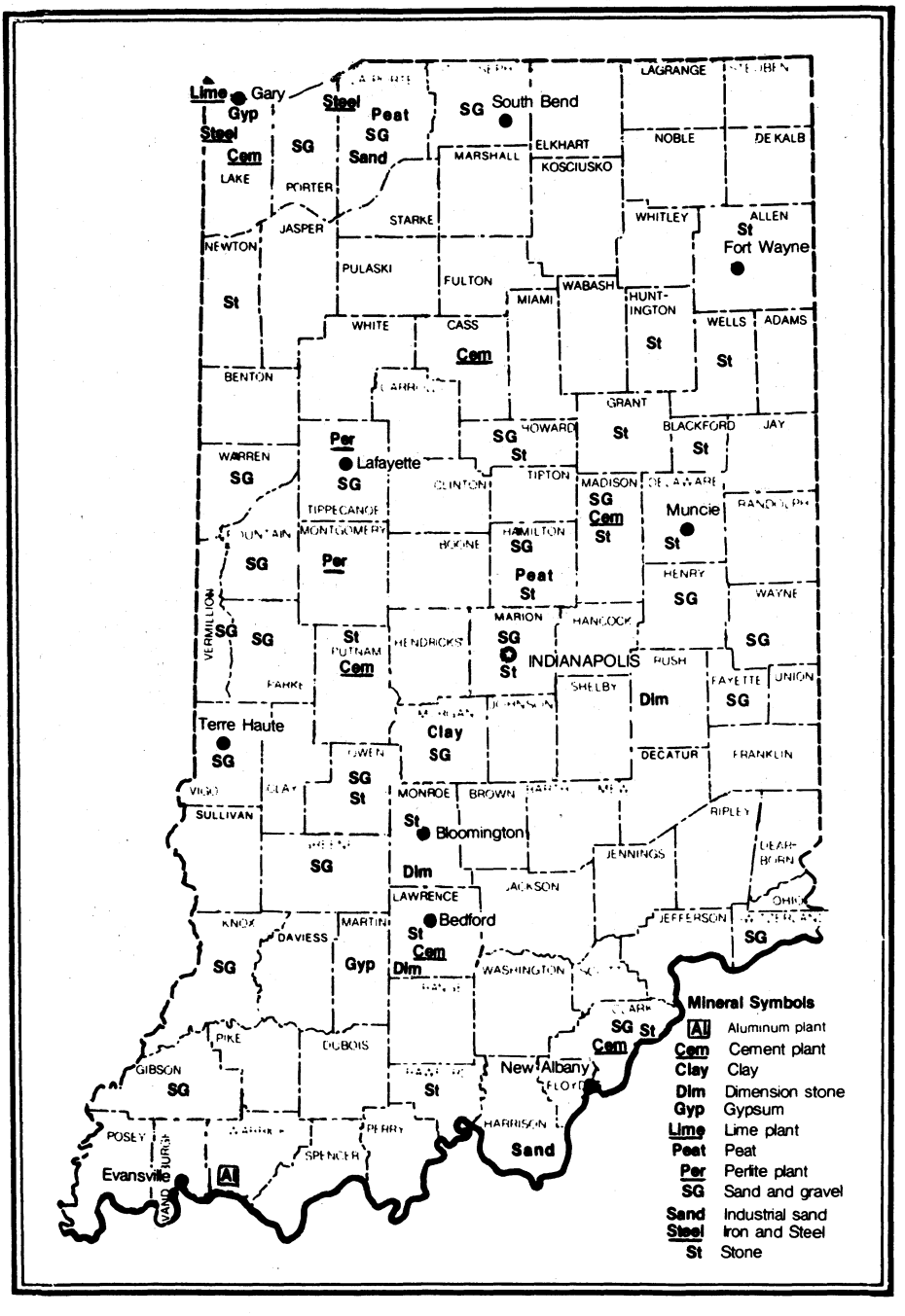

Figure 2.—Principal mineral producing localities in Indiana.

In 1985, the U.S. Government Mineral Institute Program entered its first year under Public Law 98-409, the State Mining and Mineral Resources Research Institute Program Act, which followed 7 years of activity authorized under title III of Public Law 95-87. The new act increased the required matching of funds from 1 State dollar of each Federal dollar to 1.5 State dollars for each Federal dollar in fiscal years 1985 and 1986. Thereafter, through expiration of authority in 1989, matching must be on a 2 to 1 basis. The designation of a State institution of higher learning as a mineral institute created an administrative mechanism for channeling funds to academic departments in proportion to their contribution to mineral-engineering research. Under the program, the U.S. Bureau of Mines granted $147,000 to the Mining and Mineral Research Institute of Purdue University at West Lafayette, 1 of the 31 designated institutes. Purdue continued as an affiliate of the University of Missouri at Rolla, one of the five generic mineral-technology centers in the United States with expertise in pyrometallurgy.

Also in 1985, personnel from the U.S. Bureau of Mines Twin Cities (Minnesota) Research Center studied blasting vibrations at Peabody Coal Co.'s Universal Mine at Blanford in Vermillion County. These studies were conducted for the U.S. Department of the Interior, Office of Surface Mining (OSM), and the Indiana DNR to determine the cause of unusual low-frequency, high-amplitude vibrations affecting neighboring homes near the mine. The Bureau concluded that changes in blast design might lessen the vibrations.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Abrasives.—*Manufactured.*—Jumbo Manufacturing Inc. at Tippecanoe in Marshall County manufactured chilled and annealed iron shot and grit. The quantity and value of production remained essentially unchanged from 1984 levels. Chilled iron shot and grit comprised 87% of the company's manufactured metallic abrasives. Jumbo Manufacturing also produced gray-iron castings.

Natural.—Hindostan Whetstone Co. obtained siltstone from the Hopper Quarry at Orleans in Orange County. The quantity of stone production from the "on demand" quarry fell 80% from 1984 production, whereas the value of finished stone decreased 76%. The special silica stone products manufactured at its Bedford plant in Lawrence County included cuticle removers; discs for table coasters, a new line introduced in 1984; and sharpening stones. Only 12 other companies in the United States produced special silica stone products in 1985—9 in Arkansas produced sharpening stones; 1 in Ohio produced grindstones; and 1 each in Arkansas and Wisconsin produced deburring media.

Cement.—Three companies manufactured cement in Indiana: Coplay Cement Co., a subsidiary of Société des Cemento Française, France; Lehigh Portland Cement Co., a susidiary of Heidelberger Zement AG of the Federal Republic of Germany; and Lone Star Industries Inc., the industry's largest cement manufacturer and the Nation's largest importer of cement. Despite impressive demand and high-capacity utilization, aggressive selling continued to depress industry returns; yet shipments of portland and masonry cement increased in value, 10% and 32.6%, respectively, over 1984 high levels.

Coplay manufactured both portland and masonry cements at Logansport, Cass County, and at Speed, Clark County. Lehigh manufactured aluminous cement at its Buffington Station plant at Gary, Lake County, and portland cement at Mitchell, Lawrence County. The Buffington Station plant was one of only three in the Nation that produced the nonportland hydraulic cement, also known as calcium aluminate cement, high-alumina cement, and cement bonds. This cement sets to a high-strength concrete in 24 hours. Lehigh also operated a distribution terminal at Anderson, Madison County. Lone Star Industries manufactured both portland and masonry cements at Greencastle, Putnam County.

Clays.—Compared with 1984 levels, the quantity and value of common clay and shale increased approximately 13% and 33%, respectively. Common clay and shale was produced by 11 companies at 14 operations in 10 of Indiana's 92 counties in 1985. Exclusive of unreported fire clay, production was 740,000 short tons valued at nearly $2.8 million. The construction industry, the biggest user of heavy clay products such as brick, lightweight aggregate, portland ce-

ment, sewer pipe, and tile, moved at a brisk pace throughout the year. For the third consecutive year, this increase in output continued to reverse the downward production trend that had persisted from 1978 to 1982. Of the total common clay and shale output, 60.3% was used in manufacturing portland cement and 21.6% was used in manufacturing brick. Other uses included animal feed, asphalt, electrical porcelain, lightweight aggregate, pottery, and tile.

In September, K.P.T. broke ground for a new ceramic tile plant in Bloomfield, Greene County. The $6.2 million facility, to be in full production by August 1986, will have an annual payroll of $1.6 million and employ 60 people. This "greenfield," state-of-the-art-equipped, fully automated manufacturing facility will produce 700,000 square meters of floor, wall, and countertop tiles annually. The gas-fired roller kiln was designed and built in Milan, Italy, by Welko Industries of Milan. The production flowsheet consists of a ball mill, mixer, press, glaze line, and a 40- to 50-minute, single-fired 1,200° C kiln.

Yellow Banks Clay at Huntingburg, Dubois County, increased its grinding capacity by adding a second Raymond Roller Mill. This new and larger mill was added primarily for fine grinding limestone for calcium carbonate fillers. Fire clay production increased significantly as the company expanded its markets for clay fillers used for animal feed, plastic, pottery, and rubber. The raw materials are air driven for drying, grinding, separation, and transport to storage for bulk truck shipments, and for semi-bulk shipments (reusable 1-ton supersacks), or the bagging operation. NERCO Coal Co., near Dugger in Sullivan County, was using black shale to produce a black filler.

At yearend, Glen-Gary Corp. at Brazil in Clay County was closing, and several potential buyers had expressed interest in the plant. The company produced several colors of face brick. The plant, which employed 125 workers, purchased common clay and shale and fire clay from within the county. Annual capacity was 300,000 bricks. Also experiencing difficulty in Brazil was Tecotta Industries Inc., which purchased the former plant of Logan Clay Products Co. last year. Tecotta Industries had planned to manufacture floor tiles with purchased clays at the 600-ton-per-month-capacity plant.

Fluorspar (Processed).—National Briquetting Co. at East Chicago in Lake County, one of five U.S. companies using foreign acid-grade filter cake, produced briquets for flux in steel furnaces. Several other briquetting plants were idle. Although shipments increased in 1985, reduced steel mill operation curtailed production. Indiana's fluorspar use decreased slightly from 1984 consumption.

Gypsum.—National Gypsum Co. and USG Corp. produced crude gypsum from underground mines in Shoals in Martin County. Both companies calcined crude gypsum, called land plaster, to stucco for manufacturing wallboard and plasters. Ground crude gypsum was also sold for use as "cement rock," a set retardant; and as agricultural land plaster, a soil conditioner. Lesser amounts were sold for making glass and for animal feed, a debloating additive for forcefed livestock. USG also operated a wallboard plant at East Chicago in Lake County using rock from a captive quarry in Alabaster, MI.

Although mine and plant production had remained essentially unchanged over the past 2 years, the value of calcined gypsum increased about 16% in 1985 and 6.4% in 1984. The State's wallboard manufacturers continued operating at full capacities to keep up with demand from the construction and housing industries.

After a 2-year legal battle, the St. Joseph County Circuit Court in July cleared the way for USG to develop an underground mine and wallboard manufacturing plant in La Porte County. The Court ruled that the zoning change from residential to industrial on the 120-acre site was not done arbitrarily. Nearby property owners had argued that the rezoning amounted to "spot zoning," an illegal procedure.

Lime.—Two Lake County companies produced quicklime for steelmaking. Marblehead Lime Co. operated a plant for United States Steel Corp. (USS) at Buffington Station near Gary; in total output, the Buffington operation was the fifth leading individual plant in the Nation. Inland Steel Co. operated a plant near its Indiana Harbor Works in East Chicago. Limestone for both operations was received by lake freighter from captive quarries in Michigan.

Indiana was the third leading consuming State, behind Pennsylvania and Ohio, of both lime and quicklime. Each consumed more than 1 million tons. Captive lime was used mainly in producing steel in basic oxygen furnaces. Captive use was down, influenced by the steel industry's trend

toward purchasing lime in the open market. Other leading lime uses in the State, in decreasing order of tonnage, were for water purification, sulfur removal from stack gases, and electric-furnace steel. Lime consumption in the steel industry decreased slightly, whereas, environmental uses of lime continued to increase. The quantity and value of Indiana's quicklime production decreased about 5% and 11%, respectively, from 1984 levels.

Peat.—In 1985, six companies produced 38,000 short tons of peat. Sales, totaling 54,000 tons, ranked Indiana a distant third in shipments behind Michigan and Florida. Production and sales decreased 25.5% and 11.5%, respectively, from 1984 levels. Indiana peat, 77% of which was packaged, was used for agricultural and horticultural purposes. Hyponex Corp., Hamilton County, packaged all its product; Millburn Peat Co. Inc., La Porte County, the other leading producer, packaged almost 90% of its peat. The other four active operations sold all their product in bulk. Michigan Peat Co., a former principal producer in the State, abandoned operations at its Rensselaer Bog in Jasper County. The company did not plan to resume operations.

Perlite (Expanded).—Four Indiana companies expanded out-of-State shipments of crude perlite for filter aid and for various construction industry uses. At wallboard manufacturing plants at Shoals, National Gypsum and USG produced expanded perlite for use as a lightweight aggregate in plaster. Grefco Inc. at Crawfordsville in Montgomery County and its 1984 acquisition, Chemrock Corp. at Lafayette in Tippecanoe County, produced concrete and plaster aggregate, filters, filter aid, formed products, horticultural aggregate, and loose-fill insulation from expanded perlite.

In 1985, 22,300 short tons of expanded perlite, valued at $5.5 million, was sold and used in Indiana. The quantity produced and sold or used remained essentially unchanged from 1984 levels, whereas the value increased by 10.4%.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Based on these estimates, 18.6 million short tons of construction sand and gravel valued at $55.8 million, f.o.b. plant or mine, was produced—an increase of 15.7% and 24.7%, respectively, over 1984 shipments. This tonnage is the highest reported since 1980, yet 32.6% below the record high of 1978. In order of volume, the State ranked 13th in the Nation in 1985, and Indiana's use of construction sand and gravel was 6,765 pounds per capita. About 87% of the State's production of construction sand and gravel was processed; the remainder was pit run.

In 1985, Indianapolis and Marion County exemplified the problems and opportunities facing the State's construction aggregate producers. With nine active pits and annual production worth over $6 million, Marion County was to construction sand and gravel what Lake County was to steel, and Monroe and Lawrence Counties were to building stone, but suburban sprawl and zoning codes threatened that distinction. After moving out of central Marion County, the North Carolina-based Martin Marietta Aggregates Div., the Nation's second largest aggregate company, was relegated to two county locations—a far northside pit in Castleton and a southside pit off Kentucky Avenue. As Martin Marietta would mine out its Castleton pit by 1988 and smaller local operators did the same at their sites, the bulk of the metropolitan area's construction sand and gravel production would move to the outlying Hamilton, Johnson, Morgan, and Shelby Counties. Having these operations nearby, however, would lower construction costs because the price of construction aggregate doubled for every 30 miles that it was shipped. Because of exhausted deposits and preemption of known reserves by suburban sprawl or local zoning, two local companies—American Aggregates Corp. and Martin Marietta—went underground to mine crushed limestone, a good substitute for gravel.

Of the more than 100 mined-out gravel pits in Marion County, 12 or more served as swimmable, boatable lakes bordered by housing developments. Bay Development Corp., founded to build condominiums along old gravel pits that it bought on the north side from American Aggregates, had sold nearly 200 "condos," some costing as much as $300,000, along three former gravel pits. American Aggregates had similar plans to turn its 1,800 acres of minable land in Hamilton County into lake-equipped housing subdivisions following mining.

Indianapolis' booming economy bode well

for the county's construction aggregate producers. American Aggregates, which operated six stone and sand and gravel plants in Indiana, supplied all the fill and the concrete aggregate for the Hoosier Dome contractors' and Martin Marietta, which operated seven sand and gravel plants and one crushed stone operation in the State, expected to finish its resurfacing contract at Indianapolis International Airport in 1986. Also, Martin Marietta would be supplying 200,000 tons of aggregate for the 40-acre parking lot at Purolator Corp.'s new national headquarters in Indianapolis and expected to supply additional concrete aggregate for Purolator's new office building. Meanwhile, Vulcan Materials Co. reported a flat year for its operations in the Lafayette and northeastern Indiana areas. Vulcan's asphalt and concrete aggregate production in Indiana was sustained mostly by road construction.

Industrial.—Indiana shipments of industrial sand, totaling 182,000 short tons in 1985, was valued at $1.2 million, f.o.b. plant. From 1984 levels, the volume of shipments decreased 6.2%, whereas the value increased 7.1%. Unimin Corp. at Michigan City, La Porte County, produced primarily glass sand; Crisman Sand Co. Inc. at Portage, Porter County, produced refractory sand; and Harrison Steel Castings Co. at Attica, Fountain County, produced foundry sand for its railway steel castings.

In September, Card Industrial Sand Corp. began producing glass sand east of Elizabeth in Harrison County near the Ohio River. The 381-acre silica sand mining operation, abandoned by the former Ohio River Silica Co. in 1975 because of slumping sales, required a $1.7 million investment by the new owners to return it to production. The silica-rich sand was extracted by hydromining. Most of the production was trucked 20 miles to New Albany in Floyd County and, from there, railed to television manufacturers in Kentucky. Some silica sand was also shipped, as far away as Cincinnati, OH, to Diamond Shamrock Corp. for manufacturing sodium silicate. Some production was also used by area foundries for mold and core, and by golf courses in sand traps. The company expected to add silica flour to its product line in early 1986. Much of the sand plant's business under Ohio River Silica had been with Colgate-Palmolive Co. at Jeffersonville in Clark County, which used "silica flour" to make cleansers. Total employment was expected to reach 80 with an annual payroll of $1 million. Initial annual production, utilizing one shift, was expected to be about 175,000 tons.

Slag—Iron and Steel.—Indiana shipments of iron and steel slag totaling 3.5 million short tons were valued at $11.5 million; quantity and value of sales increased over 1984 levels 10.3% and 26.6%, respectively. Although shipments of construction aggregate from iron slag decreased 14%, steel-slag-aggregate sales increased by a factor of 4.6 over 1984 levels. Blast furnace slag processors showed decreased sales, owing to the lack of availability of iron slag to process. In volume, the State became the Nation's third leading producer of steel slag for construction materials having ranked 10th in 1984. This volume of sales, 3.5 million tons, represented 10% of the total 1985 construction aggregate shipments in Indiana.

Three companies—Heckett Co. and Vulcan at East Chicago and The Levy Co. Inc. at Burns Harbor—processed slag as a substitute for natural construction aggregate, and for road base and fill materials. Levy produced air-cooled and expanded iron slag and processed steel slag. Heckett processed only steel slag, and Vulcan produced air-cooled iron slag. The air-cooled iron slag was used mainly for road base and fill materials, concrete and asphaltic concrete aggregates, and railroad ballast. The expanded iron slag was used primarily as lightweight aggregate in concrete. Essentially all blast furnace (iron) slag is eventually used. Processed steel slag was used as road base and fill materials, asphaltic concrete aggregate, and railroad ballast. About one-half the steel slag produced was recycled to blast furnaces in 1985.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years. The 1984 chapter gave estimates for the quantity and value of shipments. Data for even-numbered years are based on annual company estimates made before year-end.

Crushed.—In 1985, nearly 23.4 million short tons of crushed stone valued at $81.1 million was sold, a decrease of 12.4% and 18.4%, respectively, from the estimated 1984 levels. Because of the increased use of slag for construction aggregate in 1985 and the large increase in construction sand and gravel production over that of 1984, the total volume of construction aggregate sold or used in Indiana remained essentially unchanged from the 1984 level of consumption.

During its survey and field checks of quarries, the IGS found considerable changes in the crushed stone industry; however, the total number of active operations (88) remained nearly as it was in 1983 (89). Of the total number, three operations—one cement plant and two lime plants—used out-of-State stone. Of the remaining 85 operations, 76 produced aggregate, 5 produced ground limestone, and 4 produced cement.

American Aggregates, Indianapolis' largest aggregate supplier with 60% of that market, was developing underground mines at two of its quarries in the city—the Harding Street operations, adjacent to Martin Marietta's Kentucky Avenue underground mine on the south side of the city, and the 96th Street operation on the north side. By midyear, American Aggregates had opened two portals into the side of its Harding Street quarry and began mining limestone for construction aggregate. The portals will be lengthened and joined, and a room-and-pillar system of mining will be employed. The stone taken from the underground mine will supplement that taken from the open pit quarry, which is limited by thick overburden. Mine development at this operation is about 6 months ahead of the underground mine development at the 96th Street operation.

Martin Marietta's Kentucky Avenue operations and American Aggregates' Harding Street operations are near Interstate Highway 465, the 52-mile beltway encircling Indianapolis and most of its 760,000 inhabitants; American Aggregates' 96th Street operations, within 2 miles of the beltway, is in an area of urban expansion on the north side of Indianapolis. These three aggregate mines would not only be in their market area but also under it. American Aggregates, like Martin Marietta before, was going underground to remain near its markets and to get high-quality stone. Surficial deposits in the area are typically very sandy, and the coarse fraction, like stone crushed from some of the bedrock units, sometimes falls short of American Society for Testing and Materials (ASTM) for Class A aggregate. A major expansion of the Indianapolis International Airport created a large demand for high-quality crushed stone. Martin Marietta increased production at its Kentucky Avenue operation.

The Erie Stone Co. excavated two large tunnels beneath the railroad tracks on the south side of its Huntington quarry in Huntington County. The tunnels would give access to additional large reserves of reefal dolomite, which would extend the life of the quarry considerably. Erie Stone also quarried reefal carbonates at its Markle Quarry, Huntington County, and at its Bluffton Quarry, Wells County.

A major acquisition in 1985 was the purchase of five southeastern Indiana quarries by Koppers Co. Inc. Koppers, which owns the Russelville Stone Div. at Russelville in Putnam County, purchased the three Berry Materials Co.'s quarries—North Vernon Quarry and Hayden Quarry in Jennings County and the Versailles Quarry in Ripley County. Koppers also purchased the Scott County Stone Co. Inc. quarry near Scottsburg. Also for sale in 1985 was the Clark County quarry of Liter's Quarry of Indiana Inc.

To obtain additional reserves, May Stone & Sand Inc., a division of France Stone Co., acquired the abandoned Midwest Aggregates Quarry near Edgerton in Allen County. May Stone's Woodburn Quarry, a short distance north of the Edgerton Quarry, had limited reserves and additional land was unavailable. The Fort Wayne quarry of Allen County Aggregates was sold and renamed the Allen County Stone Co. Also, in 1985, Martin Marietta's Lapel Quarry and underground mine in Madison County were closed; company property near the site was sold, and the site was leased.

Energy Supply Inc., a coal company with Indiana operations headquartered in Dale, Spencer County, purchased the bankrupt Hy-Rock Products Co. Hy-Rock Products had an underground mine and plant at Marengo in Crawford County. Rush County Stone Co. near Milroy, Ward Stone Inc. near Francisville in Pulaski County, and Rensselaer Stone Co. Inc. in Jasper County had deepened their quarries. Martin Marietta was also deepening its Lane Quarry at the Ohio River in Clark County.

The continuing, as well as the potential, use for Indiana limestone as scrubber stone was again evidenced in 1985. The Rogers Group Inc. sold limestone from its Bloomington Quarry, Monroe County, for scrubber stone. Most was sold to the Hoosier Energy Co. generating plant at Merom Station, Sullivan County. Also, Mulzer Crushed Stone Inc., the State's second largest crushed stone producer, was considering adding scrubber stone to its product line. At Mulzer's largest operations at Cape Sandy on the Ohio River in Crawford County, the rock is about 93% calcium carbonate. This characteristic made it suitable for use in desulfurizing stack gases resulting from

coal-burning, electric-generating stations and other industrial facilities. Virtually all of the Cape Sandy production was being shipped by barge to markets in Indiana, Kentucky, and West Virginia for construction aggregates; riprap used by the U.S. Army Corps of Engineers along the Ohio River; and agricultural limestone, a by-product of dry crushing and screening.

Purdue University planned to install a new fluidized-bed (FB) boiler system that would use limestone as the sulfur dioxide absorbent. State funding would be sought from the 1986 legislature. Also, Old Ben Coal Co. was planning an FB cogenerating system to produce electricity and steam. Old Ben's plans included using the electricity and selling the steam to customers as far as 40 miles from the site. The new General Motors Corp. (GM) plant at Fort Wayne would also be using FB boilers—two rated at 200,000 pounds of steam per hour, the largest in the Nation. The boilers would use Indiana coal (3.5% sulfur) and, most probably, Indiana scrubber stone.

Another growth area for Indiana crushed stone in 1985 was fine-grind limestone for white filler material. Yellow Banks Clay at Huntingburg in Dubois County added a second and larger roller mill to increase its production of calcium carbonate fillers; the new fine-grind plant of Calcium Products Inc., a joint venture between France Stone and Pipe Creek Jr. at the Pipe Creek Jr. Quarry in Grant County, was performing well, even as demand exceeded plant capacity. The rock was a high-calcium reefal limestone.

Table 4.—Indiana: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	187	744
Riprap and jetty stone	279	1,099
Filter stone	214	710
Other coarse aggregate	2	7
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,110	4,302
Bituminous aggregate, coarse	4,935	15,060
Bituminous surface-treatment aggregate	407	1,746
Railroad ballast	901	2,868
Fine aggregate (-3/8 inch):		
Stone sand, bituminous mix or seal	99	388
Screening, undesignated	114	414
Other fine aggregate	(2)	3
Combined coarse and fine aggregates:		
Graded road base or subbase	1,459	5,333
Unpaved road surfacing	1,589	4,931
Crusher run or fill or waste	1,669	6,355
Other construction materials[3]	1,223	4,561
Agriculture: Agricultural limestone	1,307	5,170
Chemical and metallurgical:		
Lime manufacture	W	23
Flux stone	W	198
Special:		
Other fillers or extenders	14	36
Other miscellaneous[4]	2,435	7,436
Other unspecified[5]	5,493	19,730
Total[6]	23,384	81,119

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

[1]Includes limestone and dolomite; excludes a minor amount of marl withheld to avoid disclosing company proprietary data.

[2]Less than 1/2 unit.

[3]Includes stone used in stone sand (concrete), terrazzo and exposed aggregate, and stone used for other construction and maintenance purposes.

[4]Includes stone used in cement manufacture, asphalt fillers or extenders, and uses indicated by symbol W.

[5]Includes production reported without a breakdown by end use and estimates for nonrespondents.

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

Dimension.—This was another good year for Indiana's building stone industry as the quantity and value of quarry blocks and fabricated stone shipments increased 18.2% and 41.5%, respectively, over the estimated highs of 1984. Dimension stone, sold or used by the State quarries, totaled 2.60 million cubic feet, f.o.b. quarry or mill. In 1985, the State became the Nation's leading producer of dimension stone, surpassing Georgia—the leading producer of both dimension granite and marble.

Indiana dimension stone was practically synonymous with the so-called Indiana Limestone, the limestone building material dominating the national market for over a century. The limestone was quarried from the Salem Limestone formation in the Bloomington-Bedford District of southern Indiana. This two-county area—Monroe and Lawrence Counties—produced over 90% of the State's total production. Within the Bloomington-Bedford District were 8 companies producing blocks from 14 quarries. Three produced only quarry blocks, and five were fully integrated. There were six integrated mills and several independent or associated fabricators.

Some dimension limestone production, mostly veneer and flagstone, was also reported in Franklin, Putnam, and Rush Counties. For these four operators, 1985 was also a good year as production and value increased 35.5% and 33.2%, respectively, from 1983 levels when the last full annual survey was conducted. The production was from other than the famous Salem Limestone formation.

For a number of years, Elliott Stone had been using chain saws of French manufacture. Elliott Stone, which operated four saws, introduced the chain saw to the district in 1979. Late in 1985, Evans Quarries Inc. began using a French-built Perrier chain saw with a 15-foot cutting arm at its Palestine Quarry. Also, B. G. Hoadley Co. Inc. and Indiana Limestone Co. Inc. planned to use a new "band" saw being developed by W. F. Meyer Co. of Bedford. It is similar to the French-built chain saw, differing in that the W. F. Meyer saw cuts with a diamond-impregnated rubberized belt rather than diamond-capped steel teeth in a chain. Also in 1985, Elliott Stone purchased a new gallery saw, similar to the Perrier saws, but capable of cutting horizontally as well as vertically. The company was planning to mine dimension stone underground as soon as possible.

In November 1985, Indiana Limestone, the State's leading producer of building stone, purchased for redemption the controlling interest in its stock previously held by a New York-based investor group. Indiana Limestone, in estimated total annual sales, was the seventh leading dimension stone quarrier in the Nation.

In 1985, The Proctor & Gamble Co. christened its new east downtown headquarters in Cincinnati, OH. The massive limestone building with twin octagonal towers was built with 10,356 pieces of Indiana Limestone.

Table 5.—Indiana: Dimension stone sold or used by producers in 1985, by use

Use	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Rough blocks for building and construction	114,244	1,576	$6,161
Irregular-shaped stone	12,200	168	156
Dressed stone:			
Ashlars and partially squared pieces	26,319	363	5,202
Other[1]	35,482	489	8,667
Total	188,245	2,596	20,186

[1]Dressed slabs and blocks for building and construction, monumental, and flagging.

Sulfur (Recovered).—Elemental sulfur was recovered as a nondiscretionary by-product from petroleum refining at the Amoco Oil Co. refinery at Whiting in Lake County. Production, in terms of sulfur content, decreased 4.6% from the 1984 level, whereas the quantity of shipments decreased about 2% while value increased nearly 9%.

METALS

Aluminum.—The Aluminum Co. of America (Alcoa) operated a 270,000-metric-ton-per-year smelter and a six-rolling-mill fabricating plant in Warrick County near Evansville in southwestern Indiana. The fully integrated facility produced thin-gauge sheet used mostly for beverage cans,

Alcoa's largest product line.

Responding to high inventories and weak prices, Alcoa reduced its U.S. smelting rate from 91% of rated capacity in January to 78% by yearend while reducing its Warrick Operations from 92.5% to 85% over the same period. The higher operating rates at Warrick, Alcoa's largest producer of thin-gauge sheet, were attributed to its high use of recycled aluminum beverage cans and a reduction in thickness of can-body stock.

The Warrick Operations obtained about one-third of its metal by recycling beverage cans. In 1985, Alcoa collected 263,000 metric tons of used aluminum beverage cans in the United States for recycling, saving 95% of the energy required to produce that aluminum from raw material. In total, 19% of Alcoa's U.S. primary capacity in 1985 consisted of used aluminum beverage cans. According to the Aluminum Association, 97% of all U.S. beverage cans were aluminum, and 33.1 billion were recycled in 1985—about 51% of aluminum can shipments.

At midyear, Alcoa reduced the gauge-tolerance range on its can-body stock by 33% or 0.0002 inch—Alcoa's third gauge reduction. Hence, the company was producing more sheet from less aluminum, and Alcoa customers were producing more beverage cans from the same amount of metal. Also, the container and packaging sector remained the most stable and largest U.S. market for aluminum, accounting for 27% of the total shipments, and growing by about 2% in 1985.

Despite these factors, the quantity and value of ingots cast at the Warrick smelter decreased by an estimated 6% and 20%, respectively, from 1984 levels. Because of an oversupply of primary aluminum worldwide, prices declined through the year. The average U.S. spot price for ingot dropped to 49 cents per pound in 1985 from 61 cents in 1984. In December, Alcoa announced plans to close 350,000 tons of its smelting and related refining capacity. The specific facilities and timing were not disclosed by yearend.

In 1985, Alcoa started up its new high-speed sheet-coating line at the Warrick Operations. Also, the new electromagnetic ingot caster was to start in 1986, and computer-integrated manufacturing would be implemented in 1987 and beyond.

At midyear, Alcoa idled the No. 1 potline at Warrick and announced that the shutdown was probably permanent. That line was the oldest of six and most expensive to operate mainly because of energy costs. Alcoa had its own electric-generating facility for the rest of the plant but needed extra electricity to run the No. 1 potline. Alcoa was buying that power from Southern Indiana Gas & Electric Co. (SIGECO) and was paying a demand fee for having it available at all times, even if not used. Alcoa was phasing out that contract with SIGECO. Although SIGECO's rates were below average among public utilities, they were too expensive for Alcoa. Because of new technology introduced continuously since the plant started 25 years ago, the other five potlines could produce virtually as much metal as the original six lines did.

Alcoa also operated finishing mills at Fort Wayne, Lafayette, and Richmond and research facilities at Fort Wayne and Richmond.

Standard Alloys Corp. was planning to open a new secondary aluminum smelter in Hammond. In July, the smelter construction program was on schedule, and the company was looking to a September melting starting with two furnaces. Standard Alloys expected secondary aluminum sales to exceed $35 million per year and planned to enter the scrap aluminum market. At Hammond, Advanced Aluminum Products Inc., using state-of-the-art technology, opened an aluminum minimill in late 1985. A portion of the shuttered, former Pullman-Standard Inc. plant was converted to a continuous process minimill, one of three in the United States using this process. The Hammond plant produced sheet for automobiles, home siding, and storm windows. The facility had enterprise zone status; hence, would qualify for tax advantages during the first 10 years of operation.

In January, Alcan Aluminum Ltd. acquired certain aluminum assets of Atlantic Richfield Co.'s (ARCO) aluminum business, following court approval of a consent decree entered into in late 1984 between the U.S. Department of Justice, Alcan, and ARCO. Included in the purchase was ARCO's 160,000-short-ton-per-year rolling mill at Terre Haute.

Sheller-Ryobi Corp., a joint venture between Sheller-Globe Corp. (a major supplier to the automotive industry) of Toledo, OH, and Ryobi Ltd. of Japan (an aluminum and zinc diecaster), selected a site near Shelbyville in Shelby County for its manufacturing facility. The 200,000-square-foot plant would produce precision aluminum diecastings for the North American automo-

tive industry. Ryobi had a 55% interest in the newly formed joint venture.

Beryllium-Copper Alloys.—In October 1985, Cabot Corp. announced that it would sell most of its alloy and metal facilities, including its beryllium-copper alloy sector, as part of a restructuring plan. The divestiture reportedly would include its High Technology Materials Div. in Kokomo, which produced superalloys and its recently completed $17 million rolling mill at Elkhart.

Iron and Steel.—A substantial revival for the U.S. steel industry, hoped for at yearend 1984, did not materialize in 1985. U.S. pig iron shipments decreased 4.1% and value fell 0.7% from 1984 levels. U.S. raw steel production decreased 4.6% to 88.3 million short tons after 2 consecutive years of modest increases over the 33-year low of about 74.6 million tons in 1982. Shipments were also somewhat below those of 1984, retreating to 72 million tons from 73 million tons. The industry operated at less than two-thirds of capability, and although raw steel production exceeded 72% of capability in March, it dropped below 60% by yearend. Employment, 151,000 workers on wages and 57,000 on salaries, decreased 11.9% from 1984 levels—average annual employment having declined more than one-half since 1979.

Indiana continued to be the leading U.S. steelmaker, taking that top position in 1982. The State's pig iron production and value of shipments were 15.6 million tons and $3.2 billion, respectively. Indiana's market share of U.S. pig iron shipments was 31.3%—up 2.6% from that of 1984. Indiana's raw steel production at 19.7 million tons remained essentially unchanged from the 1984 output, while the State increased its market share by almost 1% to 22.3% of total U.S. raw steel output.

Adjustments within Indiana's steel industry continued. In April, Chicago-based Inland Steel announced a 30% reduction in its raw steel capacity to 6.5 million tons annually. The reduction, scheduled over an 18-month period, would include the closing of open-hearth furnaces and rolling mills at its Indiana Harbor Works. Permanently idled would be 1,050 workers at the No. 3 open-hearth shop, 14-inch and 24-inch bar mills, and the No. 3 blooming mill. Portions of the 44-inch hot-strip mill had been closed earlier in the year. The company cited steel imports, depressed steel prices, and the overvalued dollar for these closings. The company further announced that an additional 1,000 salaried jobs would be eliminated by streamlining and computerization aimed at reducing its iron and steel production costs by 20% over the next 3 years.

As Inland Steel idled high-cost capacities, however, it modernized to better compete with low-cost foreign steel. On December 17, the company commissioned its new, $200 million, continuous casting complex with the startup of a new slab caster, the second of three units comprising the No. 2 continuous casting complex. The first, a $26.5 million ladle-metallurgy station for improving quality and productivity, was completed in September. The third, a new bloom-slab caster, would come on-line in February 1986. With the permanent closure of the No. 3 open hearth shop, scheduled for July 1986, and full operation of the No. 2 continuous casting complex, Inland Steel would be casting 80% of its newly reduced capacity—6.5 million tons per year.

Both Bethlehem Steel Corp. at Burns Harbor and USS at Gary were installing slab casters with startups scheduled for 1986. Bethlehem's new slab caster would have an annual capacity of 2.2 million tons. The company already had a 2-million-ton-capacity caster at Burns Harbor. This capacity—when added to the 1.2-million-ton-capacity bloom caster in Steelton, PA, and the 2.9-million-ton-capacity slab caster coming on-stream at Sparrow Point, MD, in early 1986—would allow Bethlehem to continuously cast 60% to 65% of its semifinished steel. The new USS slab caster would be the second at the Gary Works. Its 3.3-million-ton capacity would bring the plant's continuous casting capacity to 90%.

Continental Steel Corp., which emerged from chapter 11 proceedings in 1982, again filed for creditor protection under chapter 11 of the Federal Bankruptcy Code. Continental Steel produced rod, wire, and wire products at its Kokomo plant.

Lead (Secondary).—U.S.S. Lead Refinery Inc., East Chicago, suspended secondary lead smelting after exhausting inventories of raw materials. Sales ended in November. The company cited "too narrow a spread" between raw material costs, mainly scrap batteries, and the market price of secondary lead products for its decision. Additionally, U.S.S. Lead Refinery would have had to invest up to $400,000 to comply with environmental protection regulations.

The East Chicago smelter was the only

secondary lead smelter operating in the Chicago area. The nearest active secondary smelters were in Indianapolis and the Twin Cities of Minnesota. The normal flow of scrap batteries returned to U.S.S. Lead Refinery by tolling arrangement would be, for the most part, shipped to an Indianapolis smelter.

Rare-Earth Metals.—GM, using a GM-developed rapid solidification process, planned to produce neodymium-iron-boron permanent magnets at a new plant in Anderson. The company was to produce the magnets initially for use in starter motors for cars and further expand use and applications to other motors. GM expected to market 80% of its neodymium-iron-boron magnet production outside the company. Rare-earth permanent magnets were used in a wide variety of electrical and electronic applications.

[1]State Mineral Officer (retired), Bureau of Mines, Pittsburgh, PA. For information contact J. Hill, Bureau of Mines, Minneapolis, MN.

[2]Forest Service, U.S. Department of Agriculture. Final Environmental Impact Statement, Land and Resource Management Plan. Hoosier National Forest. For information, contact Wayne-Hoosier National Forest, 3527 10th St., Bedford, IN 47421, telephone (812) 275-5987).

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Manufactured:			
Jumbo Manufacturing Inc	Box 155, 2900 Center St. Tippecanoe, IN 46570	Plant	Marshall.
Natural:			
Hindostan Whetstone Co	Box 862 2828 Garvey Lane Bedford, IN 47421	Quarry and plant	Orange (quarry) and Lawrence (plant).
Aluminum:			
Aluminum Co. of America	Warrick Operations Box 10 Newburgh, IN 47630	Smelter and fabricating plant.	Warrick.
Cement:			
Coplay Cement Co.[1 2]	Box 659, Highway 25 West Logansport, IN, 46947	Plant (portland) and quarry.	Cass.
Do	Speed, IN 47171	Plant (portland and masonry) and quarry.	Clark.
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 and masonry) and quarry.	Putnam.
Clays:			
General Shale Products Corp	Box 96 Mooresville, IN 46158	Pits and plant	Morgan.
Hydraulic-Press Brick Co., Haydite Div.	Brooklyn, IN 46111	Pit and plant (lightweight aggregate).	Do.
Yellow Banks Clay Products Inc.[1]	Industrial Park, Box 29 Huntingburg, IN 47542	Pits, quarry, plant (fillers).	Dubois.
Fluorspar (processed):			
National Briquetting Co	5222 Indianapolis Blvd. East Chicago, IN 46312	Plant	Lake.
Gypsum:			
National Gypsum Co.[3]	Box 250 Shoals, IN 47581	Underground mine and plant.	Martin.
USG Corp.[3]	Box 298 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. 12 Chesterton, IN 46304	Mill (integrated)	Porter.
Continental Steel Corp	1111 South Main St. Box 5049 Kokomo, IN 46902	Minimill	Howard.
Inland Steel Co	3210 Watling St. East Chicago, IN 46312	Mill (integrated)	Lake.
LTV Steel Co.	3001 Dickey Rd. East Chicago, IN 46312	Mills (integrated-finishing).	Do.
National Steel Corp., Midwest Steel Div.	U.S. 12 Portage, IN 46368	Mill (rolling)	Porter.
United States Steel Corp., Gary Works Div.	1 North Broadway Gary, IN 46402	Mill (integrated)	Lake.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lime:			
Inland Steel Co., Indiana Harbor Works (Limekiln).	3210 Watling St. East Chicago, IN 46312	Plant	Lake.
Marblehead Lime Co	Box 689 Gary, IN 46402	do	Do.
Peat:			
Hyponex Corp., Noblesville plant.	2013 South Anthony Blvd. Fort Wayne, IN 46803	Bogs and plant	Hamilton and Hancock.
Michigan Peat Co.[4]	Box 234, Rural Route 6 Rensselaer, IN 47978	do	Jasper.
Milburn Peat Co. Inc	Box 236 La Porte, IN 46350	do	La Porte.
Perlite (expanded):			
Chemrock Corp	Box 5465, Highway 25 at Monon RR Crossing Lafayette, IN 47903	Plant	Tippecanoe.
Grefco Inc	Box 48, 100 East Country Rd. Crawfordsville, IN 47933	do	Montgomery.
Sand and gravel:			
Construction:			
American Aggregates Corp	District Office Box 40228 4700 East 96th St. and Gray Rd. Indianapolis, IN 46240 Corporate Headquarters Drawer 160 Garst Ave. at Ave. B Greenville, OH 45331	Pits and plants (4 operations).	Hamilton, Marion, Wayne.
Hilltop Basic Resources Inc	630 Vine St. Cincinnati, OH 45202	Pit and plant	Switzerland.
Irving Materials Inc	Box 369, Rural Route 5 Greenfield, IN 46140	Pits and plants	Fayette, Hamilton, Henry, Madison, Wayne.
Martin Marietta Aggregates	Box 30013, 2170 Wycliff Rd. Raleigh, NC 27622	do	Clark, Hamilton, Howard, Marion, Vermillion, Vigo.
Rogers Group Inc	Box 849, 350 South Adams St. Bloomington, IN 47402	do	Fountain, Gibson, Greene, Knox, Morgan, Owen, Warren.
Vulcan Materials Co.[1 5]	Box 5529 Lafayette IN 47903	do	La Porte, Parke, St. Joseph, Tippecanoe.
Industrial:			
Card Industrial Sand Corp	Box 1316 New Albany, NY 47150	Pit and plant	Harrison.
Crisman Sand Co. Inc	6480 Melton Rd. Portage, IN 46368	do	Porter.
Harrison Steel Castings Co	900 Mount St., Box 60 Attica, IN 47918	do	Fountain.
Unimin Corp	258 Elm St. New Canaan, CT 06840	do	La Porte.
Slag:			
Iron:			
Vulcan Materials Co.[1]	Box 6, 500 West Plainfield Rd. Countryside, IL 60525	Plant	Lake.
Iron and steel:			
The Levy Co. Inc.[1]	Box 540 Portage, IN 46368	Plants	Lake, Porter, St. Joseph.
Steel:			
Heckett Co	Box 1071, North Main St. Butler, PA 46368	Plant	Lake.
Stone:			
Crushed:			
American Aggregates Corp	District Office Box 40228 4700 East 96th St. and Gray Rd. Indianapolis, IN 46240 Corporate Headquarters Drawer 160 Garst Ave. at Ave. B Greenville, OH 45331	Quarries and plants	Hamilton, Marion, Owen.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Crushed —Continued			
Calcium Products Inc	Swayzee, IN 46986	Quarry and plant (fillers).	Allen and Putnam.
The France Stone Co	Box 1928 Toledo, OH 43603	do	Do.
Irving Bros. Sand & Gravel	Rural Route 13 Box 300 Muncie, IN 47302	do	Blackford, Delaware, Grant, Huntington, Madison, Wells.
Martin Marietta Aggregates Div.	Box 30013, 2170 Wycliff Rd. Raleigh, NC 27622	do	Clark, Hamilton, Howard, Madison, Marion.
Mulzer Crushed Stone Inc	Box 248, 603 6th St. Tell City, IN 47586	Quarries, mine, plants.	Crawford and Perry.
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	Quarries and plant	Lawrence.
Evans Quarries Inc	Box 711 Bedford, IN 47421	Quarry and plant	Do.
B. G. Hoadley Co. Inc	Box 1224 Bloomington, IN 47402	Quarry and plants	Lawrence and Monroe.
Independent Limestone Co	6001 South Rockport Rd. Bloomington, IN 47401	Quarry and plant	Monroe.
Indiana Limestone Co. Inc	Box 72, 405 First St. Bedford, IN 47421	Quarries and plants	Lawrence and Monroe.
Indiana Sandstone Co. Inc	Box 501 Bedford, IN 47421	Quarry and plant	Lawrence.
Reed Quarries Inc	Box 64 Bloomington, IN 47402	do	Monroe.
Rush County Stone Co.[1]	Rural Route 1 Milroy, IN 46156	do	Rush.
Victor Oolitic Stone Co	Box 668 Bloomington, IN 47402	do	Monroe.
Sulfur (recovered):			
Amoco Oil Co	Box 710 2815 Indianapolis Blvd. Whiting, IN 46394	Refinery	Lake.

[1]Also crushed stone.
[2]Also clays.
[3]Also expanded perlite.
[4]Abandoned operations in 1985 with no plans to resume.
[5]Also iron slag.

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 Doss H. White, Jr.,[1] James J. Hill,[2] and Wanda J. West[3]

Iowa's nonfuel mineral production was valued at $228 million, a decline of 10% compared with 1984 figures. This was the lowest value reported since 1982. Nationally, the State ranked 32d in nonfuel mineral production, dropping from the 29th position it held in 1984. Volume of output fell for principal commodities except gypsum, which gained about 7%. Low levels of construction activity had the greatest impact on sales of the State's nonfuel mineral commodities. Permits for nonresidential housing dropped about 2%, residential construction permits fell 26%, and highway contract awards were down 11%. The sales increase for gypsum, a commodity used almost exclusively in construction, could be credited to the larger regional market served by Iowa's producers. Although the State's cement industry also served a regional market, several nearby States also had cement plants, which limited Iowa producers' regional cement sales.

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

Mineral	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
Cement:				
Masonry thousand short tons	42	$3,260	39	$3,372
Portland do.	1,730	92,699	1,618	77,890
Clays do.	623	2,695	503	2,450
Gem stones	NA	W	NA	1
Gypsum thousand short tons	1,527	12,421	1,639	13,682
Peat do.	11	400	11	415
Sand and gravel (construction) do.	13,882	37,027	e12,000	e30,500
Stone (crushed) do.	e23,800	e100,000	23,657	94,496
Combined value of lime, stone (dimension, 1985), and value indicated by symbol W	XX	4,943	XX	5,211
Total	XX	253,445	XX	228,017

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

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

Table 2.—Nonfuel minerals produced in Iowa in 1984, by county[1]

County	Minerals produced in order of value
Allamakee	Sand and gravel (construction).
Appanoose	Do.
Benton	Do.
Black Hawk	Do.
Boone	Do.
Buchanan	Do.
Buena Vista	Do.
Butler	Do.
Calhoun	Do.
Carroll	Do.
Cass	Do.
Cedar	Do.
Cerro Gordo	Cement, clays, sand and gravel (construction).
Chickasaw	Sand and gravel (construction).
Clay	Do.
Clayton	Do.
Clinton	Do.
Dallas	Sand and gravel (construction), clays.
Delaware	Sand and gravel (construction).
Des Moines	Gypsum, sand and gravel (construction).
Dickinson	Sand and gravel (construction).
Dubuque	Do.
Emmet	Do.
Fayette	Do.
Floyd	Do.
Franklin	Do.
Greene	Do.
Grundy	Do.
Guthrie	Do.
Hamilton	Do.
Hancock	Do.
Hardin	Do.
Howard	Do.
Humboldt	Do.
Iowa	Do.
Jackson	Do.
Jasper	Do.
Johnson	Do.
Jones	Do.
Keokuk	Do.
Kossuth	Do.
Lee	Do.
Linn	Sand and gravel (construction), peat.
Louisa	Sand and gravel (construction).
Lyon	Do.
Madison	Clays.
Marion	Sand and gravel (construction), gypsum.
Marshall	Sand and gravel (construction).
Mitchell	Do.
Monona	Do.
Montgomery	Do.
Muscatine	Sand and gravel (construction), peat.
O'Brien	Sand and gravel (construction).
Osceola	Do.
Page	Do.
Palo Alto	Do.
Plymouth	Do.
Polk	Cement, sand and gravel (construction).
Pottawattamie	Sand and gravel (construction).
Sac	Do.
Scott	Cement, lime, clays, sand and gravel (construction).
Shelby	Sand and gravel (construction).
Sioux	Do.
Story	Do.
Tama	Do.
Van Buren	Do.
Wapello	Sand and gravel (construction), clays.
Washington	Sand and gravel (construction).
Webster	Gypsum, sand and gravel (construction).
Winnebago	Peat.
Winneshiek	Sand and gravel (construction).
Woodbury	Sand and gravel (construction), clays.
Worth	Sand and gravel (construction), peat.
Wright	Sand and gravel (construction).
Undistributed[2]	Stone (crushed), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Iowa business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	2,904	2,903	2,884
Total civilian labor force	do.	1,421	1,412	1,416
Unemployment	percent	8.1	7.0	8.0
Employment (nonagricultural):				
Mining total[1]	thousands	1.9	2.0	2.1
Nonmetallic minerals except fuels[2]	do.	1.7	1.8	1.8
Manufacturing total	do.	202.3	211.9	204.9
Primary metal industries	do.	7.1	7.9	7.4
Stone, clay, and glass products	do.	4.9	4.8	4.4
Chemicals and allied products	do.	6.6	6.6	6.5
Petroleum and coal products[2]	do.	W	W	.2
Construction	do.	35.9	38.7	36.3
Transportation and public utilities	do.	51.3	51.5	51.4
Wholesale and retail trade	do.	268.7	277.1	277.1
Finance, insurance, real estate	do.	59.8	61.8	63.0
Services	do.	217.1	227.0	231.3
Government and government enterprises	do.	203.4	204.5	208.7
Total[3]	do.	1,040.4	1,074.7	1,074.7
Personal income:				
Total	millions	$31,572	$35,092	$36,315
Per capita		$10,872	$12,087	$12,594
Hours and earnings:				
Total average weekly hours, production workers		39.8	40.2	40.2
Mining		45.8	46.2	44.2
Total average hourly earnings, production workers		$10.1	$10.2	$10.3
Mining		$7.6	$8.0	$8.3
Earnings by industry:				
Farm income	millions	$37	$1,863	$1,905
Nonfarm	do.	$20,512	$21,865	$22,576
Mining total	do.	$80	$94	$90
Nonmetallic minerals except fuels	do.	$38	$43	$45
Coal mining	do.	$4	$6	$6
Manufacturing total	do.	$5,146	$5,475	$5,442
Primary metal industries	do.	$247	$285	$263
Stone, clay, and glass products	do.	$120	$120	$110
Chemicals and allied products	do.	$189	$197	$199
Petroleum and coal products	do.	$6	$6	$6
Construction	do.	$1,102	$1,232	$1,223
Transportation and public utilities	do.	$1,552	$1,672	$1,728
Wholesale and retail trade	do.	$3,802	$3,986	$4,053
Finance, insurance, real estate	do.	$1,254	$1,353	$1,459
Services	do.	$3,996	$4,363	$4,696
Government and government enterprises	do.	$3,339	$3,487	$3,678
Construction activity:				
Number of private and public residential units authorized[4]		7,169	7,198	5,190
Value of nonresidential construction[4]	millions	$348.3	$461.1	$445.5
Value of State road contract awards	do.	$264.6	$233.0	$207.0
Shipments of portland and masonry cement to and within the State	thousand short tons	1,159	1,218	1,089
Nonfuel mineral production value:				
Total crude mineral value	millions	$247.4	$253.4	$228.0
Value per capita		$85	$87	$79

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

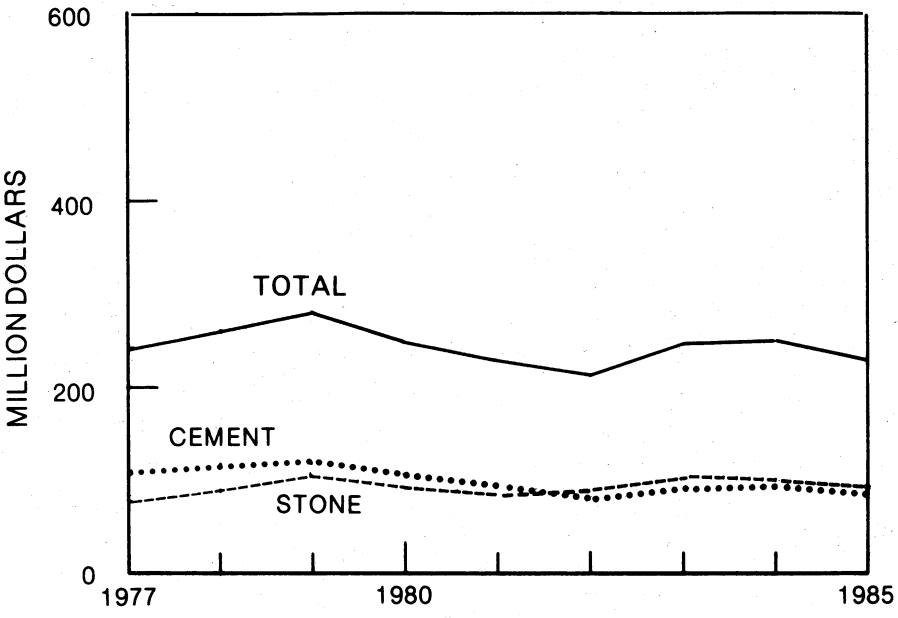

Figure 1.—Value of cement, stone, and total value of nonfuel mineral production in Iowa.

Employment.—Average annual employment in the State's mining industry, including coal, was 2,100 persons in 1985, compared with 2,000 in 1984. Employment in 1985 ranged from a low of 1,500 persons in January and February to a high of 2,400 in July. Average weekly earnings for mining personnel were $366.42 in 1985 compared with $368.68 in 1984.

Exploration Activities.—As in 1984, most of the exploration activity in the State was focused on the deeply buried structure known as the Midcontinent Rift that extends from Michigan, Minnesota, and Wisconsin in the north, through Iowa, and into Kansas. Since 1983, approximately 5 million acres of Iowa land had been leased by exploration firms interested in oil, and more than 2,500 miles of vibroseis geophysical data had been collected.[4]

In mid-December, Amoco Production Co. announced that it would drill a $4 million, 15,000-foot exploratory well in Carroll County, the deepest and most expensive well ever sunk in the State. The company had already spent approximately $10 million to lease over 800,000 acres of Iowa farmland and to conduct 1,650 miles of seismic testing.

Legislation and Government Programs.—The Iowa Geological Survey (IGS), provided information on the State's geological and hydrological resources to State and local officials and the general public. The IGS is organized into five divisions—Geologic Studies, Stratigraphy and Economic Geology, Water Resources, Technical Services, and Administrative and Support Services. In 1985, IGS had 44.5 fulltime-equivalent staff members, including 24 geologists and geohydrologists. Projects under way included development of a computerized data base of mineral production sites in Iowa, conducted together with the Iowa Department of Soil Conservation, Division of Mines and Minerals; restoration and preservation of old mine maps under an agreement with the Iowa Historical Society; and continuing research on nitrate and pesticide contamination of carbonate aquifers in northwest Iowa and alluvial aquifers in northwest Iowa. During the year, IGS personnel issued 7 publications, authored more than 30 articles, and provided information and assistance to about 1,500 individuals, corporations, and agencies.

The U.S. Bureau of Mines awarded a grant of $147,000 to the Mining and Mineral Resources Research Institute at Iowa State University, Ames, in fiscal year 1985 under the authority of title III of Public Law 95-87.

In cooperation with Iowa State Universi-

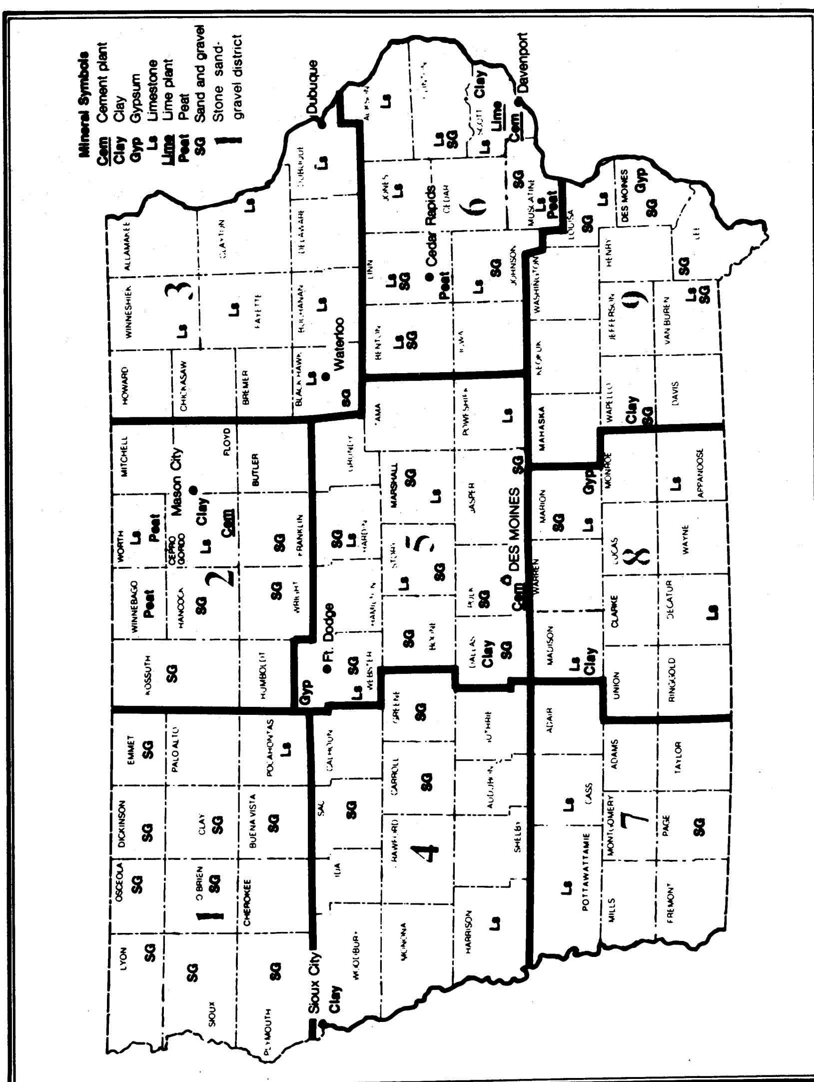

Figure 2.—Principal mineral producing localities in Iowa.

ty, the institute and the Ames National Laboratory conducted research on burning coal-water-limestone slurries in a bench-scale fluidized-bed combustion boiler in 1985. A prototype was operating at yearend, and the State began seeking matching funds from two Iowa utilities to continue the project.

A 3-year, $6,554,000 grant was awarded to Iowa by the Office of Surface Mining for five major reclamation projects under the State's abandoned mine lands program. Work would include removing high walls, regrading, eliminating water pollution problems, and revegetating the disturbed land. The projects, listed by county with estimated costs and names of the abandoned mines scheduled for reclamation, were (1) Davis County—Hall project, $492,000, 60 acres; (2) Mahaska County—Hull project, $3,420,250, 475 acres; (3) Mahaska County—Rempe project, $947,000, 108 acres; (4) Marion County—Avery project, $805,000, 106 acres; and Van Buren County—Hughes-Phillips project, $889,750, 88 acres.

The Federal Government distributed $122,532 to local governments in Iowa in fiscal year 1985 as "payments in lieu of taxes" for Federal tax-exempt lands within their boundaries.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Depressed agricultural prices during 1985, coupled with an early winter, placed a damper on Iowa construction activity. This, in turn, had a negative effect on most segments of the State's mineral industry supplying raw materials for construction purposes.

Cement.—Iowa's cement industry, the second largest contributor to the State's nonfuel mineral value in recent years, experienced a slump during 1985, and shipments of portland cement declined 6% from the 1984 output to the lowest level since 1951. The 1,642,000 short tons produced indicated that only 53.4% of the State's 3.1-million-ton capacity was utilized during 1985. The lower demand for cement resulted in severe price cuts as producers competed for a share of the available market, and the average price fell to $48.15 per ton, $5.43 less than in 1984. The unit price cut created a 16% decline in total portland cement value compared with 1984 figures. A 5% decrease in masonry cement shipments was reported; however, attendant value increased 3% over the 1984 value.

Four companies produced gray portland cement. In Cerro Gordo County, Lehigh Portland Cement Co., a subsidiary of Heidelberger Zement AG, and Northwestern States Portland Cement Co. operated dry-process plants near Mason City; in Polk County, Monarch Cement Co. operated a wet-process plant at Des Moines; and in Scott County, Davenport Cement Co., a subsidiary of Cementia Holdings AG, operated a dry-process plant near Buffalo. The companies had a total of eight kilns. With the exception of Lehigh Portland Cement, each of the companies also produced masonry cement.

Principal markets for the cement produced were ready-mixed concrete companies (60%), concrete product manufacturers (18%), highway contractors (17%), and building material dealers and other users (5%).

Cement shipments to and within Iowa during 1985 included 1,078,000 tons of portland cement and 11,000 tons of masonry cement. Compared with 1984 shipments, this represented 126,000 tons less portland and 3,000 tons less masonry.

Lehigh Portland Cement completed a $800,000 modification at its Mason City plant. The modernization project included installation of a new air classifier, pneumatic conveyors, electrical modifications, ducting, and support steel.[5]

Weak cement demand forced Northwestern States Portland Cement to terminate all operations for a 6-week period in late fall. Earlier in the year, the work force had been reduced to cut operating expenses.[6]

In July, Northwestern States Portland Cement's Mason City plant began receiving shipments of kaolin mined under contract by Schmidt Construction Co. at Redwood Falls, MN. Minnesota Valley Transportation Co. had a contract to ship 65,000 to 100,000 short tons per year to the plant.[7]

Clays.—Common clay and shale was produced by six companies at eight mines. Production decreased about 120,000 short tons below the 1984 level, and value fell about $245,000. The decrease was caused primarily by a decline in cement production, which consumed approximately two-thirds of the output, and a reduced demand for brick for home construction.

In December, W. S. Dickey Clay Manufacturing Co. closed its clay products plant at Lehigh in Webster County, one of two plants closed by the company nationwide

during 1985. Clay production at the company's associated mine ceased in July.

Midland Brick Co.'s Redfield operation in Dallas County was idle throughout 1985.

Gem Stones.—Rockhounds and amateur collectors gathered small quantities of gem stones and mineral specimens, mainly at gravel pits and quarries.

Gypsum.—Iowa ranked third among 21 gypsum producing States in 1985. With production and value increases of 7% and 10%, respectively, crude gypsum was the only mineral commodity registering a gain over 1984 output. Production was primarily from Webster County where open pit mines were operated in the Fort Dodge area by Celotex Div. (a subsidiary of Jim Walter Corp.), Georgia-Pacific Corp., National Gypsum Co., and USG Corp. The remainder was from underground mines operated by USG in Des Moines County and Kaser Corp. in Marion County. With the exception of Kaser, each of the producers operated calcining plants at or near their minesites.

Calcined production in 1985—1.2 million short tons—approximated that of 1984; however, value increased 16% to $26.6 million. Calcined gypsum was used in the firms' plants to produce both regular wallboard and "fire-stop" board, the latter designed for commercial applications. Approximately 65% of the State's board production was the wallboard type. Gypsum was also marketed for agricultural applications and cement manufacture. The segment of the industry in the Fort Dodge area employed about 645 people and had a payroll exceeding $12 million. At midyear, these four operations were operating 24 hours per day, 7 days per week.[8]

Lime.—Linwood Stone Products Co. Inc. was the only lime producer in the State. The company produced both quicklime and hydrated lime at its Scott County plant in east-central Iowa from locally mined stone. Production and value decreased slightly from 1984 levels.

During 1985, Iowa lime consumption totaled 92,000 short tons, a slight increase over that of 1984. Quicklime accounted for approximately 82% of the total; the remaining 18% was hydrated lime.

Peat.—Four companies harvested bogs in Linn, Muscatine, Winnebago, and Worth Counties. Sales were 4% less than that marketed in 1984. Following the trend of past years, approximately two-thirds of the peat sold was reed-sedge, and the remainder, hypnum. Most of the material was sold in bulk form for use on golf courses. Other uses included general soil improvement, as an ingredient for potting soil, and vegetable and nursery stock growing.

Perlite (Expanded).—National Gypsum and USG expanded perlite for plaster aggregate at their Webster County plants. The crude perlite, a volcanic rock obtained from New Mexico mines, is an amorphous aluminum silicate capable of expanding to about 20 times its original volume when heated within its softening temperature range.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Iowa's 1985 sand and gravel output was estimated to have declined by 1.9 million short tons, or 14%, from that produced during 1984. The State ranked 24th among the 50 States in production. In 1984, the last year that a production canvass was conducted, 109 companies and government agencies mined sand and gravel from 199 pits in 72 counties. Polk, Boone, Plymouth, and Sioux Counties, respectively, had the largest output and collectively accounted for about one-third of the State's production.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Crushed stone production, consisting entirely of limestone, was by 59 companies at 289 quarries in 66 of Iowa's 99 counties. Production exceeded 1 million short tons in Black Hawk, Cerro Gordo, Hardin, Johnson, and Scott Counties, which collectively accounted for more than one-fourth of the State's output. Compared with that of 1983, the last year for which data were reported, 1985 agricultural limestone sales were off 46%, and sales of many grades of construction aggregates also declined.

Approximately 95% of the crushed stone was shipped to users by truck, with small amounts shipped by rail, water, or by unspecified means.

In 1985, the U.S. Bureau of Mines began compiling crushed stone production statistics by districts for some States. Table 5 presents end use data for crushed stone produced in the nine Iowa districts that are outlined in figure 2.

Table 4.—Iowa: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	98	414
Riprap and jetty stone	150	717
Filter stone	83	416
Other coarse aggregate	39	144
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,323	5,332
Bituminous aggregate, coarse	635	2,955
Bituminous surface-treatment aggregate	1,489	6,638
Railroad ballast	86	406
Other graded coarse aggregate	170	642
Fine aggregate (-3/8 inch):		
Stone sand, concrete	437	2,048
Screening, undesignated	712	3,203
Combined coarse and fine aggregates:		
Graded road base or subbase	2,016	7,448
Unpaved road surfacing	3,321	13,185
Crusher run or fill or waste	1,803	5,797
Other construction materials[2]	383	1,326
Agricultural:		
Agricultural limestone	911	3,868
Poultry grit and mineral food	335	5,480
Chemical and metallurgical:		
Cement manufacture	2,373	5,768
Dead-burned dolomite manufacture	4	23
Flux stone	7	15
Special:		
Mine dusting or acid water treatment	356	1,797
Other miscellaneous[3]	292	1,402
Other unspecified[4]	6,634	25,472
Total	23,657	94,496

[1]Includes limestone.
[2]Includes stone sand (bituminous mix or seal), fine aggregate, combined coarse and fine aggregate, and other construction and maintenance uses.
[3]Includes stone used in abrasives, chemicals, paper manufacture, porcelain, roofing granules, sulfur oxide removal, and other uses not listed.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.

Table 5.—Iowa: Crushed stone sold or used by producers in 1985, by use and district

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3		District 4		District 5	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	W	W	(1)	(1)	37	131	--	--	(2)	(2)
Coarse aggregate, graded	W	W	236	987	1,251	3,529	--	--	145	683
Fine aggregate (-3/8 inch)	W	W	(1)	(1)	55	205	--	--	(2)	(2)
Combined coarse and fine aggregates	W	W	(1)	(1)	1,090	4,001	--	--	1,445	6,472
Other construction	--	--	--	--	--	--	--	--	402	1,952
Agricultural limestone	W	W	45	208	148	561	--	--	445	6,020
Cement manufacture	--	--	(1)	(1)	--	--	--	--	--	--
Dead-burned dolomite manufacture	--	--	--	--	--	--	--	--	--	--
Flux stone	--	--	--	--	--	--	--	--	--	--
Chemical stone	--	--	--	--	--	--	--	--	--	--
Sulfur oxide removal	--	--	--	--	--	--	--	--	(3)	(3)
Mine dusting or acid water treatment	--	--	--	--	--	--	--	--	(3)	(3)
Abrasives	--	--	--	--	--	--	--	--	--	--
Roofing granules	--	--	--	--	--	--	--	--	--	--
Paper manufacture	--	--	--	--	--	--	--	--	--	--
Porcelain	--	--	--	--	--	--	--	--	--	--
Other miscellaneous	--	--	--	--	--	--	--	--	99	499
Other unspecified[4]	--	--	825	3,275	1,633	6,363	W	W	1,404	5,736
Total	W	W	2,713	9,856	4,214	14,790	W	W	3,940	21,362

See footnotes at end of table.

Table 5.—Iowa: Crushed stone sold or used by producers in 1985, by use and district—Continued

(Thousand short tons and thousand dollars)

Use	District 6		District 7		District 8		District 9	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	173	803	W	W	[2]	[2]	[2]	[2]
Coarse aggregate, graded	707	3,521	W	W	[2]	[2]	[2]	[2]
Fine aggregate (-3/8 inch)	296	1,122	W	W	[2]	[2]	--	--
Combined coarse and fine aggregates	1,743	6,188	W	W	741	984	1,473	5,794
Other construction	7	32	--	--	739	3,653	271	1,674
Agricultural limestone	299	915	W	W	[5]	[5]	97	386
Cement manufacture	[3]	[3]	--	--	[5]	[5]	--	--
Dead-burned dolomite manufacture	[3]	[3]	--	--	--	--	--	--
Flux stone	[3]	[3]	--	--	--	--	--	--
Chemical stone	[3]	[3]	--	--	--	--	--	--
Sulfur oxide removal	[3]	[3]	--	--	[5]	[5]	--	--
Mine dusting or acid water treatment	[3]	[3]	W	W	--	--	--	--
Abrasives	--	--	W	W	--	--	--	--
Roofing granules	[3]	[3]	--	--	--	--	--	--
Paper manufacture	[3]	[3]	W	W	--	--	--	--
Porcelain	--	--	W	W	--	--	--	--
Other miscellaneous	1,164	2,070	--	--	--	--	--	--
Other unspecified[4]	632	1,445	W	W	1,234	4,804	533	2,110
Total	5,021	16,096	W	W	2,714	9,441	2,374	9,964

W Withheld to avoid disclosing company proprietary data.
[1]Withheld to avoid disclosing company proprietary data; included in "Total."
[2]Withheld to avoid disclosing company proprietary data; included with "Other construction."
[3]Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Withheld to avoid disclosing company proprietary data; included with "Other unspecified."

Dimension.—In east-central Iowa, limestone was quarried and sold in rough and dressed form principally for construction use. Wm. Becker & Sons Stone Co. operated its quarry in Dubuque County, and production by Weber Stone Co. was from a Jones County operation, which produced crushed limestone also.

METALS

Although no metallic ores were mined in Iowa in 1985, the State had an active metals industry. Metallic concentrates mined in other States and foreign countries and metallic scrap from various industries are shipped into Iowa and processed into a variety of products.

Ferroalloys.—Foote Mineral Co. operated a ferroalloy plant at Keokuk. The foundry produced ferrosilicon and high-silicon silvery pig iron. In a yearend announcement, the company noted that it would "determine the long-term viability" of the Keokuk facility in mid-1986 after completing labor negotiations and a new contract with its power supplier. The company noted that "assuming successful completion of these negotiations," it expected to continue production at the Keokuk plant.[9]

Iron and Steel.—North Star Steel Co., Wilton, operated a minimill with a finished steel capacity of 220,000 short tons per year. The mill, equipped with one 30 megavolt-ampere electric furnace, produced hot-rolled merchant bar, hot-rolled carbon special bar quality (SBQ) flats, and hot-rolled alloy SBQ flats.

The Directory of Iowa Manufacturers listed more than 40 gray and malleable iron foundries sited throughout the State. A mid-year business slump forced layoffs at one foundry; in May, Gra-Iron Foundry Corp. trimmed its work force at Marshalltown from 115 to 50. The action came 1 day after a new contract was ratified.[10]

Molybdenum.—AMAX Molybdenum Co. operated a molybdenum roaster at Fort Madison. Concentrates from the company's two mines in Colorado were roasted to produce molybdenum oxide used in the manufacture of ammonium molybdate products and molybdenum oxide concentrates. The facility also produced an ammonium paratungstate using tungsten concentrate obtained from company mines in the Northwest Territories of Canada.

Nickel.—Alloy Metal Products Inc. operated a secondary nickel smelter at Davenport. The smelter, equipped with two arc and two induction furnaces, processed primary metal and scrap to produce nickel magnesium and other alloys.

[1]State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.
[2]State Mineral Officer, Bureau of Mines, Minneapolis, MN.
[3]Editorial assistant, Bureau of Mines, Minneapolis, MN.
[4]Anderson, R. A. Petroleum Test Drilling in Iowa. IA Geol. Surv., Iowa Geol. 1986, No. 11, pp. 10-11.
[5]Pit and Quarry. Lehigh To Modify Iowa Plant. V. 77, No. 9, Mar. 1985, pp. 12-13.
[6]Northwestern States Portland Cement Co. 1985 Annual Report. P. 2.
[7]Fairfax (MN) Standard. Kaolin Reserves May Spur Future Development. Sept. 4, 1985.
[8]Des Moines Sunday Register. Gypsum Mining: A Fort Dodge "Cash Corp." June 2, 1985.
[9]Des Moines Register. Foote Mineral Co. Drops Book Value of Keokuk Plant. Dec. 31, 1985.
[10]———. Gra-Iron Foundry Corp. To Lay Off Half of Employees. May 2, 1985.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Davenport Cement Co., a subsidiary of Cementia Holdings AG.	220 Emerson Place Suite 300 Davenport, IA 52801	Quarry, clay pit, plant.	Scott.
Lehigh Portland Cement Co., a subsidiary of Heidelberger Zement AG.	Box 1882 Allentown, PA 18105	____do_____	Cerro Gordo.
Monarch Cement Co _____	Humboldt, KS 66748 ___	Plant_____	Polk.
		Quarry and clay pit __	Madison.
Northwestern States Portland Cement Co.	Box 1008 Mason City, IA 50401	Quarry, clay pit, plant.	Cerro Gordo.
Clays:			
Midland Brick Co _____	Box A Redfield, IA 50233	Pit and plant _____	Wapello.
Sioux City Brick & Tile Co___	Box 56 Sergeant Bluff, IA 51054	Pits and plants _____	Dallas and Woodbury.
Gypsum:			
Celotex Div., a subsidiary of Jim Walter Corp.	1500 North Dale Mabry Tampa, FL 33607	Open pit mine and plant.	Webster.
Georgia-Pacific Corp _____	133 Peachtree St., NE. Atlanta, GA 30303	____do_____	Do.
Kaser Corp _____	Box 3569 Des Moines, IA 50322	Underground mine and plant.	Marion.
National Gypsum Co _____	2001 Rexford Rd. Charlotte, NC 28211	Open pit mine and plant.	Webster.
USG Corp_____	101 South Wacker Dr. Chicago, IL 60606	Underground mine and plant.	Des Moines.
		Open pit mine and plant.	Webster.
Lime:			
Linwood Stone Products Co. Inc.	Route 2 Davenport, IA 52804	Plant_____	Scott.
Peat:			
Eli Colby Co _____	Box 248 Lake Mills, IA 50450	Bog and plant_____	Winnebago.
Colby Pioneer Peat Co _____	Box 8 Hanlontown, IA 50444	____do_____	Worth.
Hughes Peat Co _____	Route 2 Marion, IA 52302	____do_____	Linn.
Pikes Peat Co _____	Route 6, Box 21 Muscatine, IA 52761	____do_____	Muscatine.
Perlite (expanded):			
National Gypsum Co _____	2001 Rexford Rd. Charlotte, NC 28211	Plant_____	Webster.
USG Corp_____	101 South Wacker Dr. Chicago, IL 60606	____do_____	Do.
Sand and gravel (construction, 1984):			
L. G. Everist Inc_____	313 South Phillips Sioux Falls, SD 57102	Pits and plants _____	Plymouth and Sioux.
G. A. Finley Inc _____	Box 406 Harlan, IA 51537	____do_____	Cass, Dallas, Montgomery, Page, Pottawattamie, Shelby.
Hallett Construction Co ____	Box 13 Boone, IA 50036	____do_____	Boone, Dallas, Franklin, Greene, Marshall, Polk, Sac, Story.
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 27622	____do_____	Appanoose, Linn, Marshall, Polk, Wapello.
Stevens Sand & Gravel Co. Inc	Route 6 Iowa City, IA 52240	____do_____	Johnson and Washington.
Van Dusseldorp Sand & Gravel Inc.	Box 156 Colfax, IA 50054	____do_____	Jasper and Marion.
Weaver Construction Co____	Box 550 Iowa Falls, IA 50126	____do_____	Boone, Buena Vista, Cerro Gordo, Dallas, Franklin, Hamilton, Hardin, Kossuth, O'Brien, Sioux, Story, Webster, Wright.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone (limestone):			
Crushed:			
B. L. Anderson Inc	Box 2007 Cedar Rapids, IA 52401	Quarries and plants	Benton, Clinton, Jackson, Johnson, Jones, Linn, Tama.
Kaser Corp	Box 3569 Des Moines, IA 50322	Underground mines, quarries, plants.	Des Moines, Jasper, Keokuk, Marion, Monroe, Polk, Poweshiek, Washington.
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 27622	do	Clarke, Decatur, Linn, Madison, Marshall, Polk, Story.
P. Niemann Construction Co.	106 North Maple St. Sumner, IA 50674	Quarries and plants	Black Hawk, Bremer, Buchanan, Butler, Chickasaw, Fayette, Winneshiek.
River Products Co	220 Savings & Loan Bldg. Iowa City, IA 52240	Underground mine, quarries, plants.	Johnson, Louisa, Washington.
Schildberg Construction Co. Inc.	Box 358 Greenfield, IA 50849	Quarries and plants	Adair, Adams, Cass, Madison, Pottawattamie, Union.
Weaver Construction Co	Box 817 Iowa Falls, IA 50126	Underground mine, quarries, plants.	Black Hawk, Cerro Gordo, Franklin, Hamilton, Hardin, Worth.
Dimension:			
Wm. Becker & Sons Stone Co.	1735 Kaufmann Ave. Dubuque, IA 52001	Quarry and plant	Dubuque.
Weber Stone Co.[1]	Route 1 Anamosa, IA 52205	do	Jones.

[1]Also crushed limestone.

The Mineral Industry of Kansas

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

By James J. Hill,[1] David A. Grisafe,[2] and Wanda J. West[3]

Nonfuel mineral production in Kansas was valued at $322.2 million, an increase of about 3% over the 1984 value of $312 million. Nationally, the State ranked 23d in value of nonfuel mineral production after ranking 24th in 1984 and 25th in 1983. Output increased for all commodities except cement, clays, gypsum, crude helium, industrial sand, and lime. The State's lone lime producer was in bankruptcy proceedings and reported no production during the year. Sales of cement and salt continued to account for the greatest portion of the State's nonfuel mineral production value. The greatest percentage increases in output were reported for pumice (56%) and dimension stone (51%).

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	918	$5,537	878	$5,326
Gem stones	NA	1	NA	1
Helium:				
Crude million cubic feet	402	8,844	W	W
Grade-A do	1,015	38,063	W	W
Salt[2] thousand short tons	1,712	71,558	1,790	71,970
Sand and gravel:				
Construction do	11,796	26,358	e13,200	e31,800
Industrial do	W	W	134	1,124
Stone (crushed) do	e13,600	e48,500	15,653	57,155
Combined value of cement, gypsum, lime (1984), pumice, salt (brine), stone (dimension), and values indicated by symbol W	XX	113,149	XX	154,794
Total	XX	312,010	XX	322,170

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

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

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

Table 2.—Nonfuel minerals produced in Kansas in 1984, by county[1]

County	Minerals produced in order of value
Allen	Cement, clays.
Barber	Gypsum, sand and gravel (construction).
Barton	Sand and gravel (construction), clays.
Cherokee	Clays, sand and gravel (construction).
Cheyenne	Sand and gravel (construction).
Clark	Do.
Clay	Do.
Cloud	Sand and gravel (construction), clays.
Coffey	Sand and gravel (construction).
Comanche	Do.
Cowley	Do.
Decatur	Do.
Dickinson	Do.
Douglas	Do.
Edwards	Do.
Ellis	Do.
Ellsworth	Helium, salt, clays, sand and gravel (construction).
Finney	Sand and gravel (construction).
Ford	Do.
Franklin	Clays.
Geary	Sand and gravel (construction).
Grant	Helium, sand and gravel (construction).
Gray	Sand and gravel (construction).
Greeley	Do.
Greenwood	Do.
Hamilton	Do.
Harper	Do.
Harvey	Do.
Haskell	Do.
Hodgeman	Do.
Jackson	Do.
Jewell	Clays.
Johnson	Sand and gravel (construction).
Kearny	Do.
Kiowa	Do.
Lincoln	Do.
Logan	Do.
Lyon	Do.
McPherson	Clays.
Marshall	Gypsum, sand and gravel (construction).
Meade	Sand and gravel (construction).
Montgomery	Cement, clays.
Morton	Helium, sand and gravel (construction).
Neosho	Cement, clays.
Ness	Sand and gravel (construction).
Norton	Pumice, sand and gravel (construction).
Ottawa	Sand and gravel (construction).
Pawnee	Do.
Phillips	Do.
Pottawatomie	Do.
Pratt	Do.
Reno	Salt, sand and gravel (construction).
Republic	Sand and gravel (construction), sand (industrial).
Rice	Salt, sand and gravel (construction).
Riley	Sand and gravel (construction).
Rooks	Do.
Rush	Helium.
Russell	Sand and gravel (construction).
Saline	Do.
Sedgwick	Sand and gravel (construction), salt.
Seward	Sand and gravel (construction).
Shawnee	Do.
Sheridan	Do.
Sherman	Lime, sand and gravel (construction).
Stafford	Sand and gravel (construction).
Stevens	Do.
Sumner	Do.
Thomas	Do.
Trego	Do.
Washington	Do.
Wichita	Do.
Wilson	Cement, clays, sand and gravel (construction).
Woodson	Clays.
Wyandotte	Cement, sand and gravel (construction), sand (industrial).
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Kansas business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	2,427	2,440	2,450
Total civilian labor force	do.	1,186	1,197	1,244
Unemployment	percent	6.1	5.2	5.0
Employment (nonagricultural):				
Mining total[1]	thousands	17.2	17.9	16.7
Nonmetallic minerals except fuels[1]	do.	1.2	1.3	1.2
Coal mining[1]	do.	.4	.4	.4
Oil and gas extraction[1]	do.	15.6	16.3	15.1
Manufacturing total	do.	164.7	176.4	174.3
Primary metal industries	do.	2.4	3.2	3.0
Stone, clay, and glass products	do.	6.8	6.9	7.0
Chemicals and allied products	do.	8.0	8.0	8.1
Petroleum and coal products	do.	3.7	3.1	2.9
Construction	do.	39.7	43.6	43.9
Transportation and public utilities	do.	62.2	64.1	64.8
Wholesale and retail trade	do.	229.0	239.4	245.3
Finance, insurance, real estate	do.	50.0	51.3	52.8
Services	do.	175.9	182.8	186.9
Government and government enterprises	do.	182.9	185.2	190.5
Total[2]	do.	921.6	960.8	975.3
Personal income:				
Total	millions	$29,495	$31,864	$33,755
Per capita		$12,155	$13,058	$13,775
Hours and earnings:				
Total average weekly hours, production workers		39.1	40.1	39.5
Mining		43.1	44.6	43.9
Total average hourly earnings, production workers		$9.2	$9.4	$9.5
Mining		$9.0	$9.4	$9.8
Earnings by industry:				
Farm income	millions	$564	$788	$1,104
Nonfarm	do.	$19,543	$21,339	$22,417
Mining total	do.	$504	$531	$492
Nonmetallic minerals except fuels	do.	$25	$26	$27
Coal mining	do.	$14	$16	$16
Oil and gas extraction	do.	$465	$489	$449
Manufacturing total	do.	$4,003	$4,471	$4,605
Primary metal industries	do.	$58	$79	$76
Stone, clay, and glass products	do.	$180	$189	$191
Chemicals and allied products	do.	$216	$229	$244
Petroleum and coal products	do.	$147	$122	$121
Construction	do.	$1,269	$1,440	$1,422
Transportation and public utilities	do.	$1,909	$2,052	$2,098
Wholesale and retail trade	do.	$3,517	$3,766	$3,983
Finance, insurance, real estate	do.	$1,062	$1,148	$1,289
Services	do.	$3,704	$4,138	$4,433
Government and government enterprises	do.	$3,464	$3,683	$3,982
Construction activity:				
Number of private and public residential units authorized[3]		14,214	16,727	13,267
Value of nonresidential construction	millions	$667.1	$549.5	$539.8
Value of State road contract awards	do.	$238.3	$277.5	$275.7
Shipments of portland and masonry cement to and within the State	thousand short tons	1,004	1,266	1,313
Nonfuel mineral production value:				
Total crude mineral value	millions	$267.6	$312.0	$322.2
Value per capita		$110	$128	$131

[p]Preliminary. [r]Revised.
[1]Kansas Department of Human Resources, Division of Employment.
[2]Data may not add to totals shown because of independent rounding.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

Employment.—According to the Kansas Department of Human Resources, Division of Employment, the average monthly employment in mining and quarrying, excluding fuel minerals, was 1,214 persons, slightly less than the 1,289 persons reported in 1984. Employment fell to a low in February with 1,051 workers and peaked in June with 1,369 workers. Several quarry and sand and gravel operations suspended production in the winter months or operated at reduced levels making January, February, and December the lowest months of employment.

Legislation and Government Programs.—No legislation specifically related to the mining industry was enacted into law in 1985 although several bills dealing with the State's natural resources were enacted. Some of those bills were as follows:

1. House bill 2096 amended an existing law to allow a tax sale of an oil and gas leasehold interest when a purchaser of oil and gas from the lease is required to make payments to the sheriff toward satisfaction of the amount of unpaid personal property taxes assessed against the owner.

2. House bill 2229 provided that a landowner is not legally responsible for the proper care and control of an abandoned oil or gas well on his or her property unless the landowner operated or produced from the well, altered or tampered with the well thereby causing pollution, or assumed responsibility for the well by written contract.

3. House bill 2605 removed the requirement that the State geologist be a member of the faculty of the Department of Geology at the University of Kansas. The State geologist would continue to be an appointee of the chancellor in the unclassified service.

The Kansas Geological Survey (KGS) continued its research and service-related earth science programs in 1985. Emphasis was on ground water, geophysics, subsurface geology, and geologic data automation.

Work continued on a series of maps depicting the structural development of the Midcontinent Rift system that extends into north-central Kansas. The KGS was also working on an analysis of strategic and critical minerals and on a joint project with the U.S. Geological Survey studying the geological and geophysical setting of the Joplin Quadrangle in southeastern Kansas. Among the publications released during 1985 were "Subsurface Geology Series 6," a compilation of studies describing core of economically important rock strata in Kansas, and "Subsurface Geology Series 7," a listing of wells drilled into Precambrian rocks.

At midyear, Hutchinson Community College in Hutchinson initiated a formal education program for the mining industry called Training for Kansas Small Mining Industry. The program was funded in part by the Mine Safety and Health Administration to provide mine safety training to employees of small mining operations. Many small mine and quarry operators do not have the facilities or the resources to train employees, and Federal law mandates that new mine employees receive 24 hours of safety training and that all employees receive an 8-hour refresher course each year.

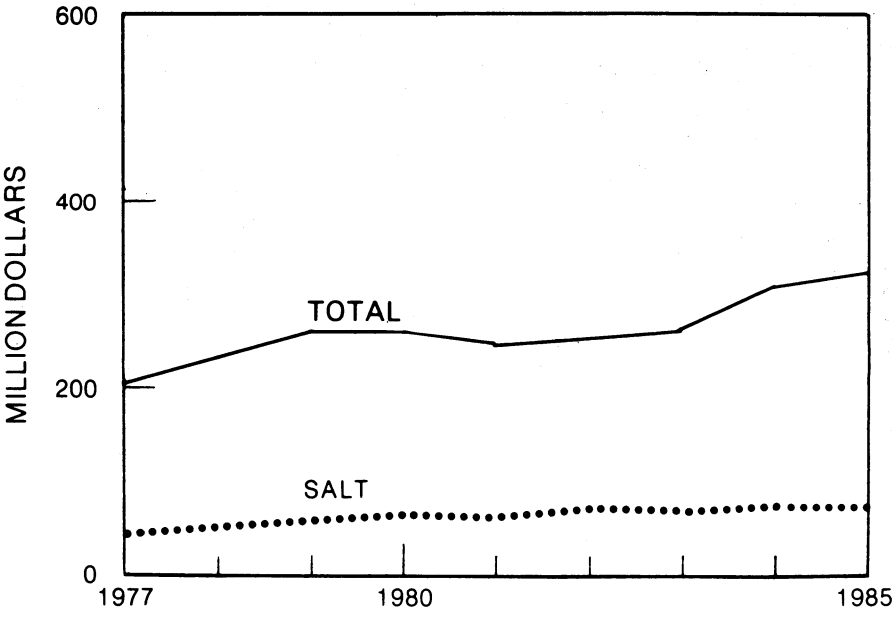

Figure 1.—Value of salt and total value of nonfuel mineral production in Kansas.

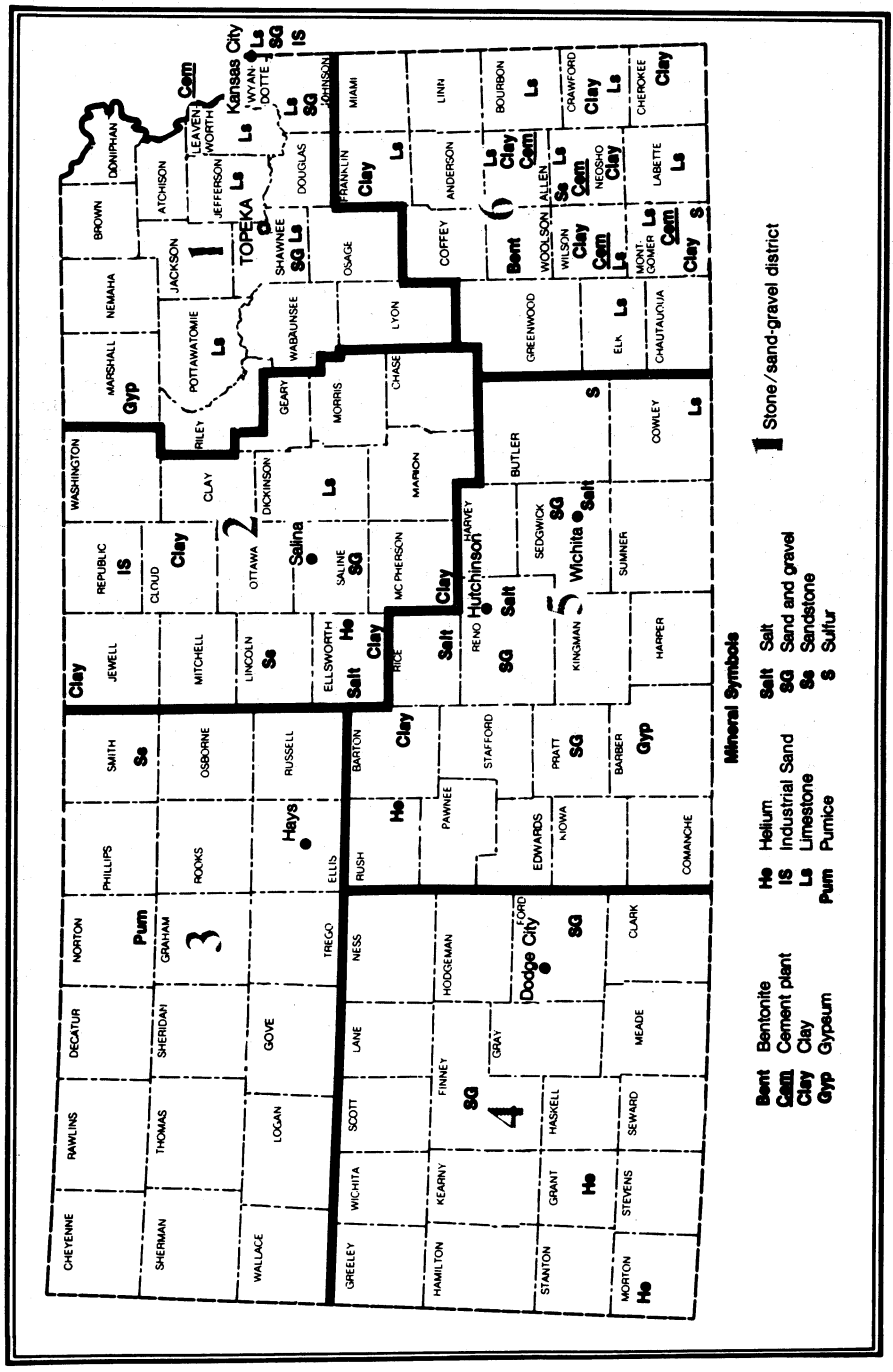

Figure 2.—Principal mineral producing localities in Kansas.

Two publications concerning Kansas were released by the U.S. Bureau of Mines during 1985. Information Circular (IC) 8998 "Inverted Pyramid-Shaped Plugs for Closing Abandoned Mine Shafts, Galena, KS, Demonstration Project" described and gave results of a shaft closure demonstration project where plugs were fabricated and used to close abandoned open mine shafts in the Galena area. IC 9028 "Helium Resources of the United States, 1983" estimated the helium resource base in the United States.

The U.S. Bureau of Mines Rolla Research Center worked on a process to treat waste at a plant in Coffeyville that had accumulated over a period of years in the course of producing drilling mud for the oil industry. The waste pile contained barium (about 40%), coal (about 12%), and lead and zinc (2% or less). A method was developed to recover the valuable constituents in the waste while leaving a nonhazardous residue.

Underground cutting tests with an In Seam Tester were performed by the U.S. Bureau of Mines Twin Cities Research Center at the Independent Salt Co. mine in Kanopolis. The work was part of the Bureau's effort to define the empirical relationship between cutting parameters, dust generation, and cutting forces for coal and other types of rock.

An administrative grant of $366,383 was provided to the State of Kansas by the Federal Office of Surface Mining Reclamation and Enforcement in 1985 for reclamation purposes under title IV of the abandoned mined land program. Also, the State received a title V grant of $161,629 for administration and enforcement purposes that was matched 50% by the State.

The Environmental Protection Agency's (EPA) Kansas City office began a $325,000 study of six abandoned lead and zinc mining areas in Cherokee County in July to determine if the sites were causing problems, and if problems existed, what could be done to correct them.

Kansas received $344,711 in fiscal year 1985 from the Federal Government as "payments in lieu of taxes" for Federal lands within the State's boundaries. The State also received $795,000 as its share of revenues from Federal mineral leases.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Cement.—Kansas ranked 14th nationally in portland cement sales, dropping from the 11th place position it held in 1984. The State ranked 17th in masonry cement sales, the same position it held in 1984. Sales for portland and masonry cement dropped 11% and 20%, respectively, during 1985.

Five companies operated cement plants that had a total of 13 kilns. Three companies operated wet-process plants—Ash Grove Cement Co., General Portland Inc., and Lone Star Industries Inc. Dry-process plants were operated by Lehigh Portland Cement Co. and The Monarch Cement Co. All the plants produced masonry cement and Types I and II—general use and moderate heat portland cement. One or more of the companies also produced Type III, high-early-strength, an oil-well cement, and a waterproof portland.

About 70% of the portland cement sales were to ready-mixed concrete companies. Most of the sales were in bulk (96%) and shipped by truck (86%).

Approximately 2.7 million short tons of cement rock and limestone, 375,000 tons of clay and shale, and 75,000 tons of gypsum were consumed in the manufacture of cement, along with lesser quantities of iron ore, mill scale, pyrite, sand, and sandstone. Raw materials consumed in cement manufacture totaled 3.2 million tons.

Cement shipments to and within Kansas in 1985 included 1,293,000 tons of portland cement and 20,000 tons of masonry cement. This represented 50,000 tons more of portland cement and 3,000 tons less of masonry cement than was shipped in 1984.

General Portland (Victor Div. of LaFarge Corp.) received a permanent permit from the EPA to burn solvent wastes as a supplemental fuel at its Fredonia plant in April. Construction of a supplemental fuel facility was completed early in 1985, and the firm expanded its use of low-cost waste fuels because of high power costs in the area. The Fredonia plant served markets in Kansas, Missouri, Nebraska, and Oklahoma.

Ash Grove Cement of Overland Park purchased Arkansas Cement Corp., a subsidiary of Arkla Inc. of Little Rock. The purchase included the Foreman, AR, plant and five distribution terminals, enabling Ash Grove Cement to expand its Midwest

markets to the South.

Clays.—Nationally, Kansas ranked 16th in total clay and shale production. Output and value dropped about 4% in 1985. Average value was $6.06 per short ton. Common clay and shale was produced by 10 companies at 19 pits in 12 counties. About 50% of the clay output was used in the manufacture of cement. The second largest use was for lightweight aggregate, followed by face brick manufacture. Lesser quantities of clay were used in the manufacture of sewer pipe and roofing tile. The major use of the lightweight aggregate was for concrete block.

A micaceous bentonitic clay was mined by Micro-Lite Inc. in Woodson County for use in manufacturing feed and fertilizer supplements.

During 1985, the Wilkinson Inc. clay operation at Weir, Cherokee County, was acquired by a new firm called Cherokee County Clay. The firm reestablished markets in the local area by improving its product through selectively mining an underclay and discarding a pyrite-rich layer that had made the clay unsuitable for use by pottery manufacturers.

Pittsburg Pottery Co. Inc. at Pittsburg, Crawford County, shut down operations in December for a 3-month period. The firm had purchased clay from local and out-of-State producers for the pottery operation. In 1985, the company finished renovating its plant by installing a new shuttle kiln that used a microprocessor to control the firing cycle, thereby reducing firing time to 14 hours compared with the old cycle of 7 days. Fuel consumption was slashed by 75%.

Cloud Ceramics, a division of General Finance Inc., installed a new plug cutter at its brick plant at Concordia as part of a capital improvement program that had been under way for several years.

In late June, Kansas Brick & Tile Co. Inc. at Hoisington, Barton County, brought its new $4.5 million brick plant on-stream. The highly automated operation greatly increased the company's production and sharply lowered fuel consumption. A microcomputer controls the entire firing cycle for each kiln car, allowing the company to produce special jobs where deviations from the normal firing cycle and atmospheres are required.

Gypsum.—Nationally, Kansas ranked eighth in production of crude gypsum. Output declined about 10% during 1985. Average value per short ton increased 11%. Two companies produced gypsum in the State. Georgia-Pacific Corp. operated an underground mine and calcining plant at Blue Rapids, Marshall County, and National Gypsum Co. operated an underground and surface mine at Sun City, Barber County, and calcined the crude gypsum at its Medicine Lodge plant. Calcined gypsum output and total value increased 4% and 7%, respectively, in 1985.

National Gypsum's Sun City Mine ranked eighth nationally in crude ore production and its associated Medicine Lodge plant also ranked eighth in calcined gypsum output in 1985.

Helium.—Crude helium production was reported from two plants in Ellsworth and Grant Counties. Both production and value declined slightly in 1985. Grade-A helium production and value increased modestly. Output was reported in Ellsworth, Grant, Morton, and Rush Counties.

Federal demand for helium increased about 33% in fiscal year 1985 because of stepped up U.S. Department of Defense research that used liquid helium, including research in progress in the President's Strategic Defense Initiative as well as continuing strong sales to the Space Shuttle Program.

Lime.—The State's only lime producer, The Great Western Sugar Co., filed for protection under Chapter 11 of the Federal bankruptcy law in March. The company had produced lime for use in its sugar beet refinery near Goodland. No production was reported in 1985.

Perlite (Expanded).—Crude perlite shipped in from other States was expanded at the Lite-Weight Products Inc. plant in Kansas City, Wyandotte County. Sales increased sharply in 1985.

Pumice and Pumicite.—Calvert Corp. was the State's sole producer of pumice, with a small mine and plant in Norton County. Sales increased about 56% in 1985 through the efforts of the firm's owners to penetrate new markets. Major sales were for use as an abrasive, an absorbent, and filter aid.

Salt.—Kansas ranked fifth of 14 States in salt sales. In 1985, production increased 5%; sales, 7%; and total sales value, 6%. Salt was produced in Ellsworth, Reno, and Rice Counties by five companies. American Salt Co., Carey Salt Co., and Independent Salt Co. operated underground mines. American Salt and Carey Salt also evaporated salt from brines, as did Cargill Inc. and Morton

Thiokol Inc. Vulcan Materials Co., Chemicals Div., produced brine that was used as feedstock to electrolytically separate chlorine, hydrogen, and sodium hydroxide at its operations near Wichita, Sedgwick County.

Salt sales were for deicing, agricultural use, meatpacking preservative, water treatment, and table salt.

American Salt was granted a 6-month extension in June to develop a cleanup proposal for a freshwater aquifer that it had been charged with polluting near its plant at Lyons. About 100 wells had been drilled by the firm's consultants to determine the extent of the pollution and to formulate plans for the cleanup, which was under the direction of a Federal court.

Both Carey Salt and Cargill Salt received safety awards from the Salt Institute in 1985.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Sand and gravel mined for construction purposes was estimated to have increased about 12%, or to 13.2 million short tons in 1985. Average value per ton was estimated to have increased about 8%.

Ritchie Sand Co., a division of Ritchie Corp., began operating a new pit and $1.5 million plant near Wichita, Sedgwick County, on July 1. Described as the largest plant in Kansas, the firm expected to process 750,000 to 1 million tons of sand and gravel per year at the site.

Industrial.—Sand used for industrial purposes was produced by Holiday Sand & Gravel Co. and HUB Materials Inc. in Wyandotte County, and by Alsop Sand Co. Inc. in Republic County. Production and value decreased in 1985. Average value per short ton was about $8.40. Most of the industrial sand was sold for fiberglass manufacture; the next largest quantity of sales was for sandblasting. Sales were also made for foundry use, traction, and miscellaneous uses. Foundry sand commanded the highest unit price at $11.00 per ton.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Table 4.—Kansas: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	147	299
Riprap and jetty stone	89	365
Filter stone	136	635
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,267	5,827
Bituminous aggregate, coarse	1,258	6,062
Bituminous surface-treatment aggregate	432	1,896
Railroad ballast	377	2,093
Fine aggregate (-3/8 inch):		
Stone sand, concrete	4	41
Stone sand, bituminous mix or seal	93	292
Screening, undesignated	311	842
Other fine aggregate	594	1,615
Combined coarse and fine aggregates:		
Graded road base or subbase	2,443	8,111
Unpaved road surfacing	876	3,260
Terrazzo and exposed aggregate	11	W
Crusher run or fill or waste	394	1,684
Other construction[2]	586	2,437
Agricultural: Agricultural limestone	874	3,934
Chemical and metallurgical: Cement manufacture	3,029	7,866
Special:		
Other miscellaneous[3]	1,355	5,670
Other unspecified[4]	1,375	4,226
Total	[5]15,653	57,155

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

[1]Includes limestone, quartzite, sandstone, and other crushed stone.

[2]Includes coarse aggregate (large), coarse aggregate (graded), combined coarse and fine aggregates, and other construction and maintenance uses.

[3]Includes stone used in chemicals, magnesium metal manufacture, paper manufacture, roofing granules, sulfur oxide removal, other uses not listed, and value indicated by symbol W.

[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.

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

Crushed.—Kansas ranked 22d of 49 States in crushed stone production. Production and value increased 15% and 18%, respectively, in 1985. Output was by 49 companies and government agencies at 131 quarries in 43 counties. Johnson County with 10 active limestone quarries producing 2.2 million short tons led in output, followed by Wyandotte County, where 3 limestone quarries yielded 1.3 million tons. These two metropolitan counties (both in the Kansas City area) accounted for more than one-fifth of the State's 1985 crushed stone output.

Limestone produced from 127 quarries accounted for 96% of the crushed stone production. Sandstone and quartzite from three quarries in Lincoln, Neosho, and Smith Counties accounted for most of the remainder, with a small amount of "other stone" reported from Norton County.

In 1985, the U.S. Bureau of Mines began compiling crushed stone production statistics by districts for some States. Table 5 presents end-use data for crushed stone produced in the six Kansas districts that are outlined in figure 2.

Table 5.—Kansas: Crushed stone sold or used by producers in 1985, by use and district

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	197	917	(1)	(1)	--	--
Coarse aggregate, graded	1,950	8,785	(1)	(1)	--	--
Fine aggregate (-3/8 inch)	260	859	(1)	(1)	W	W
Combined coarse and fine aggregates	1,878	8,241	72	364	--	--
Other construction	128	499	576	3,475	--	--
Agricultural limestone	576	2,882	98	379	--	--
Cement manufacture	636	1,591	(2)	(2)	--	--
Chemical stone	(2)	(2)	--	--	--	--
Sulfur oxide removal	(2)	(2)	--	--	--	--
Magnesium metal manufacture	(2)	(2)	--	--	--	--
Roofing granules	(2)	(2)	(2)	(2)	--	--
Paper manufacture	(2)	(2)	--	--	--	--
Other miscellaneous	313	1,492	595	2,891	--	--
Other unspecified[3]	512	1,675	411	919	--	--
Total	6,450	26,941	1,752	8,028	W	W

Use	District 4		District 5		District 6	
	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	1	14	W	W	191	430
Coarse aggregate, graded	14	137	W	W	1,093	4,495
Fine aggregate (-3/8 inch)	8	62	--	--	656	1,705
Combined coarse and fine aggregates	--	--	W	W	1,464	4,216
Other construction	--	--	W	W	--	--
Agricultural limestone	--	--	79	263	122	411
Cement manufacture	--	--	--	--	2,110	4,769
Roofing granules	--	--	--	--	(2)	(2)
Other miscellaneous	--	--	W	W	579	2,150
Other unspecified[3]	--	--	--	--	452	1,632
Total	23	213	W	W	6,667	19,808

W Withheld to avoid disclosing company proprietary data.
[1]Withheld to avoid disclosing individual company proprietary data; included with "Other construction."
[2]Withheld to avoid disclosing individual company proprietary data; included with "Other miscellaneous."
[3]Includes production reported without a breakdown by end use and estimates for nonrespondents.

Approximately 88% of the crushed stone was shipped by truck, 3% by rail, and the remainder was shipped by other or unspecified methods.

In April, Quartzite Stone Co. of Lincoln, Lincoln County, brought its new $2 million crushing and sizing plant on-stream, increasing the company's efficiency in meeting demand for its products. The firm produced aggregates for a variety of uses and also fabricated cement pipe.

Dimension.—Kansas ranked 16th of 36 States in production of dimension stone. Production and value increased 51% and 70%, respectively, in 1985. Limestone was quarried by Bayer Stone Inc. in Pottawatomie and Riley Counties and by H. J. Born Stone Co. Inc. in Chase and Cowley Counties.

Production was sold as rough blocks, irregular-shaped stone, and as cut veneer stone.

Bayer Stone installed an in-line polisher at its plant in St. Marys, Pottawatomie County. The new machine, the first used in Kansas, polishes limestone panels with rotating diamond and abrasive cutting heads that have both lateral and vertical movements. The firm also installed an anchor slotting machine for processing stone panels.

Sulfur (Recovered).—Sulfur was recovered at the petroleum refining operations of Texaco Refining & Marketing Co. at El Dorado in Butler County. Farmland Industries Inc. at Coffeyville in Montgomery County sold material from stocks. Sales dropped 18% in 1985. Unit value increased $7.20 per metric ton.

[1]State Mineral Officer, Bureau of Mines, Minneapolis, MN.
[2]Associate scientist, Mineral Information, Kansas Geological Survey, Lawrence, KS.
[3]Editorial assistant, Bureau of Mines, Minneapolis, MN.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co.[1 2]	Box 25900 Overland Park, KS 66225	Plant and quarry	Neosho.
General Portland Inc., Victor Div., LaFarge Corp.[1 2]	7701 East Kellogg St. Suite 240 Wichita, KS 67207	do	Wilson.
Lehigh Portland Cement Co., Heidelberger Zement AG.[1 2]	718 Hamilton Mall Allentown, PA 18105	do	Montgomery.
Lone Star Industries Inc.[2]	Box 12449 Dallas, TX 75225	do	Wyandotte.
The Monarch Cement Co.[1 2]	Box 187 Humboldt, KS 66748	do	Allen.
Clays:			
Buildex Inc., a division of Clemens Coal Co.	Box 299 Pittsburg, KS 66762	Pits and plants	Franklin and McPherson.
Cloud Ceramics, a division of General Finance Inc.	Box 369 Concordia, KS 66901	Pits and plant	Cloud.
W. S. Dickey Clay Manufacturing Co	Box 6 Pittsburg, KS 66762	do	Cherokee and Crawford.
Ideal Basic Industries Inc	Box 8789 Denver, CO 80201	Pit	Jewell.
Justin Industries Inc., Acme Brick Co	Box 98 Kanopolis, KS 67454	Pits and plants	Cherokee and Ellsworth.
Kansas Brick & Tile Co. Inc	Box 540 Hoisington, KS 67544	Pit and plant	Barton.
Micro-Lite Inc	Route 4, Box 50B Chanute, KS 66720	do	Woodson.
Gypsum:			
Georgia-Pacific Corp	133 Peachtree St., NE. Atlanta, GA 30303	Underground mine and plant.	Marshall.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	Open pit, underground mine, plant.	Barber.
Helium:			
Kansas Refined Helium Co	Otis, KS 67565	Plant	Rush.
Union Carbide Corp., Linde Div	Box 444 Somerset, NJ 08873	Plants	Ellsworth, Grant, Morton, Rush.
Perlite (expanded):			
Lite-Weight Products Inc	1706 Kansas Ave. Kansas City, KS 66105	Plant	Wyandotte.
Pumice and pumicite:			
Calvert Corp	Box 97 Norton, KS 67654	Pit and plant	Norton.
Salt:			
American Salt Co	3142 Broadway Kansas City, MO 64111	Wells and underground mine.	Rice.
Carey Salt Co., a division of Processed Minerals Inc.	1800 Carey Blvd. Hutchinson, KS 67501	Underground mine	Reno.
Cargill Inc., Salt Div	Box 1403 Hutchinson, KS 67501	Wells	Do.
Independent Salt Co	Box 36 Kanopolis, KS 67454	Underground mine	Ellsworth.
Morton Salt Co., a division of Morton Thiokol Inc.	110 North Wacker Dr. Chicago, IL 60606	Wells	Reno.
Vulcan Materials Co., Chemicals Div	Box 7689 Birmingham, AL 35223	do	Sedgwick.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Construction (1984):			
Builders Sand Co	4150 Kansas Ave. Kansas City, KS 66106	Dredges and plants	Johnson and Wyandotte.
Holliday Sand & Gravel Co., a division of List & Clark Construction Co.	6811 West 63d St. Overland Park, KS 66202	Pits and plants	Do.
Miles Sand Inc	4852 North Meridian Wichita, KS 67204	Pit and plant	Sedgwick.
Ritchie Sand Co., a division of Ritchie Corp.	6500 West 21st St. Wichita, KS 67204	Dredge and plant	Do.
Industrial:			
Holliday Sand & Gravel Co., a division of List & Clark Construction Co.	6811 West 63d St. Overland Park, KS 66202	Pit and plant	Wyandotte.
HUB Materials Inc	Box 11126 Kansas City, KS 66111	____do	Do.
Stone:			
Crushed:			
Limestone:			
Ash Grove Cement Co[3]	Box 25900 Overland Park, KS 66225	Quarries, underground mine, plants.	Johnson, Linn, Neosho.
N. R. Hamm Quarry Inc	Box 17 Perry, KS 66073	Quarries and plants	Various (7 counties).
Inland Quarries	Box 2249 Kansas City, KS 66110	Underground mine and plant.	Wyandotte.
McAdam Construction Co	Moran, KS 66755	Quarries and plants	Allen, Anderson Bourbon, Cowley, Linn.
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 27622	____do	Various (8 counties).
Midwest Minerals Inc	Box 412 Pittsburg, KS 66762	____do	Cherokee, Crawford, Labette, Montgomery, Neosho, Wilson.
Sandstone:			
J. H. Shears Sons Inc	Box 1605 Hutchinson, KS 67504	Quarry and plant	Lincoln.
Dimension:			
Limestone:			
Bayer Stone Inc	6th and Mission St. Marys, KS 66536	Quarries	Pottawatomie and Riley.
H. J. Born Stone Co. Inc	Route 3, Box 312 Silverdale, KS 67005	____do	Chase and Cowley.
Sulfur (recovered):			
Farmland Industries Inc	North Linden St. Coffeyville, KS 67337	Secondary recovery plant.	Montgomery.
Texaco Refining & Marketing Co	Box 1650 Tulsa, OK 74102	____do	Butler.

[1]Also clays.
[2]Also crushed stone.
[3]Also crushed sandstone.

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 Garland R. Dever, Jr.[2]

The value of Kentucky's nonfuel mineral production in 1985 was $267.6 million, $10.4 million more than that of 1984. Crushed stone continued to be the leading nonfuel mineral produced and accounted for about 50% of the total value. The State ranked second in ball clay and lime production. Nationally, the State ranked 27th in the value of nonfuel minerals produced, up one place from that of 1984. Leading commodities produced in terms of value were crushed stone, lime, portland cement, and construction sand and gravel. Other nonfuel minerals produced included ball, common, and fire clay, industrial sand, masonry cement, and zinc. Commodities processed or manufactured but not included in table 1 included aluminum, ferroalloys, synthetic graphite, pig iron, steel, iron and steel slag, expanded perlite, recovered sulfur, and exfoliated vermiculite.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	r 2662	r 2$2,533	775	$6,487
Gem stones	NA	1	NA	1
Sand and gravel (construction) thousand short tons	7,839	18,252	e7,600	e19,000
Stone (crushed) do.	e37,300	e133,000	3 38,022	3 134,978
Combined value of cement, clays (ball clay and fire clay, 1984), lime, sand and gravel (industrial), stone (crushed sandstone, 1985), and zinc	XX	r103,422	XX	107,092
Total	XX	r257,208	XX	267,558

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

Table 2.—Nonfuel minerals produced in Kentucky in 1984, by county[1]

County	Minerals produced in order of value
Boone	Sand and gravel.
Boyd	Clays.
Breckinridge	Sand and gravel.
Bullitt	Clays.
Calloway	Sand and gravel.
Carlisle	Clays.
Carroll	Sand and gravel.
Carter	Clays.
Clinton	Sand and gravel.
Daviess	Do.
Graves	Clays, sand and gravel.
Hancock	Clays.
Hart	Sand and gravel.
Henderson	Do.
Jefferson	Cement, clays, sand and gravel.
Jessamine	Zinc.
Lawrence	Sand and gravel.
Lewis	Do.
Livingston	Do.
Martin	Do.
Mason	Lime, sand and gravel.
Oldham	Sand and gravel.
Pendleton	Lime.
Powell	Clays.
Trimble	Sand and gravel.
Union	Do.
Whitley	Clays.
Undistributed[2]	Stone (crushed), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Kentucky business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	3,714	3,720	3,726
Total civilian labor force	do	1,701	1,715	1,695
Unemployment	percent	11.7	9.3	9.5
Employment (nonagricultural):				
Mining total[1]	thousands	42.3	45.6	43.6
Nonmetallic minerals except fuels[2]	do	2.2	2.3	2.2
Coal mining	do	36.7	39.7	37.9
Manufacturing total	do	242.5	257.4	255.5
Primary metal industries	do	16.3	18.2	17.5
Stone, clay, and glass products	do	7.5	7.6	7.9
Chemicals and allied products	do	13.2	13.3	13.3
Petroleum and coal products	do	4.0	3.9	3.8
Construction	do	46.6	50.5	55.1
Transportation and public utilities	do	62.7	65.2	66.5
Wholesale and retail trade	do	265.6	282.1	296.0
Finance, insurance, real estate	do	53.1	55.1	57.3
Services	do	222.9	234.8	245.9
Government and government enterprises	do	216.6	223.0	227.6
Total[3]	do	1,152.3	1,213.8	1,247.6
Personal income:				
Total	millions	$35,186	$38,604	$40,328
Per capita		$9,475	$10,377	$10,824
Hours and earnings:				
Total average weekly hours, production workers		39.2	39.2	38.9
Total average hourly earnings, production workers		$8.8	$9.3	$9.5
Earnings by industry:				
Farm income	millions	$406	$1,163	$914
Nonfarm	do	$24,146	$26,296	$27,712
Mining total	do	$1,588	$1,840	$1,814
Nonmetallic minerals except fuels	do	$47	$51	$53
Coal mining	do	$1,423	$1,661	$1,644
Oil and gas extraction	do	$119	$128	$117
Manufacturing total	do	$5,771	$6,424	$6,605
Primary metal industries	do	$532	$599	$585
Stone, clay, and glass products	do	$166	$175	$190
Chemicals and allied products	do	$416	$439	$453
Petroleum and coal products	do	$164	$163	$173

See footnotes at end of table.

Table 3.—Indicators of Kentucky business activity —Continued

		1983[r]	1984	1985[p]
Earnings by industry—Continued				
Nonfarm—Continued				
Construction	millions	$1,387	$1,520	$1,577
Transportation and public utilities	do.	$1,869	$2,056	$2,166
Wholesale and retail trade	do.	$3,906	$4,157	$4,432
Finance, insurance, real estate	do.	$1,041	$1,112	$1,268
Services	do.	$4,133	$4,519	$4,893
Government and government enterprises	do.	$4,315	$4,529	$4,808
Construction activity:				
Number of private and public residential units authorized[4]		11,839	13,276	13,770
Value of nonresidential construction[4]	millions	$392.2	$476.9	$591.1
Value of State road contract awards	do.	$452.2	$318.0	$322.0
Shipments of portland and masonry cement to and within the State	thousand short tons	889	1,054	1,092
Nonfuel mineral production value:				
Total crude mineral value	millions	$224.5	$257.2	$267.6
Value per capita		$60	$69	$72

[p]Preliminary. [r]Revised.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]Data may not add to totals shown because of independent rounding.
[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

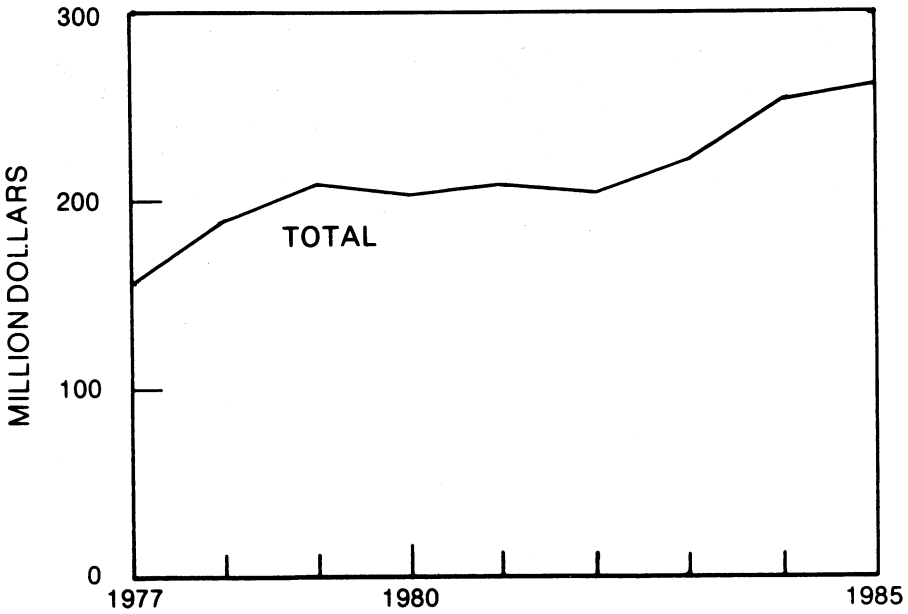

Figure 1.—Total value of nonfuel mineral production in Kentucky.

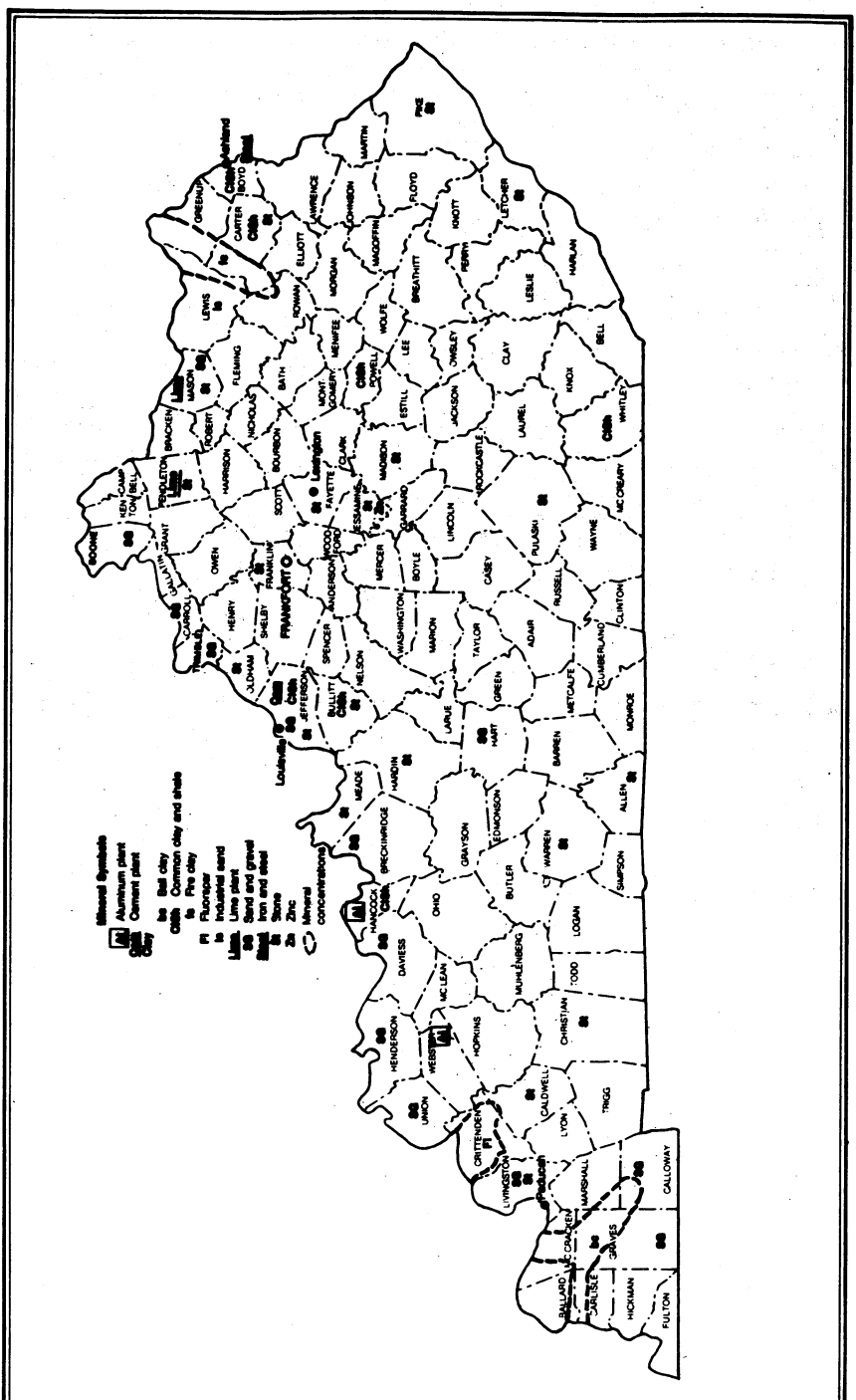

Figure 2.—Principal mineral producing localities in Kentucky.

Trends and Developments.—More than 625,000 short tons of commodities were shipped on the Tennessee-Tombigbee Waterway during the first 6 months after it was opened to traffic in early 1985. This was far below the 10 to 20 million short tons of cargo projected annually by the U.S. Army Corps of Engineers in 1976. The leading commodity shipped during the first 6 months was construction stone totaling 108,000 tons, followed by coal at 99,300 tons, and grain at 73,600 tons. Shipments of fuel amounted to 69,960 tons and construction sand and gravel totaled 55,250 tons. All other commodities shipped totaled 219,606 tons, which included chemicals, fertilizer, iron ore and steel, and caustic soda.

During the year, two companies were engaged in tar sands projects in western Kentucky. Kentar Ltd. (formerly Tarco Inc.) extracted heavy oil from surface-mined tar sands of the Big Clifty Sandstone (Mississippian age) using a solvent process at its pilot plant in Logan County. In addition, Kensyntar recovered heavy oil from the Big Clifty in Edmonson County by an in situ process. Kensyntar also renewed its leases and planned to resume work on the project when the price of oil becomes more favorable for an economic operation. In January, however, the U.S. Synthetic Fuels Corp. rejected the Means Oil Shale project for Federal financial aid. The proposed project in east-central Kentucky was sponsored by Southern Pacific Petroleum, Central Pacific Minerals, and Dravo Corp.

In 1985, Kentucky again retained its rank as the top coal producing State in the Nation. Production from underground and surface mines totaled 169,616,063 short tons, down slightly from the 1984 production of 170,678,291 tons, based on Kentucky Department of Mines and Minerals data. The five coal districts of eastern Kentucky produced 125,824,722 tons; western Kentucky mines produced 43,791,341 tons.

In September, groundbreaking ceremonies were held at the Tennessee Valley Authority's Shawnee steam plant, west of Paducah, for construction of the 160-megawatt atmospheric fluidized bed combustion (AFBC) demonstration plant. The plant, scheduled for completion in 1988, was designed to demonstrate on a commercial scale the economic and environmental aspects of the AFBC process. The facility would be able to burn western Kentucky's high sulfur coals, and in addition, create a broader market for the State's abundant limestone resources, which are needed for the combustion process.

In 1985, the State continued to lead the Nation in the consumption of industrial explosives and blasting agents. More than 720 million pounds (19% of the U.S. total) was sold during the year. Principal uses were for coal mining, construction work, and rock quarrying.

Legislation and Government Programs.—The Kentucky General Assembly, which convenes every other year, was not in session in 1985. However, the constitutionality of House bill 32, the "broad-form deed bill," was contested in the Kentucky Supreme Court. The law, passed by the 1984 General Assembly and in effect since July of that year, required coal operators to obtain the right to mine from landowners if the method of mining to be used was not known or prevalent at the time the deed was signed. As of yearend, no decision had been reached by the State's high court.

In August, the Office of Surface Mining (OSM) and a group of environmental organizations signed an agreement resolving a longstanding dispute over 2-acre coal minesites, principally in Kentucky and Virginia. The dispute concerned regulation of coal mines affecting 2 acres or less, which are exempt from provisions of the Surface Mining Control and Reclamation Act of 1977. Under terms of the agreement, OSM will take prompt, aggressive action to eliminate 2-acre abuses. OSM will list all 2-acre sites in Kentucky and Virginia; identify legitimate 2-acre operations; inspect the mines for violations; and issue violation notices or shut down the mines, as appropriate. The agreement was intended to end the unfair advantages some mining companies have been taking of the 2-acre exemption. Only bona fide small "pick and shovel" operators will be allowed to mine coal on sites under 2 acres without paying reclamation costs.

In December, the U.S. Congress passed and sent to the President House Resolution 1627, designating approximately 13,330 acres in the Daniel Boone National Forest as an addition to the National Wilderness Preservation System.

The Kentucky Geological Survey (KGS), part of the University of Kentucky, continued evaluating the State's mineral resources. In 1985, KGS and the Kentucky Center for Energy Research Laboratory (KCERL) jointly investigated limestone resources for use in fluidized bed combustion plants, seeking stone with high-sulfur-

sorption capacity and low-abrasion and low-attrition characteristics. A study of zinc deposits in south-central Kentucky was completed, and KGS participated in the Midcontinent Strategic and Critical Minerals Program sponsored by the U.S. Geological Survey. The investigation of sand and gravel resources along the Ohio River Valley for sources of construction aggregate was continued.

Eleven new publications were issued by KGS during 1985. One of these was a report on the structure and thickness of the Devonian-Mississippian Shale sequence in extreme southeastern Kentucky and adjacent parts of Tennessee and Virginia. Another publication, prepared in cooperation with the National Speleological Society, provides comprehensive information about caves and karst geology in Kentucky. Other publications included a study of Pennsylvanian age plant fossils in southeastern Kentucky, a report on a persistent fossil zone in the Kinkaid Limestone, an oil and gas drilling activity summary for 1984, a study related to a possible Silurian reef trend in western Kentucky, and a guidebook for the Geological Society of Kentucky.

The U.S. Department of Energy signed a $1.8 million cooperative agreement with a consortium headed by the University of Kentucky to further coal liquefaction research. In addition to the University of Kentucky, the consortium included the Kentucky Energy Cabinet and four other universities—Pittsburgh, Syracuse, Utah, and West Virginia. Syracuse University will provide technology assessments for the research and the other members will provide the facilities and personnel to conduct the coal liquefaction experiments.

OSM awarded Kentucky $1.7 million for six major reclamation projects under the State's abandoned coal mine lands program. The grant brought to more than $82.5 million the amount the State has been awarded to restore land and water resources adversely affected by past unregulated coal mining practices. The OSM grant went to the Abandoned Lands Division of the Kentucky Natural Resources and Environmental Protection Cabinet.

In December, groundbreaking ceremonies were held for a new $14 million Mining and Mineral Resources Building at the University of Kentucky, Lexington. The building, scheduled for completion in 1987, will house the KGS, Department of Mining Engineering, and other coal-related offices and laboratories.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Cement.—Kosmos Cement Co. Inc., a subsidiary of Moore McCormack Cement Inc., operated the State's only cement plant at Kosmosdale, Jefferson County. The 670,000-short-ton-per-year-capacity coal-fired plant produced both portland and masonry cement utilizing the dry process. Limestone used at the plant was barged from the company's Battletown quarry, approximately 28 miles from the plant. Proven reserves were estimated at 54 million tons.[3] In addition to limestone, other raw materials consumed at the plant included anhydrite, clay, fly ash, gypsum, and iron ore.

Clays.—In 1985, 13 companies produced common clay and shale, fire clay, and ball clay from 17 mines in the State. Common clay was produced by 9 companies at 11 pits and was used principally for the production of common and face brick, lightweight aggregate for use in concrete block, and structural concrete products. Fire clay was mined by one company in Carter County and was used primarily for fire brick and block. Ball clay, primarily used for bonding in ceramic ware, was produced by two companies with five operations in Carlisle and Graves Counties.

Fluorspar.—In November, Moodie Minerals Exploration Co. acquired an option to purchase all of the assets of United States Steel Corp. and Marathon Oil Co. in the Illinois-Kentucky fluorspar district. The agreement included the inactive Frontier Spar Corp. mine and 600-short-ton-per-day mill near Salem.

Limited exploratory drilling was conducted in the western Kentucky portion of the Illinois-Kentucky fluorspar district. No exploration activity was reported in either the State's central mineral district or south-central zinc district.[4]

Gem Stones.—Gem material and mineral specimens were collected in various parts of the State. The State is well known for its Halls Gap millerite and honessite, agate, and coalfield fossils.

Graphite (Synthetic).—Three 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. produced graphite electrodes at a plant in Hickman, Fulton County, and Ashland Petroleum Co., Carbon Fibers Div., produced high-modulus fibers at its plant in Cattlesburg, Boyd County. During the year, Ashland Petroleum announced plans to expand the plant from 30 to 100 short tons per year capacity of pitch-based fiber.

Superior Graphite began producing ceramic grades of beta-silicon carbide at its facility in Hopkinsville by a continuous, high-temperature, proprietary technology that produces an inexpensive, free-flowing granular material. Previously, silicon carbide was made by batch processes and had to be pulverized to meet abrasive, metallurgical, and refractory industry specifications. The main markets targeted for the new line of silicon carbide are the newly emerging, high-tech ceramic and advanced refractory industries.

Lime.—In 1985, Kentucky ranked second of 36 States that produced lime in the Nation. Two companies each operated underground mines and calcining facilities in Mason and Pendleton Counties. Both output and value rose 7% and 13%, respectively, over that of 1984.

Dravo Lime Co., a subsidiary of Dravo Corp., produced Thiosorbic lime (quicklime) from a 1-million-short-ton-per-year plant at Maysville in Mason County. The plant was the second largest of 116 plants in the Nation that produced lime. The lime was primarily sold to coal-fired electric generating plants in the Ohio Valley for use in sulfur dioxide removal.

The Black River Lime Co., jointly owned by Armco Inc. and LTV Steel Co., produced both quicklime and hydrated lime at the Nation's sixth largest plant at Carntown in Pendleton County. The lime was sold for steel production and other industrial and chemical uses, primarily in the Midwest and upper South.

Near yearend, Dravo announced that it reached an agreement in principle to acquire the Black River Lime operation in Carntown. The transaction would include an underground mine with more than 150 million tons of recoverable limestone reserves and a 660,000-short-ton-per-year lime plant. Acquisition of the facility would increase the overall lime capacity of Dravo by 40% making it one of the largest lime producers in the world. As part of the purchase agreement, Dravo would also receive long-term contracts to supply lime to two large steel producers.

Perlite (Expanded).—Kentucky ranked sixth of 31 States that expanded perlite. One company, International Permalite Co., expanded perlite shipped in from other States at a plant at Florence in Boone County. Most of the perlite was used for roof insulation board, as a horticultural aggregate, and as an oil absorbent.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Based on these estimates, output of construction sand and gravel decreased 3% compared with that of 1984. In 1984, 21 companies produced construction sand and gravel at 27 operations in 17 counties. Most of the construction sand and gravel produced in the State was obtained from dredging and open pit operations in glacial outwash and alluvial deposits along the Ohio River Valley. Main uses were for concrete aggregate, asphaltic concrete, and road base and coverings.

Industrial.—One company mined industrial sand in the State in 1985. Industrial Supply House of Greenup Inc. produced silica sand from an operation in Lewis County. The principal use was for traction. Another company, Murray Silica Sand Co., processed industrial sand at a plant in Murray, Calloway County, from a company pit in northern Tennessee.

Slag—Iron and Steel.—One company processed slag produced by the State's iron and steel industry. The Heckett Co. processed both air-cooled iron (blast furnace) slag at a plant in Ashland, Boyd County, and steel slag from electric furnaces at Owensboro, Daviess County. The construction industry was the major user of the iron and steel slag products.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone continued to be the leading mineral produced, accounting for about one-half of the State's total value in 1985. In 1985, production amounted to 3 8 million short tons valued at $134.9 million. Lime-

stone was mined by 53 companies at 102 quarries; crushed sandstone was mined at 1 quarry.

In January, ownership of the Three Rivers Rock Co. quarry in Livingston County was transferred by Standard Oil Co. (Indiana) to Cyprus Minerals Corp., as part of a move by Indiana Standard to spin off its assets in coal, metals, and industrial minerals to its shareholders.

The KGS continued working with the KCERL on evaluating limestones and dolomites for fluidized bed combustion systems. A deposit of Lexington Limestone used in test runs at the KCERL fluidized bed combustion pilot plant was sampled to determine its chemical characteristics. In addition, an investigation of potential sources of limestone that would have a low rate of attrition in a fluidized bed boiler was in progress.

Table 4.—Kentucky: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	208	898
Riprap and jetty stone	1,737	6,014
Filter stone	838	3,205
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,494	12,668
Bituminous aggregate, coarse	3,314	12,424
Bituminous surface-treatment aggregate	301	1,311
Railroad ballast	198	891
Fine aggregate (-3/8 inch):		
Stone sand, concrete	427	1,547
Stone sand, bituminous mix or seal	668	2,299
Screening, undesignated	496	1,876
Other fine aggregate	2,455	8,704
Combined coarse and fine aggregates:		
Graded road base or subbase	6,197	22,219
Unpaved road surfacing	2,021	7,203
Crusher run or fill or waste	1,261	4,772
Other construction[2]	967	2,526
Agricultural:		
Agricultural limestone	2,333	8,498
Poultry grit and mineral food	22	195
Special:		
Other miscellaneous[3]	4,629	15,333
Other unspecified[4]	6,455	22,394
Total[5]	38,022	134,978

[1]Includes limestone; excludes a minor amount of sandstone withheld to avoid disclosing company proprietary data.
[2]Includes stone used in terrazzo and exposed aggregate, coarse aggregate (large), coarse aggregate (graded), and stone used for other construction and maintenance purposes.
[3]Includes stone used in cement and lime manufacture, flux and chemical stone, abrasives, mine dusting or acid water treatment, asphalt fillers or extenders, chemicals, paper manufacture, and other uses not specified.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Sulfur (Recovered).—Elemental sulfur was recovered as a nondiscretionary byproduct at Ashland Oil Inc., Catlettsburg, Boyd County.

Vermiculite (Exfoliated).—Crude vermiculite mined in other States was exfoliated by W. R. Grace in Wilder, Campbell County. The product was used primarily in loose-fill and block insulation, fireproofing, lightweight aggregate, and soil conditioning.

METALS

Aluminum.—Kentucky continued to rank third behind Washington and New York in the production of primary aluminum. National-Southwire Aluminum Co. operated a 190,000-short-ton-per-year plant in Hawesville, Hancock County, and Alcan Aluminum Ltd. operated a 180,000-short-ton-per-year smelter in Sebree, Webster County.

In March, Alcan closed one of its three potlines at the Sebree primary smelter, reducing capacity by 60,550 tons. The company cited low U.S. prices for aluminum ingot products and high inventories as reasons for the production cutback. About 250 of the company's 850-member work force were affected by the closure. The cutback reduced Alcan's worldwide operating rate from 91.5% to 88.5% of installed capacity.

In October, National-Southwire filed a request with the Kentucky Public Service

Commission to order the Big Rivers Electric Corp. to decrease its rates. National-Southwire bought about 35% of the power produced by Big Rivers, which was facing a Federal foreclosure suit by the Rural Electrification Administration after defaulting on more than $1 billion in Government loans related to construction of its D. B. Wilson plant. More than 70% of Big Rivers power was purchased by National-Southwire and Alcan's Sebree smelter.

In November, Reynolds Metals Co. opened a new $4.9 million aluminum annealing facility in Louisville. The facility, designed to increase capacity and quality at the company's Plant No. 1, is part of a broad effort to improve Reynolds competitive position. Reynolds Plant No. 1 makes more than one-half of the company's flexible packaging division foil. The company also operates an aluminum extrusion plant, powder and paste plant, and warehouse in Louisville and has a total local employment of about 900.[5]

Iron and Steel.—Shipments of pig iron rose slightly above those of 1984. One company, Armco, produced pig iron at a plant in Ashland, Boyd County. Raw steel production amounted to 2.29 million short tons, down slightly from 2.33 million tons in 1984; however, 1985 production represented an increase of nearly 62% above the 1982 low of 1.42 million tons.

In November, Armco drafted a long-range plan to upgrade some areas of its Ashland Works that will eliminate about 100 jobs annually. Upgrading will include modification at the blast furnace operations, the basic oxygen shop, tandem cold mill, and conversion of a bloom caster to a slab caster. Phaseout is likely to include the hot-strip mill, reduction to one blast furnace, and closing of one coke battery.

In December, North Star Steel Co., a subsidiary of Cargill Inc., purchased 80% of the stock of Ohio River Steel Corp.'s minimill at Calvert City, Marshall County, through a financial reorganization plan approved by the U.S. Bankruptcy Court. Earlier in the year, Ohio River Steel had filed for chapter 11 protection from creditors. The remaining 20% of the stock was owned by companies and individuals with claims against Ohio River Steel. As part of the reorganization plan, North Star must invest $6 million in the mill and be prepared to loan the mill an additional $2 million if the $6 million is not enough to provide working capital and pay claims.

During the year, two steel minimills were closed in the State. In August, Kentucky Electric Steel Corp. closed its Ashland plant after failing to resolve a 4-month strike and continuing financial losses. The plant, which remained closed during the strike, had produced carbon and alloy flats and rounds for equipment manufacturers and steel service centers. In November, Green River Steel Corp. permanently closed its specialty steel minimill in Owensboro because of continuing financial losses. The minimill, which produced alloy and specialty carbon bar and semifinished steel, had two electric arc furnaces and a vacuum degassing unit with an annual production capacity of 175,000 short tons. The closing affected about 500 workers.

SKW Alloys Inc. produced ferroalloys at its plant in Calvert City, Marshall County. The plant produced both 50% and 75% ferrosilicon and other alloys. During the year, SKW announced that it planned to end production but not marketing of manganese ferroalloys in the United States. SKW had been producing manganese ferroalloys at Calvert City but ceased production after workers went on strike in September 1983. Also near yearend, the company announced that it planned to acquire the specialty foundry product lines of Foote Mineral Co. that were formerly produced at Foote's Graham, WV, plant, which closed at yearend 1985. Under terms of the agreement, Foote will supply technical assistance in 1986 and 1987 and will receive as compensation some of the profit generated by the ferroalloy products over the next 6 years.

Zinc.—Lexington Quarry Co. (Catnip Hill operation) continued to recover and concentrate a small amount of zinc ore as a by-product of underground limestone mining. The zinc concentrate was shipped to an out-of-State smelter.

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[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2]Head, Industrial and Metallic Minerals Section, Kentucky Geological Survey, Lexington, KY.

[3]Moore McCormack Resources Inc. Securities and Exchange Commission Form 10-K Report, 1985. P. 2.

[4]Kentucky Geological Survey. Exploration 1985. Min. Eng., v. 38, No. 5, May 1986, p. 330.

[5]The Courier Journal (Louisville, KY). Reynolds Metals Heats Up Louisville Operation. Nov. 27, 1985.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum (primary):			
Alcan Aluminum Ltd	Sebree, KY 42555	Smelter	Webster.
National-Southwire Aluminum Co.	Box M Hawesville, KY 42348	do	Hancock.
Cement:			
Kosmos Cement Co. Inc.,[1] [2] a subsidiary of Moore McCormack Cement Inc.	Dixie Highway Box 72319 Louisville, KY 40272	Plant	Jefferson.
Clays:			
Ball clay:			
Kentucky-Tennessee Clay Co	Box 449 Mayfield, KY 42066	Mines and plant	Carlisle and Graves.
Old Hickory Clay Co	Box 66 Hickory, KY 42051	do	Graves.
Common clay:			
General Shale Products Corp	Box 3547 CRS Johnson City, TN 37602	Mine and plant	Jefferson.
Kentucky Solite Corp	Box 27211 Richmond, VA 23261	do	Bullitt.
U.S. Brick Inc., Sipple Div	Box 567 Stanton, KY 40380	do	Powell.
Fire clay:			
Ford Burchett Clay Co	Route 1, Box 850 Olive Hill, KY 41164	Mine	Carter.
Ferroalloys:			
SKW Alloys Inc	Box 217 Calvert City, KY 42029	Plant	Marshall.
Graphite (synthetic):			
Ashland Petroleum Co., Carbon Fibers Div.[3]	Ashland, KY 41101	do	Boyd.
Sigri Carbon Corp	Box 229 Hickman, KY 42050	do	Fulton.
Superior Graphite Co	Box 535 Hopkinsville, KY 42240	do	Christian.
Iron and steel (pig iron):			
Armco Inc	Middletown, OH 45202	do	Boyd.
Newport Steel Corp	9th & Lowell Sts. Newport, KY 41072	Plants	Campbell.
Lime:			
Black River Lime Co	Route 1 Butler, KY 41006	Mine and plant	Pendleton.
Dravo Lime Co., a subsidiary of Dravo Corp.[2]	One Gateway Center Pittsburgh, PA 15222	do	Mason.
Perlite (expanded):			
International Permalite Co	300 North Haven Ave. Ontario, CA 91762	Plant	Boone.
Sand and gravel (1984):			
Construction:			
Daviess County Sand & Gravel Co.	Rural Route 1, Box 28 Owensboro, KY 42301	Dredge	Daviess.
Evansville Materials Inc	Box 249 Tell City, IN 47586	Dredges	Do.
Ingram Materials Inc	10 Fatherland St. Nashville, TN 37213	Dredge	Livingston.
Martin Marietta Corp.[2]	Box 30013 Raleigh, NC 27622	Pits	Boone, Carroll, Jefferson, Oldham.
Nugent Sand Co. Inc	Box 6072 1833 River Rd. Louisville, KY 40206	Dredge	Trimble.
Industrial:			
Industrial Supply House of Greenup Inc.	Box 647 422 Harrison St. Greenup, KY 41144	Pit	Lewis.
Stone (crushed):			
Kentucky Stone Corp	Box 7556 Louisville, KY 40207	Underground mines, quarries, plants.	Various.
Reed Crushed Stone Co	Box 35 Gilbertsville, KY 42044	Quarry and plant	Livingston.
Rogers Group Inc	Box 310 Shepherdsville, KY 40165	Quarries and plants.	Bullitt, Christian, Grayson, Oldham.
Three Rivers Rock Co	Box 218 Smithland, KY 42081	Quarry and plant	Livingston.
Vermiculite:			
W.R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Campbell.
Zinc:			
Lexington Quarry Co.[2]	2200 Catnip Hill Rd. Nicholasville, KY 40356	Underground mine and plant.	Jessamine.

[1]Also clays.
[2]Also stone.
[3]Also sulfur.

The Mineral Industry of Louisiana

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

By James R. Boyle[1] and Charles G. Groat[2]

The value of Louisiana's nonfuel mineral production in 1985 was $522.3 million, an increase of nearly $11 million over that of 1984. The increase in unit prices of salt offset a decrease in the estimated value of construction sand and gravel and a drop in the output of Frasch sulfur. The State led the Nation in salt output, was second in Frasch sulfur output, and was fifth in the production of recovered sulfur from oil refineries. The combined value of salt and Frasch sulfur remained the major portion of the State's total nonfuel minerals value in 1985. Louisiana ranked 15th nationally in value of nonfuel minerals produced and 9th in value of industrial minerals. Louisiana produced 3.0% of the Nation's industrial minerals, valuewise.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	547	[2]$10,858	334	$7,017
Gem stones	NA	1	NA	1
Salt thousand short tons	13,101	112,142	12,325	138,955
Sand and gravel:				
Construction do	17,040	54,664	e15,000	e48,000
Industrial do	266	3,757	267	3,838
Stone (crushed) do	e4,100	e19,500	[3]4,820	[3]25,956
Sulfur (Frasch) thousand metric tons	2,007	W	1,698	W
Combined value of cement, clays (bentonite, 1984), gypsum, lime, stone (miscellaneous crushed, 1985), and values indicated by symbol W	XX	310,548	XX	298,501
Total	XX	511,470	XX	522,268

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

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

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

[3]Excludes miscellaneous crushed stone; value included with "Combined value" figure.

Table 2.—Nonfuel minerals produced in Louisiana in 1984, by parish[1]

Parish	Minerals produced in order of value
Allen	Sand (industrial).
Ascension	Salt.
Assumption	Do.
Beauregard	Sand and gravel.
Bienville	Clays.
Caddo	Do.
Cameron	Do.
Catahoula	Sand and gravel.
Claiborne	Clays.
East Baton Rouge	Sand (industrial).
East Feliciana	Do.
Iberia	Salt.
Iberville	Do.
Jefferson	Sulfur, salt.
Jefferson Davis	Sand and gravel.
Lafayette	Do.
La Salle	Do.
Livingston	Do.
Morehouse	Do.
Natchitoches	Clays.
Orleans	Cement, lime.
Ouachita	Sand and gravel.
Plaquemines	Sulfur, salt.
Pointe Coupee	Clays.
Rapides	Sand and gravel.
Red River	Sand (industrial).
Sabine	Sand and gravel.
St. Bernard	Do.
St. Helena	Sand and gravel, clays.
St. Martin	Salt, sand and gravel.
St. Mary	Salt, lime.
St. Tammany	Sand and gravel, clays.
Tangipahoa	Sand and gravel.
Terrebonne	Sulfur, salt.
Union	Sand and gravel.
Vermilion	Do.
Vernon	Do.
Washington	Do.
Webster	Sand (industrial).
West Feliciana	Sand and gravel.
Winn	Gypsum.
Undistributed[2]	Stone (crushed), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Trends and Developments.—The State's economy weakened in 1984, and remained weak throughout 1985. The performance of the economy was linked to weaknesses in the energy, petrochemical, construction, and international trade sectors. Louisiana's chemical industry, a major consumer of mineral output and the State's largest employer, has lost about 2,000 employees in the last 2 years. Although the index of leading indicators increased nationally during 1985, the Louisiana Economic Indicator (LEI) dropped monthly throughout 1985. The LEI, was nearly 111 in January, and dropped to slightly over 103 by yearend. Louisiana's immediate economic future is closely tied to oil price movements. Low oil prices will adversely affect the general construction industry. In addition, for every $1 decline in oil prices, State revenue collections are reduced from $45 to $50 million.

Severance tax receipts for 1985, as reported by the Louisiana Department of Revenue, totaled $3.8 million, up from $3.6 million in 1984. Minerals included in the tax were brine ($45,000), gravel ($488,000), salt ($332,000), sand ($658,000), shell ($276,000), stone ($12,000), and sulfur ($2 million). The increase was due basically to an increase in the severance tax on gravel, sand, and shell to $0.06 per short ton that was initiated in August 1984.

Announcement of a $1 billion interstate completion between Lafayette and Shreveport, one of the five largest highway projects in the Nation, would positively impact on construction aggregate producers along the 200-mile section. However, with no major stone operations in the State, crushed stone requirements would be shipped in from surrounding States and possibly foreign sources.

The State's first lignite mine began operations during the year. Lignite was being stockpiled to fuel a 640,000-kilowatt powerplant expected to begin commercial operations in early 1986. The mine, near Mansfield, has a capacity of 2.5 million short tons of lignite per year. The lignite will be transported from the mine to the plant on a 7-1/2-mile-long conveyor system.

The phasedown of lead content in gasoline to 0.5 gram per gallon caused the closure of Ethyl Corp.'s lead antiknock compound plant at Baton Rouge. Ethyl was a major domestic producer of ethylene dibromide, a scavenger in lead antiknock compounds.

During the year, 966,000 short tons of cement and clinker was imported through the Port of New Orleans from Canada, France, Mexico, Spain, and Venezuela, up from 636,000 tons in 1984. Some of the cement was destined for markets as far inland as Minneapolis. Other minerals handled through the Port of New Orleans included coal, ferroalloys, gypsum, limestone, salt, sand, and various nonferrous ores and concentrates.

The port at Burnside handled minerals predominantly during the year. The facilities handled 3.8 million short tons of material during 1985, down from 4.1 million tons in 1984. Minerals handled included alumina, bauxite, cement, chrome, clays, coal, coke, ferrochrome, ferromanganese, ferrosilicon, fluorspar, ilmenite, iron ore, manganese ore, pig iron, rutile, salt, silicomanganese, vanadium slag, vermiculite, and zircon. Major minerals handled were alumina and bauxite. The port at Lake Charles handled barite, cement, and crushed stone.

Table 3.—Indicators of Louisiana business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	4,441	4,461	4,481
Total civilian labor force	do.	1,913	1,941	1,987
Unemployment	percent	11.8	10.0	11.5
Employment (nonagricultural):				
Mining total	thousands	80.7	81.6	81.5
Nonmetallic minerals except fuels	do.	3.2	3.1	3.0
Oil and gas extraction	do.	77.5	78.5	78.5
Manufacturing total	do.	180.1	182.4	178.3
Primary metal industries	do.	3.7	3.6	3.5
Stone, clay, and glass products	do.	7.7	8.1	7.1
Chemicals and allied products	do.	30.3	29.4	28.3
Petroleum and coal products	do.	13.1	13.0	12.5
Construction	do.	115.2	118.3	105.9
Transportation and public utilities	do.	118.2	118.6	115.2
Wholesale and retail trade	do.	369.4	383.6	386.8
Finance, insurance, real estate	do.	82.0	83.9	85.3
Services	do.	304.6	314.5	319.9
Government and government enterprises	do.	315.0	318.6	324.7
Total	do.	1,565.2	1,601.5	[1]1,597.5
Personal income:				
Total	millions	$46,720	$49,173	$50,513
Per capita		$10,521	$11,022	$11,274
Hours and earnings:				
Total average weekly hours, production workers		40.0	41.6	41.7
Mining		46.2	46.9	47.0
Total average hourly earnings, production workers		$9.8	$10.1	$10.4
Mining		$11.3	$11.2	$11.2
Earnings by industry:				
Farm income	millions	$292	$408	$251
Nonfarm	do.	$34,412	$36,167	$36,881
Mining total	do.	$2,712	$2,788	$2,860
Nonmetallic minerals except fuels	do.	$83	$87	$89
Oil and gas extraction	do.	$2,624	$2,693	$2,761
Manufacturing total	do.	$4,998	$5,192	$5,264
Primary metal industries	do.	$117	$111	$105
Stone, clay, and glass products	do.	$172	$187	$160
Chemicals and allied products	do.	$1,162	$1,185	$1,190
Petroleum and coal products	do.	$644	$656	$673
Construction	do.	$3,321	$3,401	$3,085
Transportation and public utilities	do.	$3,260	$3,360	$3,426
Wholesale and retail trade	do.	$5,685	$5,965	$6,039
Finance, insurance, real estate	do.	$1,694	$1,797	$1,967
Services	do.	$6,858	$7,545	$7,921
Government and government enterprises	do.	$5,701	$5,952	$6,249
Construction activity:				
Number of private and public residential units authorized[2]		33,867	28,073	18,766
Value of nonresidential construction[2]	millions	$1,209.5	$1,260.5	$1,226.1
Value of State road contract awards	do.	$390.0	$502.2	$715.0
Shipments of portland and masonry cement to and within the State	thousand short tons	2,564	2,730	2,485
Nonfuel mineral production value:				
Total crude mineral value	millions	$446.8	$511.5	$522.3
Value per capita		$101	$115	$117

[p]Preliminary. [r]Revised.
[1]Data do not add to total shown because of independent rounding.
[2]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

International Minerals & Chemical Corp. (IMC) began a $12 million retrofit program to revamp its 1,150-short-ton-per-day ammonia plant at Sterlington. By 1986, IMC plans to install a new horizontal converter and thus improve CO_2 recovery and heat exchange efficiency.

Along with the ailing Florida phosphate industry, Brewster Phosphates shut down its fertilizer operations at Luling and Geismar.

PPG Industries Inc. announced plans to build a $50 million, 150-megawatt cogeneration unit at its Lake Charles chlor-alkali plant. The facility was scheduled for completion late in 1986. The Dow Chemical Co., a producer of caustic chlorine at Plaquemine, announced plans to build a spare reactor at its coal gasification project. The project, to be completed in 1987, would ensure reliability of the plant, which extracts 30 million British thermal units of gas per day. Occidental Chemical Corp. also announced a $21 million expansion at its caustic soda and chlorine plant at Taft.

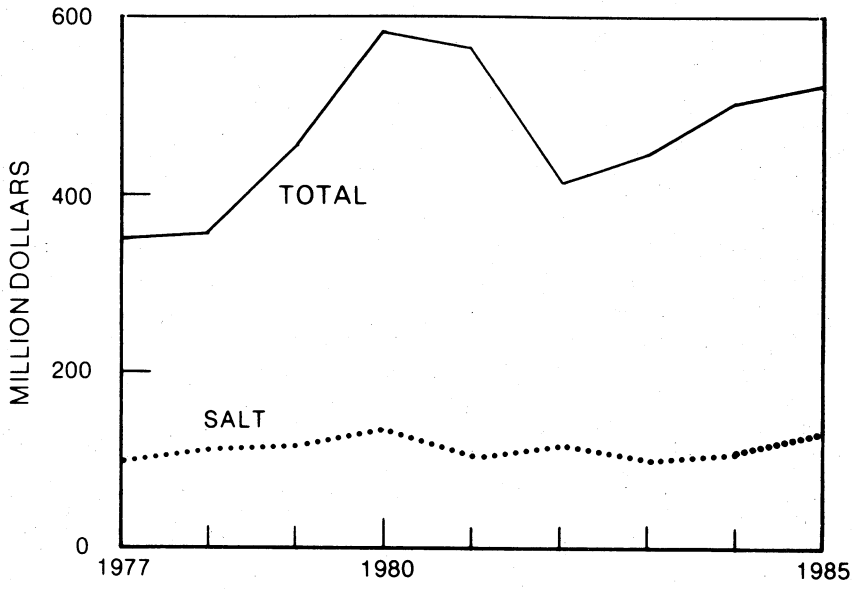

Figure 1.—Value of salt and total value of nonfuel mineral production in Louisiana.

Expansions and/or modifications to production facilities of nonfuel mineral-related industries as announced by the State Department of Commerce were as follows: activated aluminum, 1 expansion ($3 million); anhydrous ammonia, 1 expansion ($3 million); carbon black, 7 expansions ($11.6 million); chemical fertilizer, 1 expansion ($4.3 million); chlorine-caustic soda, 11 expansions ($89.5 million); foundry castings, 1 expansion ($800,000); lime, 1 expansion ($2.5 million); silica products, 1 expansion ($1.9 million); and sulfuric acid, 1 expansion ($3 million).

Employment.—The unemployment rate in Louisiana remained in double figures for the year, increasing from 10% in 1984 to 11.5% in 1985, the second highest unemployment rate in the Nation. Employment in the nonmetallic sector remained relatively stable at about the same level as that of 1984. Construction employment dropped, and that of primary metals decreased slightly, particularly near yearend.

Legislation and Government Programs.—During the year, the State enacted legislation that prohibits treatment, storage, or disposal of any hazardous waste in salt domes or sulfur mines.

The Louisiana Geological Survey (LGS), a nonregulatory branch of the Department of Natural Resources, provided geologic data and/or technical support to regulatory agencies, industry, the general public, and academic researchers. Major activities of the LGS were coastal programs, water resources, energy and mineral resources, and mapping and research.

The coastal program included projects on (1) identification and assessment of subsurface sand deposits, (2) a study of potential impacts of dredging, (3) an assessment of the impacts of land loss rates and coastal erosion, (4) a monitoring program to provide ground truthing for storm impact studies, (5) an assessment of peat deposits, and (6) studies of sedimentology, stratigraphy, and depositional history of the State's Continental Shelf.

The water resources section published a report, "Capital Area Recharge Region Study Based on Geologic and Hydrologic Studies in Southwestern Mississippi and Southeastern Louisiana," which included the Capital Area Recharge Map.

The energy and mineral resources section continued its research on coal resources and enhanced gas recovery.

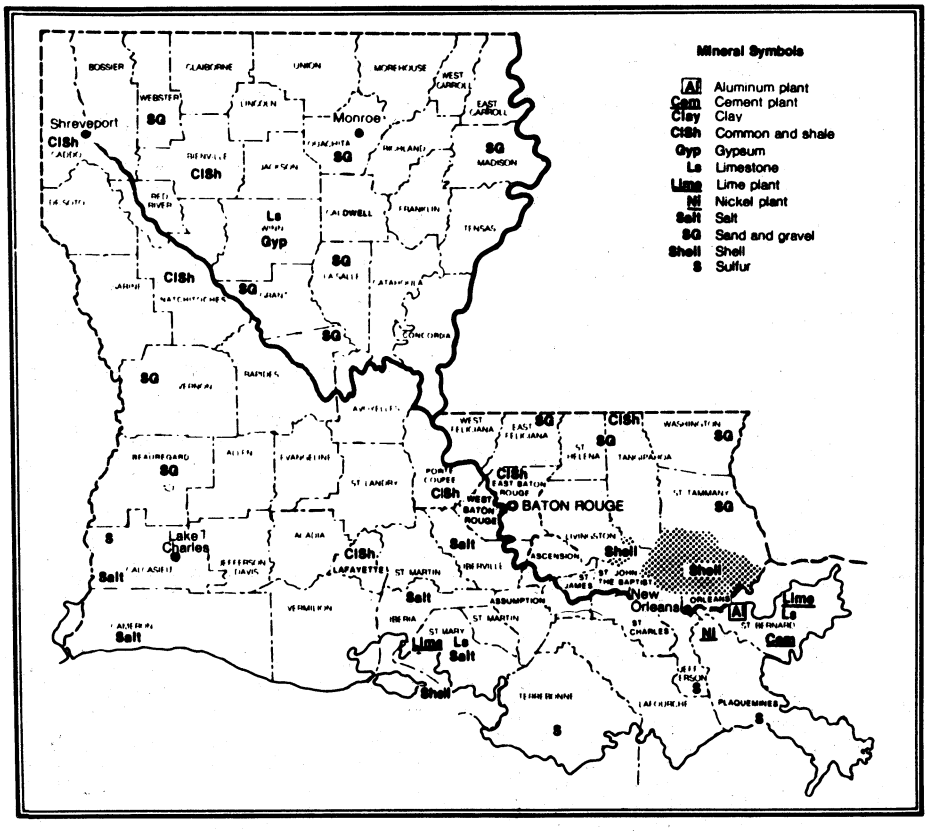

Figure 2.—Principal mineral producing localities in Louisiana.

The mapping and research section conducted projects on gulf coast stratigraphic correlation charts, assisted the U.S. Geological Survey on its Quaternary Geologic Map, and performed stratigraphic, sedimentological, and engineering studies of the Wilcox Group.

The Mineral Resources Institute of the Louisiana State University received a grant of $147,000 from the U.S. Bureau of Mines under title III of Public Law 95-87, designed to encourage the training of mining engineers and other scientists involved in mineral-related studies. Research was conducted on the following areas of mining and mineral resources in the State that had a demonstrated need: minerals extraction; minerals processing; economic, legal, and business-related questions; and environmentally related research. The institute sponsored 47 research projects as follows: extraction, 16 projects; processing, 15 projects; economic, legal, and business, 5 projects; and environmental, 11 projects. The majority were energy related with other studies involving general geology and sand resource utilization.

The U.S. Bureau of Mines published several reports of interest to the mining industry of the State. Two Information Circulars (IC), IC 9008, "Analysis of Dredge Safety Hazards," and IC 9030, "Design and Operation of Four Prototype Fire Detection Systems in Noncoal Underground Mines," were of interest to the dredging and salt mining industries. In addition, Report of Investigation 8971, "Measurement of Air Velocity in Mines." was also published. The Cote Blanche Mine became the second gulf coast salt mine to adopt the Bureau's Metrologger Acoustic Monitoring System for detecting methane-rich zones of salt. The system assesses the methane content of a salt sample, allowing mine crews to be alerted to the outburst hazard posed by methane-rich areas.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Barite.—Imported and domestic barite was crushed and ground at 10 plants in Louisiana for use in oil and gas drilling; output decreased from that of 1984, along with unit values. Slightly more than 218,000 short tons of barite ore was imported through the port at Lake Charles; the major portion imported was from China. Demand in the drilling mud market remained at a relatively low level. The Dowell Schlumberger Co. sold its plant in Amelia to DL Mud Co., which leased it to the Hughes Drilling Fluids Co.

Calcium Chloride (Synthetic).—Texas United Chemical Corp. produced synthetic calcium chloride using hydrochloric acid and limestone at its plant in Lake Charles. Production and value decreased, along with a decrease in unit values. Synthetic calcium chloride was used in concrete-set acceleration, dust control, oil and gas drilling, road deicing, and other uses.

Cement.—Output of portland cement decreased over 14% while that of masonry cement increased slightly. The decrease in demand occurred as construction activities remained low throughout the year. Major uses for portland cement were ready-mixed concrete, concrete products, building materials, and highway construction. Prices of portland cement increased slightly while that of masonry cement remained stable. At the beginning of 1985, Lone Star Industries Inc. operated a facility in New Orleans that included two wet-process kilns. The majority of output was portland cement with a small amount of masonry cement. Raw materials for the 750,000-short-ton-per-year plant were received at Lone Star's bulk handling dock on the Michoud Canal near the plant. In 1985, aragonite was imported from the Bahamas, coal was received from domestic mines, and gypsum was imported from Jamaica. Other raw materials included clays, iron ore, limestone, and sand. The Lone Star cement plant, which was closed during the year, remained closed at year-end.

Clays.—Louisiana's clay industry produced only common clay with output decreasing substantially. Bentonite mining ceased in 1984 because of problems associated with clay suitability; the bentonite had been shipped to Jackson, MS, to produce acid-activated clays. Common clay was mined by six companies at eight mines in six parishes. The major end use of common clay was in the manufacture of lightweight aggregates for use in concrete block and structural concrete. The common clay market, tied closely to construction activities, decreased as construction dropped during 1985. The tonnage of clay used in brick manufacture decreased from that of 1984. The average price of common clay increased from $20.13 per short ton in 1984 to $21.03 per ton in 1985.

Table 4.—Louisiana: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1981[1]	380	6,338
1982	326	[1]6,216
1983	[1]505	10,793
1984	547	[1]10,858
1985	334	7,017

[1]Excludes bentonite.

Fluorspar.—Agrico Chemical Co., Donaldsville, and Freeport Chemical Co., Uncle Sam, operated fluosilicic acid facilities during the year.

Gypsum.—Winn Rock Inc. mined anhydrite at its quarry near Winnfield, Winn Parish. Output decreased substantially from that of 1984. National Gypsum Co., Jefferson Parish, and USG Corp., Orleans Parish, produced calcined gypsum from crude material shipped into the State. Calcined gypsum output decreased slightly while value increased over that of 1984.

Lime.—Production of lime remained stable as markets remained weak for the third straight year; output remained at its lowest level in over 10 years. Quicklime output decreased slightly as hydrated lime output increased. USG produced both quicklime and hydrated lime from shells at its facility in New Orleans, while S. I. Lime Co. received quicklime from Kentucky and converted it to hydrated lime at its plant in Amelia. Output was used in water purification and softening, road stabilization, petrochemicals, and oil and grease. Dravo Lime Co. was constructing a hydrator and storage facilities in Baton Rouge. The $2.5 million facility was scheduled for completion in 1986. Raw materials will be shipped in from Alabama and Kentucky.

Nitrogen.—The total annual capacity of anhydrous ammonia in Louisiana was

about 7.1 million short tons or nearly 41% of the national capacity. Of the 43 domestic producers of anhydrous ammonia, 14 operated facilities in the State. Jupiter Chemical Co. announced a $3 million expansion program at its Westlake facilities.

Perlite (Expanded).—Crude perlite was expanded by Filter-Media Co. Inc. of Louisiana from material shipped into the State at its facilities in Reserve, St. John the Baptist Parish. Output sold or used increased over that of 1984; expanded perlite was used as a filter aid, for insulation, and in concrete aggregate.

Salt.—Louisiana remained the leading salt producing State in the Nation with approximately one-third of the Nation's output. Production decreased 5.9% while value increased 23.9% compared with that of 1984, indicating an increase in unit prices. Eleven companies recovered salt at 12 operations in 10 parishes. Five were underground mines with the remaining being solution mines. The Louisiana Department of Revenue reported that nearly $400,000 was received in severance taxes from 14.5 million short tons of salt and brine production.

Markets for salt appeared to be solid as several companies producing caustic chemicals and chlorine announced expansion plans in 1985. Chlorine, caustic soda, and soda ash were the largest domestic markets for salt using over one-half of the Nation's output.

Morton Thiokol Inc. closed its chemical herbicide plant at Weeks Island during the year because of a liability problem. The facility used methyl isocyanate (MIC) in the production of herbicides, and users of MIC were considered responsible during transit of the material. Morton closed the facility rather than assume liability for MIC during transit.

Cargill Inc. intentionally flooded its Belle Isle salt mine to eliminate the potential danger of collapse. The mine was closed in 1984 because studies indicated weaknesses in the salt dome's structural integrity.

Sand and Gravel.—Louisiana produced both construction and industrial sand and gravel in 1985. Estimated total output of sand and gravel decreased from that of 1984.

Construction.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

According to estimates, production of construction sand and gravel had not recovered from the decline that started in 1977. Many operations maintained production intermittently during the year, depending on proximity and type of construction activities. Most pits were relatively small with no individual pit producing over 1.5 million short tons. In 1984, production was from 95 operations by 65 companies in 24 parishes. Leading parishes in 1984 were St. Helena, St. Tammany, East Baton Rouge, and Webster.

Industrial.—Three companies produced industrial sand from four parishes with output remaining about the same as that of 1984; unit prices increased slightly. Primary markets were in the glass and foundry industries, which remained depressed. Ottawa Silica Co., with an operation in northern Louisiana, announced signing a letter of intent to be acquired by Energy & Materials Inc. (EMI) of New Jersey. Ottawa was the third largest producer of industrial silica sand, while EMI was the fourth largest producer of industrial sand.

Stone (Crushed).—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend. Louisiana Department of Revenue severance tax records indicate nearly 5 million short tons of crushed stone was mined. Shell dredgers paid a royalty to the State of nearly $0.34 per cubic yard.

Reported production of crushed stone to the U.S. Bureau of Mines in 1985 increased over that estimated for 1984; unit prices also increased. Shell accounted for more than 90% of the State's total crushed stone output and nearly two-thirds of the national output of shell. Three companies produced shell in Orleans and St. Mary Parishes at seven operations. Anhydrite was mined at one quarry in Winn Parish. Crushed stone was used primarily for coarse and fine aggregates, cement manufacture, and lime manufacture; anhydrite was used basically as a road base.

Environmental opposition continued against dredging in coastal Louisiana and Lake Pontchartrain. Environmental groups expressed concern that shell dredging was irreversibly damaging lake bottoms and stirring up sediment that was endangering underwater life. A direct appeal to the Governor to halt dredging was denied on

the basis that the Governor could not circumvent the authority of the legislature. The legislature by resolution called on the House and Senate Natural Resource Committees to function as a joint legislative panel to investigate the shell dredging industry. The committee planned to review the effect the industry had on the environment and the revenue paid to the State. The study was to be finished before the legislature convenes in April 1986.

Sulfur.—Louisiana ranked second nationally in output of Frasch sulfur and fifth in recovered elemental sulfur. In terms of value, sulfur remained the State's leading nonfuel mineral. Frasch sulfur shipments decreased while production increased slightly. Output remained at a relatively low level because of the weakened demand for phosphate fertilizer. Freeport Minerals Co., with Frasch facilities in Jefferson and Plaquemines Parishes, operated at reduced levels to match weak market demands. Freeport Minerals continued with plans to reopen its offshore mine in Caminada Pass. The facility would add 600,000 long tons per year of capacity with reopening scheduled for mid-1987, subject to market conditions.

Nine oil companies recovered elemental sulfur from nine refineries in seven parishes. Output was 405,000 metric tons valued at $45.1 million, compared with 319,926 tons valued at $29.9 million in 1984.

Table 5.—Louisiana: Sulfur produced and shipped from Frasch mines

(Thousand metric tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1981	2,440	2,235	W
1982	1,312	1,239	W
1983	1,286	1,643	W
1984	1,937	2,007	W
1985	2,071	1,698	W

W Withheld to avoid disclosing company proprietary data.

Vermiculite (Exfoliated).—Vermiculite was exfoliated by W. R. Grace & Co. at its plant in New Orleans; output decreased. Principal end uses were in concrete and plaster aggregates, horticulture, loose fill insulation, and block insulation.

METALS

Aluminum.—Louisiana remained 1 of 17 States capable of producing aluminum, with no reported production in 1985. Reduced demand and lower prices have prevented Kaiser Aluminum & Chemical Corp. from reopening its Chalmette aluminum smelter. Kaiser took a $160 million write-down covering the value of its idled Baton Rouge alumina refinery but maintained its alumina plant at Gramercy where it produced various alumina chemicals. The Aluminum Co. of America's (Alcoa) chemical plant at Videlia operated at capacity following an expansion in capacity of 20%. Alcoa produced various activated alumina catalyst substrates and raw materials for the catalyst industry.

Ormet Corp., citing high production costs, ceased production in December at its Burnside alumina refinery. The company will purchase material on the open market. Both Consolidated Aluminum Corp. and Revere Copper and Brass Inc., partners in the venture, indicated their interests were for sale. Ormet's Burnside refinery has been operating at a reduced rate prior to its shutdown.

Iron and Steel.—Bayou Steel Corp. operated its minimill at LaPlace at reduced levels during the year but started up its second furnace in the third quarter. The facility has a raw steel capacity of 650,000 short tons per year and a finished product capacity of 450,000 tons per year. The plant was adversely impacted overseas by the rising dollar and suffered losses totaling $153 million since its startup in 1982. Late in the year, the facility was sold to RSR Corp. of Dallas, TX. Bayou was supplying LTV Co. in Pennsylvania with up to 200,000 tons of semifinished product. In addition to producing light bars and sections, the plant produced forging billets and heavy bars.

Iron and steel foundries constituted only a small part of the mineral industry in Louisiana. Raw materials included coal, limestone, sand, and scrap, nearly all from sources in the Southeast. According to the Directory of Louisiana Manufacturers, 12 gray iron foundries, 6 steel foundries, and 1

malleable iron foundry operated in the State. Only 8 employed more than 100 people.

Nickel.—AMAX Inc.'s Port Nickel nickel refinery in Braithwaite was shut down in November, leaving the Nation with no primary nickel or cobalt refining capacity. The plant operated below capacity prior to the shutdown. The nickel-cobalt matte feedstock purchased by AMAX from Agnew Mining Co. Pty. Ltd. in Australia was to be resold to Sherritt Gordon Mines Ltd. in Canada and to Outokumpu Oy in Finland. AMAX released Bamangwato Concessions Ltd. (BCL) from its contract to supply AMAX with the majority of nickel matte for the refinery. The refinery had received about 60% of its matte from BCL and 40% from Agnew. Late in the year, AMAX initiated a pilot program on its process to recover nickel from spent petroleum catalysts. The process yielded a nickel-cobalt sulfate that could be sold without further processing or processed in pure metal.

[1]State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.
[2]State geologist, Louisiana Geological Survey, Baton Rouge, LA.

Table 6.—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	Box 12449 Dallas, TX 75225	do	Orleans.
Clays:			
Athens Brick Co. Inc	Box 70 Athens, TX 75751	Mines and plant	Caddo.
Big River Industries Inc	Box 66377 Baton Rouge, LA 70806	Mine and plant	Pointe Coupee.
Kentwood Brick & Tile Manufacturing Co. Inc.	Drawer F Kentwood, LA 70444	do	St. Helena.
Gypsum:			
National Gypsum Co	Box 128 Westwego, LA 70094	Plant	Jefferson.
USG Corp	101 South Wacker Dr. Chicago, IL 60606	do	Orleans.
Winn Rock Inc	Box 790 Winnfield, LA 71483	Quarry	Winn.
Lime:			
S. I. Lime Co., Pelican State Lime Div	3 Riverchase Office Plaza Suite 204 Birmingham, AL 35244	Plant	St. Mary.
USG Corp	101 South Wacker Dr. Chicago, IL 60606	do	Orleans.
Salt:			
Domtar Chemicals Inc., Shifto Salt Div	4825 North Scott Shiller Park, IL 60176	Underground mine	St. Mary.
The Dow Chemical Co	Midland, MI 48640	Brine wells	Iberville.
International Salt Co	Clarks Summit, PA 18411	Underground mine	Iberia.
Morton Salt Co	110 North Wacker Dr. Chicago, IL 60606	do	Do.
PPG Industries Inc	Box 1000 Lake Charles, LA 70604	Brine wells	Calcasieu.
Sand and gravel (1984):			
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	Dredges and plants	St. Tammany and Washington.
Texas Industries Inc	Box 5472 Alexandria, LA 71301	Dredges, pits, plants.	Beauregard, Grant, La Salle, Ouachita, Rapides, St. Tammany.
Stone (crushed):			
Winn Rock Inc	Box 790 Winnfield, LA 71483	Quarry and plant	Winn.
Shell:			
Louisiana Materials Co	Box 8214 New Orleans, LA 70182	Dredge	Orleans.
Pontchartrain Dredging Corp	Box 8005 New Orleans, LA 70182	do	Do.
Radcliff Materials Inc	Box 151 Morgan City, LA 70381	Dredges	Orleans and St. Mary.
Sulfur:			
Native:			
Freeport Minerals Co	200 Park Ave. New York, NY 10166	Frasch process	Jefferson and Plaquemines.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	Parish
Sulfur —Continued			
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 was about $41 million in 1985 and increased for the third consecutive year. Maine's $3.2 million gain in value in 1985 was primarily due to cement production. Cement shipments increased approximately 25% as a result of strong demand from the construction industry.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	43	$97	50	$100
Gem stones	NA	400	NA	400
Sand and gravel (construction) thousand short tons	7,885	19,228	e7,200	e18,000
Stone (crushed) do	e1,300	e4,400	1,459	5,114
Combined value of cement, garnet (abrasive), peat (1984), and stone (dimension)	XX	13,814	XX	17,494
Total	XX	37,939	XX	41,108

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

Table 2.—Nonfuel minerals produced in Maine in 1984, by county

County	Minerals produced in order of value
Androscoggin	Sand and gravel, clays.
Aroostook	Sand and gravel.
Cumberland	Sand and gravel, clays.
Franklin	Sand and gravel, garnet (abrasive).
Hancock	Sand and gravel.
Kennebec	Do.
Knox	Cement, sand and gravel.
Lincoln	Sand and gravel.
Oxford	Do.
Penobscot	Do.
Piscataquis	Do.
Sagadahoc	Do.
Somerset	Do.
Waldo	Do.
Washington	Peat, sand and gravel.
York	Sand and gravel, peat.
Undistributed[1]	Stone (crushed and dimension), gem stones.

[1]Data not available by county for minerals listed.

Table 3.—Indicators of Maine business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	1,145	1,156	1,164
Total civilian labor force	do	537	551	550
Unemployment	percent	9.0	6.1	5.4
Employment (nonagricultural):				
Mining total	thousands	0.2	0.2	0.1
Manufacturing total	do	109.2	110.6	106.2
Stone, clay, and glass products[1]	do	1.0	1.0	1.3
Chemicals and allied products[1]	do	.9	.9	.9
Construction	do	16.9	20.4	23.0
Transportation and public utilities	do	18.4	19.1	19.3
Wholesale and retail trade	do	94.5	101.3	108.4
Finance, insurance, real estate	do	18.1	19.6	20.9
Services	do	84.6	90.6	95.3
Government and government enterprises	do	83.1	83.9	85.9
Total	do	425.0	445.7	459.1
Personal income:				
Total	millions	$11,798	$12,980	$13,835
Per capita		$10,304	$11,228	$11,887
Hours and earnings:				
Total average weekly hours, production workers		39.9	39.9	40.0
Total average hourly earnings, production workers		$7.6	$8.0	$8.4
Earnings by industry:				
Farm income	millions	$69	$98	$60
Nonfarm	do	$8,044	$8,852	$9,500
Mining total	do	$22	$30	$27
Manufacturing total	do	$2,220	$2,391	$2,396
Stone, clay, and glass products	do	$19	$21	$29
Chemicals and allied products	do	$22	$23	$23
Construction	do	$480	$607	$682
Transportation and public utilities	do	$505	$558	$581
Wholesale and retail trade	do	$1,300	$1,430	$1,585
Finance, insurance, real estate	do	$344	$376	$451
Services	do	$1,523	$1,732	$1,918
Government and government enterprises	do	$1,539	$1,648	$1,781
Construction activity:				
Number of private and public residential units authorized[2]		4,174	6,570	8,113
Value of nonresidential construction[2]	millions	$184.6	$166.9	$300.5
Value of State road contract awards	do	$45.8	$72.0	$73.0
Shipments of portland and masonry cement to and within the State	thousand short tons	231	275	293
Nonfuel mineral production value:				
Total crude mineral value	millions	$26.4	$37.9	$41.1
Value per capita		$23	$33	$35

[p]Preliminary. [r]Revised.
[1]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

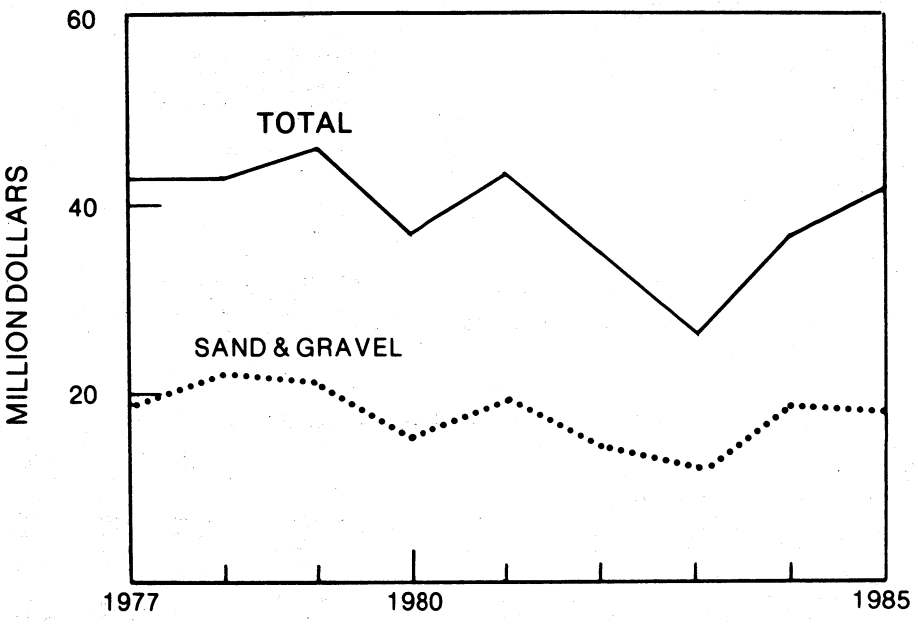

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Maine.

Exploration Activities.—Late in the year, Chevron Resources Co. acquired Getty Mining Co.'s interest in the copper-gold-lead-silver-zinc deposit at Mount Chase in Penobscot County. Getty discovered the deposit in 1984, but work was curtailed by its parent company, Texaco Inc., which intended to divest its Getty subsidiaries. Chevron also continued exploration in the area surrounding the Bald Mountain deposit in Aroostook County.

The Penobscot Indian Nation continued its Mining and Minerals Program to assess the mineral potential of 145,000 acres of Penobscot Nation and Passamaquoddy Tribe Trust Lands. J. S. Cummings Inc. continued as a consultant to the program.

Noranda Exploration Inc. continued base and precious metals exploration in central Somerset and northern Franklin Counties. Noranda also conducted a statewide mineral reconnaissance program.

Other companies involved in exploration in 1985 included Appalachian Resources Inc., F. M. Beck Inc., FMC Corp., North American Exploration Inc., and Scintilore Exploration Ltd.

Cobalt reserves in Maine at Crawford Pond, Knox County, were identified in a U.S. Bureau of Mines report on cobalt availability.[4]

Legislation and Government Programs.—The 1985 Maine Legislature enacted Legislative Document 1466, Public Law, chapter 201, "An Act To Clarify Certain Aspects of Mineral Exploration, Development, and Disclosure." Subchapter III of the law, "Mining on State Lands," covers exploration, staking claims, and mining on State-owned land. Subchapter IV of the law, "Information on Mining Exploration," specifies requirements for registration of persons or companies conducting mineral exploration in Maine, and for filing and publication of notice of intent to file for site location development permits.

The Maine Geological Survey (MGS) continued a study on the economic potential of mining minerals from the ocean bottom along the coast in a 5-year research project with the U.S. Minerals Management Service. Preliminary investigations in the second year of the project identified deposits of copper, gold, nickel, and scandium.

The MGS also participated in the U.S. Geological Survey (USGS) Cooperative Geologic Mapping Project (COGEOMAP), conducting bedrock mapping in the Calais

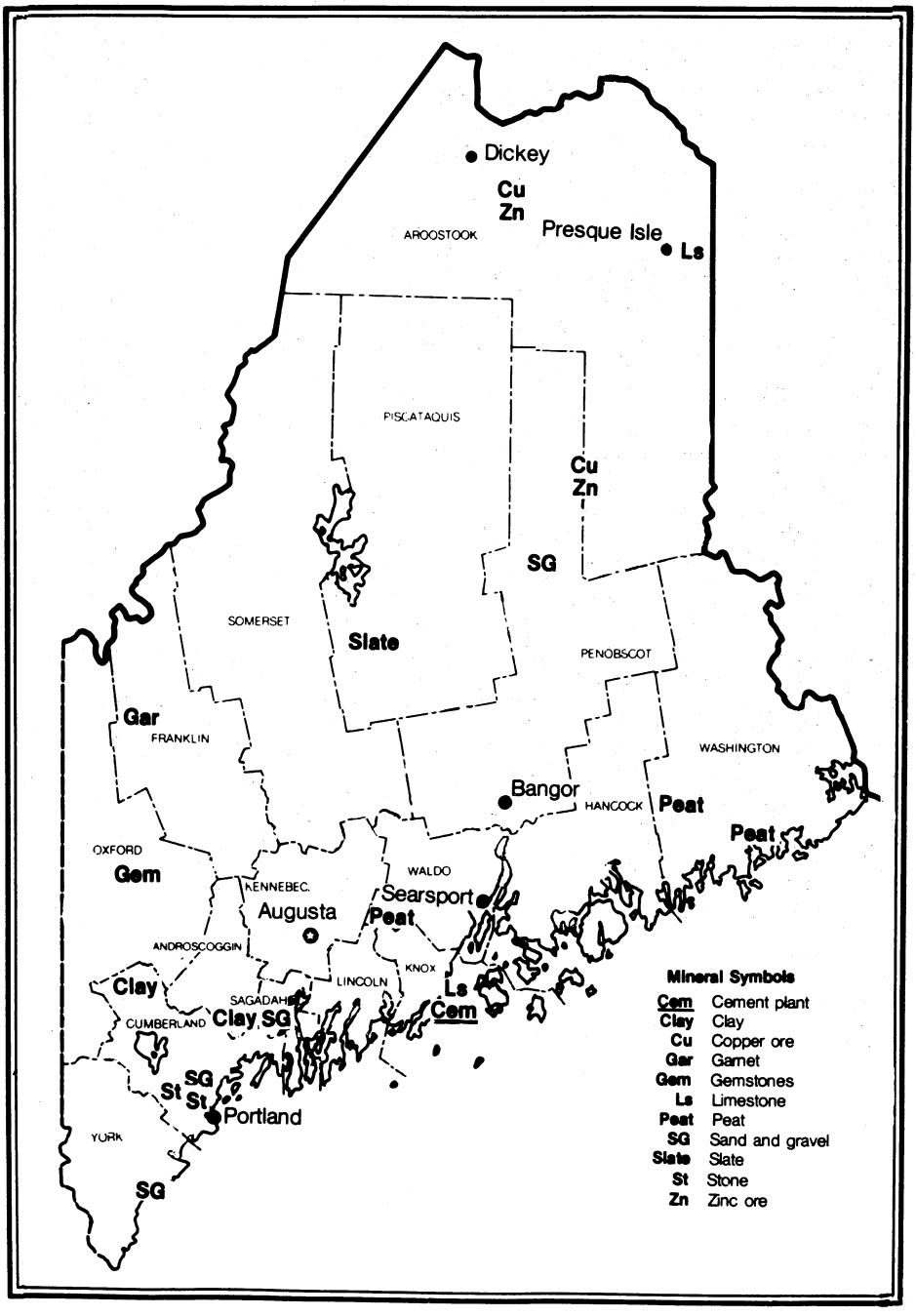

Figure 2.—Principal mineral producing localities in Maine.

15-minute Quadrangle in eastern Maine. Other bedrock mapping projects focused on other Presilurian areas in northern and eastern parts of the State; stratigraphy and structure of mid-coastal Maine; and plutonic rocks in Penobscot Bay. Work also continued on Pleistocene-Recent crustal movements in the coastal zone as part of an investigation for the U.S. Nuclear Regulatory Commission. The MGS continued an update and expansion of the existing USGS Mineral Resources Data System (MRDS) file for the State of Maine. MRDS is a computerized mineral data storage and analysis system. A report on mineral production in Maine from 1906 to 1977 was published in connection with the Conterminous United States Mineral Appraisal Program of the USGS.[5] The report identified value of mineral production by county for guidance in long-range land use planning.

Two new State geologic maps were published in 1985. The new full-color maps, both at a scale of 1:500,000, show the bedrock and surficial geology of Maine.

Additional information on publications and MGS projects may be obtained from the Maine Geological Survey, State House Station No. 22, Augusta, ME 04333, telephone 207-289-2801.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Cement.—Portland and masonry cement were produced at the Dragon Cement Co. plant in Thomaston, Knox County. A strong market in Portland, Maine's fastest growing city, and throughout the Northeast generated the demand for full-capacity production (individual company data is proprietary). The plant was New England's only cement manufacturing operation.

Clays.—Morin Brick Co. mined clay in Androscoggin and Cumberland Counties for use in brick manufacture.

Garnet.—Industrial Garnet Extractives Inc. (IGE), West Paris, was one of three companies producing garnet in the United States. Total domestic output increased 24% in 1985, whereas IGE's output increased 61% compared with 1984 production (State and individual company data are proprietary). Increased output by IGE paralleled the strong demand for garnet used in sandblasting and water filtration.

Gem Stones.—Pink tourmaline (rubellite) associated with lavender and purple apatite was mined at the Mount Rubellite Quarry near Hebron, Oxford County. The curator of minerals at the Harvard University Museum termed the discovery the most significant in Maine since the discovery of gem-quality tourmaline in Newry in 1972 in which hundreds of thousands of dollars of gem stones were recovered.[6] At Newry in 1973, a foot-long tourmaline crystal called the "Jolly Green Giant," was found and subsequently displayed at the Smithsonian Institution in Washington, DC.

Peat.—No peat production was reported in 1985. Down East Peat Co., the State's leading producer in 1984, sold peat stockpiled in 1983. Down East also continued to arrange financing for construction of a $20 million, peat-fired electrical generating plant in Deblois, Washington County. A fire at the site indefinitely delayed plans that originally called for the generating station to be in operation in 1986.

Sand and Gravel (Construction).—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

The estimated output of construction sand and gravel declined slightly compared with the 1984 total.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—State production increased 12%, primarily because of an increase in demand for limestone used in cement manufacture. Types of stone quarried, in descending order of output, were limestone, traprock, sandstone, and marl. The counties of Cumberland, Knox, and Penobscot accounted for 86% of the State's production. Leading uses for crushed stone, in addition to cement manufacture, were for concrete aggregate and railroad ballast. Unit prices (f.o.b. plant) ranged from $1.39 for road base to $6.18 for riprap, with the average price of $3.82.

Table 4.—Maine: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate, graded: Concrete aggregate, coarse	285	776
Combined coarse and fine aggregates: Other construction[2]	391	1,342
Special: Other miscellaneous[3]	784	2,996
Total	[4]1,459	5,114

[1]Includes limestone, marl, sandstone, and traprock.
[2]Includes stone used in bituminous aggregate (coarse), graded road base or subbase, bituminous surface-treatment aggregate, riprap and jetty stone, railroad ballast, stone sand (concrete), stone sand (bituminous mix or seal), and fine aggregate.
[3]Includes stone used in cement manufacture, poultry grit and mineral food, production reported without a breakdown by end use, and estimates for nonrespondents.
[4]Data do not add to total shown because of independent rounding.

Dimension.—New England Stone Industries Inc. quarried dimension granite at Crotch Island, Hancock County. Late in the year, New England Stone purchased a dormant building in Stonnington and planned to use it for finishing granite blocks. The firm, if successful in arranging $3 million in financing, was expected to purchase European machinery for the finishing operation. By finishing the granite near the quarry, New England Stone anticipated increasing output threefold. In 1985, the granite was shipped to the company's finishing mill in Smithfield, RI.

[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.
[2]State geologist and director, Maine Geological Survey, Augusta, ME.
[3]Geologist, Maine Geological Survey, Augusta, ME.
[4]Mishra, C. P., C. D. Sheng-Fogg, R. G. Christiansen, J. F. Lemons, Jr., and D. L. Giacomo. Cobalt Availability—Market Economy Counties, A Minerals Availability Program Appraisal. BuMines IC 9012, 1985, 33 pp.
[5]Bawiec, W. J. Mineral Production of Maine From 1906-1977—Diversity, Magnitude, and Spatial Distribution of Commodities. Northeast. Geol., v. 7, No. 2, 1985, pp. 26-40.
[6]Bridgton (ME) News. Rare Minerals Discovered at Hebron Quarry. Oct. 17, 1985, p. 3.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Dragon Cement Co.[1]	Box 191 Thomaston, ME 04861	Quarry and plant	Knox.
Clays:			
Morin Brick Co	Mosher Rd. Gorham, ME 04038	Pits and mills	Androscoggin and Cumberland.
Garnet:			
Industrial Garnet Extractives Inc	Box 56A West Paris, ME 04289	Mill	Oxford.
		Quarry	Franklin.
Perlite (expanded):			
Grefco Inc	Box 177 Thomaston, ME 04861	Plant	Knox.
Sand and gravel (construction):			
Harry C. Crooker & Sons Inc	R.F.D. 4, Old Bath Rd. Brunswick, ME 04011	Pits and plants	Lincoln and Sagadahoc.
Dragon Products Co	Box 191 Thomaston, ME 04861	do	Androscoggin, Franklin, Hancock, Somerset.
R. J. Grondin & Son	Rural Route 4, Box 65 Gorham, ME 04038	Pits	Cumberland and York.
Lane Construction Corp.[1]	Box 627 Presque Isle, ME 04769	do	Aroostook, Penobscot, Waldo, Washington.
Madawaska Brick & Block Co	R.D. 1, Box 250 Madawaska, ME 04765	Pit and plant	Aroostook.
Maine Department of Transportation.	Augusta, ME 04333	Pits and plants	Androscoggin, Aroostook, Franklin, Hancock, Kennebec, Knox, Lincoln, Oxford, Penobscot, Piscataquis, Sagadahoc, Waldo, Washington.
Portland Sand & Gravel Co. Inc	Gray Rd. Cumberland, ME 04021	Pit and plant	Cumberland.
Tilcon Inc	Box 209 Fairfield, ME 04937	Pits and plants	Cumberland, Somerset, York.
Stone:			
Crushed:			
Blue Rock Industries	58 Main St. Westbrook, ME 04092	Quarries and mill	Cumberland and Kennebec.
The Cook Concrete Co	960 Ocean Ave. Portland, ME 04103	Quarry and mill	Cumberland.
Dragon Products Co	Box 191 Thomaston, ME 04861	Quarries	Knox.
Lane Construction Corp	Box 103 Bangor, ME 04401	do	Aroostook and Penobscot.
Dimension:			
Maine-New Hampshire Granite Corp.	Box 207 Milford, NH 03055	Quarry	Washington.
New England Stone Industries Inc.	Providence Pike Smithfield, RI 02917	do	Hancock.

[1]Also stone.

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By William A. Bonin[1]

Maryland's 1985 nonfuel mineral production was valued at $258.3 million. This $16.6 million increase over 1984 values was almost 30% over that of 1983, the former record-high year. The leading commodities in terms of value were stone, cement, and sand and gravel.

Water-granulated iron slag was processed for slag cement; expanded iron slag was crushed for lightweight concrete aggregate; and air-cooled iron slag and steel slag were used as substitutes for natural construction aggregate and as road base and fill material. Imported crude gypsum was calcined for manufacturing wallboard, and vermiculite shipments were exfoliated for insulation fills. Alumina and iron ore concentrate were shipped into the State for the production of metals. Titanium dioxide pigments were also manufactured.

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

Mineral		1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
Clays[2]	thousand short tons	347	$1,484	336	$1,647
Gem stones		NA	2	NA	2
Lime	thousand short tons	7	419	10	608
Peat	do	5	W	W	W
Sand and gravel (construction)	do	14,234	46,671	e17,000	e58,000
Stone:					
Crushed	do	e22,100	e94,000	24,406	98,584
Dimension	do	e17	e864	18	1,218
Combined value of cement, clays (ball clay), sand and gravel (industrial), and values indicated by symbol W		XX	98,261	XX	98,215
Total		XX	241,701	XX	258,274

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

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

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

Table 2.—Nonfuel minerals produced in Maryland in 1984, by county[1]

County	Minerals produced in order of value
Anne Arundel	Sand and gravel (construction).
Baltimore	Sand and gravel (construction), clays.
Calvert	Sand and gravel (construction).
Caroline	Do.
Carroll	Cement, clays.
Cecil	Sand and gravel (construction).
Charles	Do.
Dorchester	Do.
Frederick	Cement, clays, sand and gravel (construction), lime.
Garrett	Peat, sand and gravel (construction).
Harford	Sand and gravel (construction and industrial).
Kent	Clays.
Prince Georges	Sand and gravel (construction), clays.
Queen Annes	Sand and gravel (construction).
St. Marys	Do.
Somerset	Do.
Talbot	Do.
Washington	Cement, clays.
Wicomico	Sand and gravel (construction).
Worcester	Do.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Legislation and Government Programs.—Chapter 335 of the Session Laws of 1985 was, particularly to the State's sand and gravel producers, the most important legislation signed by the Governor. The law, entitled "Mineral Resources—Local Comprehensive Plans," required a county or municipal corporation to include in its comprehensive zoning plan, a mineral resources plan element to identify land that should be maintained for mining use, and to recommend and prepare for postmining use of the land. These requirements were also made applicable in chartered home-rule counties. To assist counties and municipalities in implementing this law, the Maryland Geological Survey (MGS) had available "Land for Potential Resource Development" maps to a scale of 1:62,500 for 12 of the State's 23 counties: Allegany and Garrett, excluding coal; Anne Arundel; Baltimore County and City; Carroll; Cecil; Frederick; Harford; Howard; Montgomery; Prince Georges; and Washington. The sand and gravel resources of Calvert, Charles, and St. Marys Counties, mapped in 1985, would be published in 1986. Other than the scheduled mapping of Wicomico County for this purpose, no order of priority for mapping the Eastern Shore had been established at yearend. Also, significant to the State's extractive industries was House bill 1654, the so-called Cecil County Sand and Gravel Tax. Though specific to a single county and one mineral commodity, the implications were far reaching. The bill, which died in committee, would have permitted the governing body of Cecil County to impose a tax not to exceed 5 cents per ton on the mining of sand and gravel in Cecil County, to adapt necessary regulations, and to define certain terms relating to sand and gravel mining.

Two pieces of legislation affecting Maryland's coal industry were House bill 466/Senate bill 220, the Steep Slope Mining Bill, which was vetoed by the Governor, and House bill 1553/Senate bill 760, which was withdrawn in the House and failed to get out of committee in the Senate. The Steep Slope Mining Bill would have repealed a provision of law that prohibits the Maryland Bureau of Mines from issuing an open pit or strip mining permit on slopes of 20° or more, subject to certain conditions. Maryland was the only State among the 26 coal producing States that banned steep slope mining. House bill 1553/Senate bill 760 would have permitted development of a 357-mile-long coal slurry pipeline across the State and would have given to western Maryland coal shippers unrestricted access to the pipeline to boost Maryland's shipments.

Also, in 1985, as part of its Chesapeake Bay initiative, Maryland took over sediment control enforcement for areas in the State that had not demonstrated an acceptable program of their own. In a somewhat related matter, a bill banning the sale and use of phosphate-containing detergent was passed by the Maryland Legislature during the final hour of the 1985 session and signed by the Governor. Phosphate was a nutrient blamed for many of the problems of an overenriched Potomac River and Chesapeake Bay.

The MGS, an agency of the State's Department of Natural Resources, conducted applied research in the fields of geology, water resources, and archeology. In State fiscal year 1985, MGS expenditures were $2.5 million, an increase of about 30% over that of the prior 2 years. Mineral resource aspects of the MGS in 1985 included progress on five quadrangle geologic maps and completion of fieldwork on two others. Also, a COGEOMAP project was initiated in Charles County with the U.S. Geological Survey preparing the geologic base map and the MGS preparing mineral resources and geologic factors affecting land modification. In cooperation with the Minerals Management Service, the MGS continued framework evaluation of the State's inner Continental Shelf.

Table 3.—Indicators of Maryland business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	4,301	4,349	4,392
Total civilian labor force	do.	2,203	2,243	2,253
Unemployment	percent	6.9	5.4	4.6
Employment (nonagricultural):				
Mining total[1]	thousands	1.9	1.7	1.7
Coal mining[2]	do.	1.0	.9	.8
Manufacturing total	do.	214.1	219.4	217.1
Primary metal industries	do.	21.0	18.9	15.8
Stone, clay, and glass products	do.	7.1	7.3	6.9
Chemicals and allied products	do.	13.1	12.5	12.8
Petroleum and coal products	do.	.8	.8	.9
Construction	do.	101.4	116.0	129.0
Transportation and public utilities	do.	87.1	89.2	89.7
Wholesale and retail trade	do.	427.8	451.5	472.7
Finance, insurance, real estate	do.	98.8	103.8	109.6
Services	do.	413.4	444.5	472.4
Government and government enterprises	do.	379.6	387.9	392.9
Total	do.	1,724.1	1,814.0	1,885.1
Personal income:				
Total	millions	$58,614	$64,462	$69,680
Per capita		$13,629	$14,821	$15,864
Hours and earnings:				
Total average weekly hours, production workers		40.0	41.0	40.3
Total average hourly earnings, production workers		$9.0	$9.4	$9.7
Earnings by industry:				
Farm income	millions	$151	$303	$253
Nonfarm	do.	$37,496	$41,573	$45,418
Mining total	do.	$124	$151	$140
Nonmetallic minerals except fuels	do.	$16	$18	$20
Coal mining	do.	$32	$37	$33
Manufacturing total	do.	$5,396	$5,839	$6,137
Primary metal industries	do.	$744	$740	$674
Stone, clay, and glass products	do.	$183	$205	$211
Chemicals and allied products	do.	$377	$375	$408
Petroleum and coal products	do.	$26	$29	$31
Construction	do.	$2,560	$3,090	$3,533
Transportation and public utilities	do.	$2,514	$2,695	$2,870
Wholesale and retail trade	do.	$6,521	$7,237	$7,932
Finance, insurance, real estate	do.	$2,102	$2,358	$2,771
Services	do.	$8,893	$10,150	$11,389
Government and government enterprises	do.	$9,221	$9,883	$10,453
Construction activity:				
Number of private and public residential units authorized[3]		39,799	38,551	42,137
Value of nonresidential construction[3]	millions	$963.4	$1,473.9	$1,873.6
Value of State road contract awards	do.	$250.1	$331.0	$421.0
Shipments of portland and masonry cement to and within the State	thousand short tons	1,379	1,480	1,642
Nonfuel mineral production value:				
Total crude mineral value	millions	$199.4	$241.7	$258.3
Value per capita		$46	$56	$59

[p]Preliminary. [r]Revised.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

Foreign Oceanborne Commerce.—At the Port of Baltimore, fertilizer and fertilizer materials were the only nonfuel mineral commodities exported—1,028 short tons, down 49% from 1984 levels. However, import trade of nonfuel mineral commodities included iron ore (4,125,402 tons, down 21%), gypsum (691,163 tons, up 5%), alumina (384,971 tons, down 2%), fertilizer and fertilizer materials (349,525 tons, up 6%), cement (196,820 tons, up 19%), ferroalloys (121,061 tons, down 23%), clays (54,478 tons, up 34%), miscellaneous ores and concentrates including chrome ore (53,714 tons, down 64%), and manganese ore (51,871 tons, up slightly).

In late May, a record-high amount of iron ore was unloaded at the Chessie System Railroads' Curtis Bay pier in Baltimore as 92,960 short tons was moved from a ship to railroad hopper cars. It took 6 days to unload the Hong Kong-registered *M.V. Iberia,* which carried iron ore pellets from Sept Isle, Quebec, Canada, for the Iron Ore Company of Canada. The ore was loaded into 937 open-top Chessie hopper cars for transport to the Armco Steel Corp. plant at Ashland, KY. According to a Chessie spokesperson, that cargo was the largest of its kind ever unloaded at an east coast port.

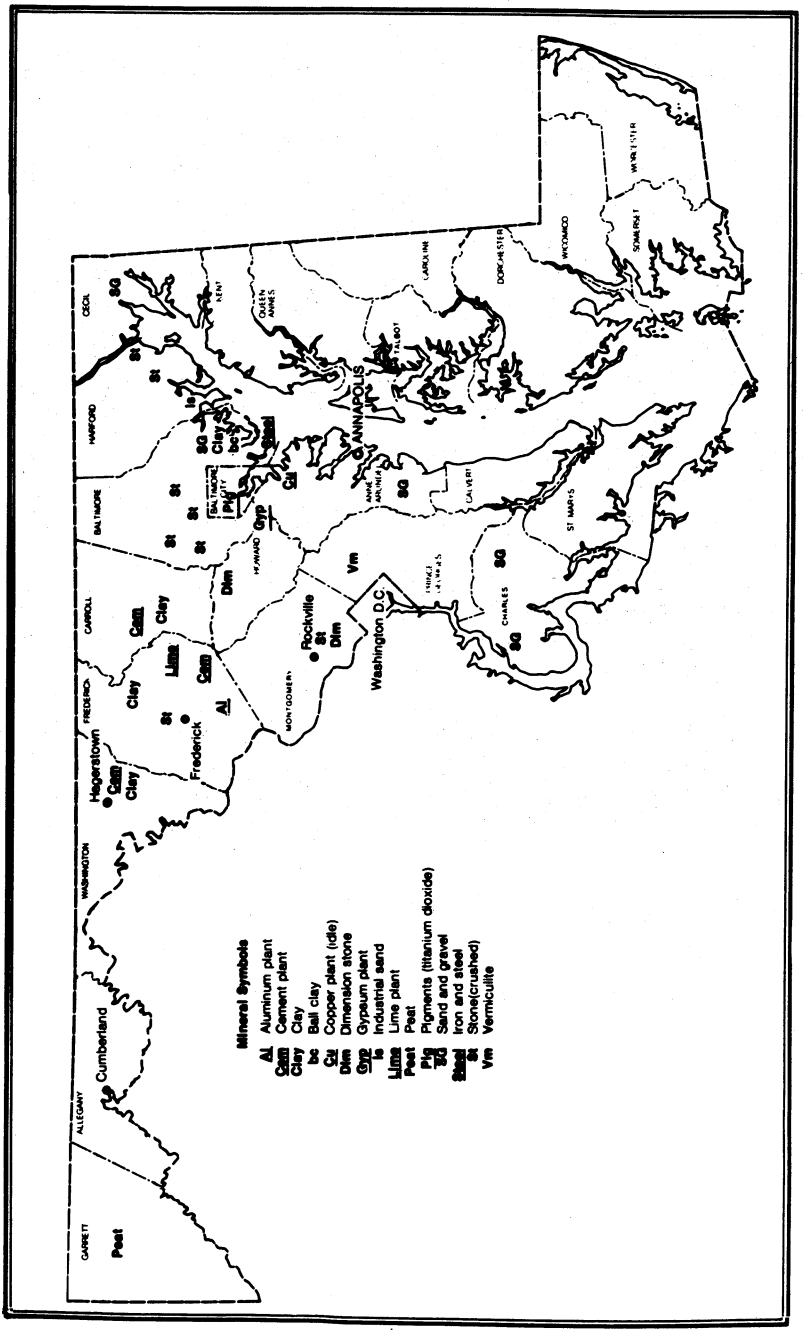

Figure 1.—Principal mineral producing localities in Maryland.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Cement.—Portland cement was produced by Coplay Cement Co. at Lime Kiln in Frederick County, Independent Cement Co. (formerly Lone Star Cement Inc.) in Hagerstown in Washington County, and Lehigh Portland Cement Co. at Union Bridge in Carroll County. Independent Cement and Lehigh Portland also manufactured masonry cement.

Reflecting continued growth in the construction industry, U.S. cement demand increased for the third consecutive year. Maryland's total production and value of shipments remained essentially unchanged from the record-high levels of 1984. At Atlantic Cement Co. Inc.'s processing facility adjacent to the "L" blast furnace of Bethlehem Steel Corp. at Sparrows Point, the quantity and value of water-granulated iron slag used to manufacture slag cement increased by one-quarter and one-third, respectively.

Despite high-capacity use rates by the State's cement industry, aggressive selling prices held profits in check as inexpensive imports established themselves as an alternative for part of the U.S. supply. Imports increased 64% to 14.5 million short tons, the highest level in recorded U.S. history. Consequently, industry restructuring included a definite focus on regaining control of the import situation, as acquisition and position taking occurred during 1985.

Blue Circle Industries PLC of the United Kingdom, a worldwide producer and distributor of cement and allied products, purchased Newmont Mining Corp.'s Atlantic Cement for $145 million. The acquisition included a 1.5-million-ton-per-year portland cement plant at Ravena, NY; the 800,000-ton-per-year slag cement plant at Sparrows Point; a fleet of cement-carrying barges; and whole or partial interest in a number of distribution terminals. Atlantic Cement served a 16-State market along the eastern seaboard by means of a fleet of barges that delivered its products to coastal distribution centers. The new company was renamed Blue Circle-Atlantic.

The Canadian-based cement manufacturer, St. Lawrence Cement Inc. of Mount Royal, Quebec, purchased Lone Star Cement's quarry and plant near Hagerstown. Lone Star Cement, the largest cement manufacturer and importer in the United States, sold that operation and its Baltimore distribution terminal to St. Lawrence Cement for $63.5 million. The Maryland operations were run by Independent Cement of Albany, NY, the U.S. subsidiary of St. Lawrence Cement. Most of their shipments were to ready-mixed concrete plants. St. Lawrence Cement was a publicly owned corporation. Its largest stockholder was Holderbank Group Companies, a Swiss company that was one of the world's largest cement manufacturers. The limestone quarry and plant occupied about 200 acres. The remainder of the 870-acre site in Security, an unincorporated area 2 miles east of Hagerstown, was leased to farmers. About 65% of the cement was sold in the Baltimore-Washington area, and the remainder was marketed in western Maryland and parts of Pennsylvania, Virginia, and West Virginia. The new owner recognized the United Cement, Lime, and Gypsum Allied Workers Union as the bargaining agent for the 121 workers.

Additionally, Allentown Cement Co. Inc. of King of Prussia, PA, acquired National Gypsum Co.'s distribution terminal at Bowie. In the same corporate change, Allentown Cement acquired National Gypsum's cement plant at Evansville, PA, and a Jersey City, NJ, terminal.

Chromium (Chemicals).—Allied-Signal Corp. (formerly Allied Corp.), a principal U.S. producer of chromium chemical products, at midyear discontinued operations at its Baltimore chromium chemicals and compounds plant. Byproduct sodium sulfate was also produced at the facility. A total of 84 salaried and 230 hourly employees were affected by the shutdown. Allied-Signal planned to dismantle the plant, but the company's other Maryland facilities would not be affected. Chromium ore had been processed at this Allied-Signal plant and other facilities in the Baltimore area since 1845. The plant, with an annual capacity of 65,000 short tons, had operated since 1954. Major end uses for its various chromium chemicals and compounds included metal finishing, pigments, tanning, and corrosion control. The Baltimore plant had a gross payroll of more than $10.6 million in 1984.

Over the past 3 years, the company lost over $35 million in the chromium chemical business. Allied-Signal cited a continued weakening in the chromium chemicals world supply-demand balance.

Clays.—Common clay and shale was mined for the production of lightweight aggregate and the manufacture of brick and portland cement. Pit production, totaling 336,000 short tons, was valued at $1.6 million. From 1984 levels, quantity decreased 3% while value increased 11%. For the most part, the State's five brickmakers were operating at or near capacity to meet the demand of full order books because of an upturn in building construction. Also, Lehigh Portland, one of the State's three cement manufacturers, mined clay and shale for use in manufacturing portland cement at its Union Bridge plant in Carroll County. The value of Maryland's portland cement shipments increased 2.4% over 1984 record-high sales and accounted in part for the increased value of mined clay and shale. The company also expanded shale for use as lightweight aggregate at its Woodsboro plant in Frederick County.

Ball clay was mined by Cyprus Industrial Minerals Co. at operations 5 miles north of Baltimore on Route 40. Its production was used in ceramics, animal feed, pottery, refractories, adhesives, and sealants. Increased demand resulting from the continued recovery of the housing industry aided the impressive increase in value.

Gypsum (Calcined).—Crude gypsum imported from Canada was calcined by National Gypsum and USG Corp. at plants in Baltimore for manufacturing wallboard and related products. Although housing starts remained constant for the third year in a row, lower interest rates added to the increase in repair and remodeling work. Particularly significant in 1985 for Maryland's wallboard manufacturers was the large stock of older buildings that were renovated in their markets. Although the quantity of stucco produced for wallboard and plasters decreased 4.3% from that of 1984, estimated value increased by 4.3%.

Some byproduct gypsum, obtained from SCM Corp.'s SCM Pigments Div. plant in Baltimore, was mixed with natural gypsum and commercially used in the manufacture of wallboard at USG's plant. The quantity and value of byproduct gypsum shipments from the titanium dioxide pigments chemical plant increased 8.1% over 1984 levels.

Lime.—S. W. Barrick & Sons Inc., at its Woodsboro operations in Frederick County, produced industrial and agricultural lime and crushed limestone. Lime production totaled 10,000 short tons and was valued at $608,000. Of total lime production, 65% was hydrated and the remainder was quicklime.

Peat.—Garrett County Processing & Packaging Corp. mined reed-sedge and humus peat near the town of Accident in the western corner of the State. About 86% of the processed material was sold in bulk for agricultural and horticultural purposes. The remainder was packaged and sold as a soil conditioner called Free State Peat. Product lines included reed-sedge peat in bulk or bag, humus peat in bulk only, and mixed potting soil.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Based on these estimates, a total of 17 million short tons valued at $58 million, f.o.b. plant or pit, was produced in Maryland in 1985, an increase of 19.4% and 24.3%, respectively, over 1984 shipments. This tonnage was the highest production ever reported in Maryland. Based on 1985 census data, Maryland's per-capita production of construction sand and gravel was 3.87 tons, about 1,000 pounds above the total U.S. per-capita consumption. The State's average price per ton at $3.41 was 36 cents above the U.S. average.

Environmental regulations, zoning conflicts, and depletion of near-market deposits continued to rank among the principal problems facing the State's construction sand and gravel producers. Maryland's aggregates industry, in general, found the State enforcement of mining and reclamation regulations to be firm, fair, reasonable, and in accord with achieving valid environmental goals. However, the sand and gravel producers, in particular, found local zoning ordinances to be overly restrictive; especially in the citing of new processing plants. This caused some producers, in instances, to truck from new pits to existing plants, rather than haul processed material directly to markets.

Increased demand for construction sand and gravel, particularly concrete gravel and concrete sand for the Washington-Baltimore area, spurred modernization of existing plants in Anne Arundel and Prince Georges Counties and the development of a new mine and processing plant in Charles County.

An automatic sand classifying tank with a programmable control system was installed as a prototype at the Campbell Sand

& Gravel Co. plant near Crofton in Anne Arundel County. The programmable system could be adapted to the most complex sand and gravel plants and would be economical for the smaller operator. At Eastern Aggregates Inc.'s plant near Davidsonville, also in Anne Arundel County, a new computer-controlled sand classifier was instrumental in increasing concrete sand production. Also improved at this around-the-clock operation was product quality, since the classifier tracked the sand's fineness modulus every 6 minutes and automatically adjusted according to the program. Eastern Aggregates had three plants in Maryland—one near Davidsonville, which did all of the wet processing; one near Lothian in Anne Arundel County that had dry-screening facilities; and one near Brandywine in Prince Georges County. No mining was done at Davidsonville because the company was holding 28 acres of raw material in reserve for future use. The Lothian and Brandywine plants served as the source of raw material processed in the automated classifier. It was a 6-mile haul from the Lothian pit and 23 miles from Brandywine. Prior to 1985, Eastern Aggregates had been a division of J. E. Owens III Contracting Inc.

On October 7, 1985, the concrete aggregate processing plant of Goose Bay Aggregates near Chicamuxen in Charles County on the Potomac River, started operations. The plant, four 1-acre sediment ponds, and conveyors to the mine face occupied 60 acres in the 800-acre "greenfield" facility site. The area to be mined was expected to occupy over 500 acres, and there was 1-1/2 miles of conveyor to the barge-loading facility on the river. The product was trucked to the stack loader at the river in 1985 because the conveyor was not completed. Howat Concrete Co. Inc., parent of Goose Bay Aggregates, operated a concrete aggregates transfer facility on the Anacostia River near the South Capitol Street Bridge in Washington, DC, and four concrete plants in the Washington area. Previously, Howat Concrete purchased much of its concrete aggregate. All of Goose Bay Aggregates' production was for captive use, but Howat Concrete planned to eventually market to competitors.

Maryland's Charles County Sand & Gravel Co. Inc. was one of four National Sand & Gravel Association member companies that received safety awards from the Mine Safety and Health Administration as a result of their outstanding safety records in the "open pit" category by attaining at least 130,000 employee-hours of exposure with no lost-time injury or fatalities during 1984. The company's Charles County Waldorf Pit placed second with 137,721 employee-hours.

Industrial.—Harford Sands Inc., Joppa, produced industrial sands at its Magnolia operation in Harford County. Products included abrasive, filter, foundry, and specialty sands. Specialty sand was used in sand traps on golf courses, foundry sand was used for cores and molds for casting common metals, filter sand was used in treating water supplies, and abrasive sand was used for sandblasting. The quantity and value of reported production, f.o.b. plant, increased 20.5% and 46.8%, respectively, over 1984 levels.

Slag—Iron and Steel.—Two companies at facilities on the property of Bethlehem Steel at Sparrows Point processed iron slag. Blue Circle-Atlantic, a subsidiary of Blue Circle Industries of the United Kingdom and the new owner of Atlantic Cement, produced a finely ground, water-granulated iron slag product called Newcem, a slag cement. Also, Maryland Slag Co., a wholly owned subsidiary of The Arundel Corp., crushed air-cooled iron slag for road base material and as a substitute for natural construction aggregate at its 5,000-ton-per-day plant. Maryland Slag also began marketing steel slag for road base material owing to cutbacks in steelmaking by Bethlehem Steel, its supplier of blast furnace slag.

C. J. Langenfelder & Sons Inc., also operating under a contract with Bethlehem Steel, crushed cured steel slag from the basic oxygen and open-hearth furnaces for use as road base material. Maryland Slag acted as sales agent for the company.

Over the past 3 years, the unit value of processed water-granulated iron slag has increased significantly and has been much higher than that of steel slag. This unit-value difference, combined with the modest increase in pig iron shipments from Bethlehem Steel, has all but dried up the availability of iron slag for use as a substitute for natural construction aggregate and road base material and has also preempted its use as lightweight concrete aggregate.

Over 1984 levels, the quantity and value of iron slag sales increased 26% and 33%, respectively, and although some steel slag sales were reported in 1985, none were reported in 1983 or 1984. The quantity and value of slag shipments have been withheld to avoid disclosing company proprietary data.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—In 1985, there were 18 companies operating 29 quarries in 10 of Maryland's 23 counties producing crushed stone, and 1 operator, C. J. Langenfelder, crushed oyster shells dredged from Chesapeake Bay for use as driveway coverings, other unpaved road surfaces, and as poultry grit. At its Texas Quarry, 15 miles north of Baltimore, Genstar Stone Products Co., the State's largest producer of crushed stone and 1 of the top 10 in the United States, coproduced calcium carbonate fillers. The layered marble member in the mile-wide band of Cockeysville marble was mined by surface and underground methods from within the quarry and processed on-site for its very white, ultrabright, high-purity (93%) calcite. Seven product lines were marketed throughout the Eastern United States and Canada for use in paint and coatings, plastics and paper coatings, caulks and sealants, and adhesives. Also, Stoneyhurst Quarries, a dimension stone quarrier, coproduced a small quantity of crushed marble at its operations at Bethesda in Montgomery County.

Total crushed stone production, valued at $98.6 million, was 24.4 million short tons. Over 1984 levels, shipments increased 2.3 million tons (10.4%) while value increased $4.6 million (4.9%). The average unit value was $4.04 per ton, down 21 cents from that of 1984.

Based on 1985 census data, Maryland's per-capita production of crushed stone was 5.56 tons, about 750 pounds above the total U.S. per-capita consumption. Combined output from the State's two leading counties—Baltimore and Frederick—accounted for about 45% of the State total. Almost 90% of the State's shipments was by truck, 4% was by barge, and the remainder was by rail from Frederick County and other modes.

A total of 15.8 million tons (65%) of Maryland's crushed stone production was processed from carbonate rocks, for the most part, marble; 2.7 million tons (11%) was processed from granite and gneiss; and the remainder was crushed from sandstone, traprock, quartzite, other metamorphics, and oyster shells. Of the carbonate rocks, 12 million tons (76%) was used for concrete and bituminous aggregates, roadstone and coverings, riprap and railroad ballast, and other construction uses; 2.6 million tons (16%) was used for cement manufacture; 1.2 million tons (8%) was used for agricultural and other uses; and 19,000 tons was used for lime manufacture.

The year's most significant expansion belonged to Genstar in 1985. Genstar began a $9 million expansion program at its Texas Quarry. The program, to be completed in November 1986, would increase production capacity by 50% and would be, according to company officials, the most advanced crushing facility in the industry. The expansion program would include a continuous crusher system and new, state-of-the-art automation equipment for tertiary crushing that would be programmed on-site by minicomputers. The 600-acre quarry employed 500 persons at its combined operations, which included crushed stone, sand and gravel, calcium carbonate fillers, packaged cement mixes, and limestone products.

Also during 1985, The Arundel Corp., the State's second leading producer of crushed stone, made a capital investment at one of its three Maryland quarries. At the Greenspring Quarry, just north of Baltimore, the company installed an automated hoist system extending vertically up the quarry face to maximize the recovery of remaining reserves. The quarrying area at this location was confined and it became necessary to eliminate the haulroads from the quarry floor in order to extract rock. According to the company, this is the first use of such a system for a stone quarry in the United States. This project cost in excess of $3 million. At the Havre de Grace Quarry on the Susquehanna River in northern Maryland, the company reported increased demand for its riprap stone, which is used to protect shorelines and marine structures. This quarry supplied riprap to control beach erosion at Ocean City and was expected to provide the riprap for the Hampton Roads Bridge project in Virginia.

Rockville Crushed Stone Inc. was involved in the industry's largest change of ownership during the year, and less than coincidentally, was involved in the industry's most significant land-use conflict. Rockville Crushed Stone was seeking new zoning on 530 acres in Boyds, Montgomery County, to operate a 110-acre crushed stone quarry. The land was zoned rural-residential, and the company was asking for the mineral resource recovery zone designation. Boyds' residents, about 700 in all, had successfully defeated several quarry plans in the past 25 years, the last 5 years of which have been

intense. Rockville Crushed Stone, a closely held corporation, also operated a crushed stone quarry near Rockville, also in Montgomery County, and a sand and gravel facility at White Marsh, Baltimore County. In mid-April, the company was sold to London & Northern America Inc., a British-based firm, for $26.1 million with an additional $3 million due upon the successful completion of its zoning request to operate the Boyds Quarry. This land-use conflict was unresolved at yearend.

Shipment of crushed stone into and out of the State further increased during 1985. The Chessie System Railroads, a unit of CSX Corp., expanded its successful "rock runner" trains, which hauled construction aggregate on a continuous cycle into the Maryland market. The new service, called Maryland Rock Runner, operated on a three-round-trip-per-week basis from the eastern West Virginia quarry of Millville Quarry Inc. to delivery points in the Baltimore area. A total of 68 carloads of construction aggregate were picked up at the Millville, WV, quarry and delivered to the company's distribution point at Bladensburg, Fort Meade Junction, and Baltimore. Following deliveries, the same crew returned the empty cars 108 miles to the quarry at Millville later the same day. Specially designed rapid discharge cars were used in this train service.

The principal market area of Maryland Materials Inc., near North East in Cecil County at the head of Chesapeake Bay, was the entire Delmarva Peninsula where the bulk of its customers are. The company reported that delivery to the tip of the peninsula, 123 miles away, was easier than to the Baltimore area, 43 miles distant. Futhermore, there were more competitors between their quarry and the Baltimore area where there were a number of crushed stone producers. The stone being crushed was a high-silica content (70% to 75%) granite gneiss that was well suited for the 500-ton-per-hour plant designed to produce clean stone for the hot-mix asphalt overlay market. Also produced were riprap and jetty stone, railroad ballast, and gabion stone. Overall, Maryland Materials reported 1985 as one of its best years ever with sales 25% over that of 1984 because the economy was extremely good in Delaware, especially the city of Wilmington, but also in northern Maryland where they were reaping the benefits of the gasoline tax increase that went to support highway maintenance.

Table 4.—Maryland: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	2,622	9,348
Riprap and jetty stone	525	2,744
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,787	14,714
Bituminous aggregate, coarse	2,688	11,798
Bituminous surface-treatment aggregate	479	2,199
Railroad ballast	23	108
Fine aggregate (-3/8 inch): Stone sand, concrete	163	881
Combined coarse and fine aggregates:		
Graded road base or subbase	1,786	7,943
Unpaved road surfacing	5,075	25,184
Crusher run or fill or waste	2,278	8,992
Other construction materials[2]	1,145	4,305
Chemical and metallurgical:		
Cement manufacture	2,619	5,057
Lime manufacture	19	78
Special:		
Other miscellaneous[3]	1,197	5,232
Other unspecified[4]	W	W
Total	24,406	[5]98,584

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

[1]Includes limestone, granite, sandstone, shell, and traprock.

[2]Includes stone used in agricultural limestone, filter stone, stone sand (bituminous mix or seal), fine aggregate (screen), and other construction and maintenance purposes.

[3]Includes stone used in agricultural marl and other soil conditioners, poultry grit and mineral food, flux stone, asphalt fillers or extenders, whiting or whiting substitute, and data indicated by symbol W.

[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.

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

Dimension.—In 1985, eight companies quarried dimension stone in four counties—one each in Garrett and Howard Counties, two in Montgomery County, and four in Baltimore County. In terms of both quantity and value of shipments, Montgomery and Baltimore Counties were the leading producers. Granite gneiss and quartzite were the principal rock types quarried. Irregular-shaped stone accounted for 72% of total sales, while cut stone and veneer accounted for 16%. In order of decreasing value, other products included flagstone, rough block, and monument stone.

Stoneyhurst Quarries, the State's leading producer at its Bethesda operations in Montgomery County, quarried and cut granite gneiss for building stone and flagging. The company also coproduced a small quantity of crushed stone. The State's other two leading producers were Weaver Stone Co. and Patapsco Natural Stone Quarry Inc. They quarried and cut quartzite, also for building stone and flagging.

Titanium Dioxide (Pigments).—The pigment plant of SCM in Baltimore produced titanium dioxide pigments for use in lacquers, paint, paper, plastics, and varnishes. Annual plant capacity was 64,000 short tons by the sulfate process and 46,000 tons by the chloride process.

SCM reportedly signed a 10-year, $200 million contract with Associated Minerals Consolidated Ltd. (AMC) to purchase synthetic rutile from a processing plant that AMC planned to build 240 miles north of Perth, Western Australia, that would be operational in early 1987. The contract was expected to supply one-third of SCM's titanium concentrate requirements for its chloride process titanium dioxide pigments plants at Baltimore, MD; Ashtabula, OH; and Stallingborough, England.

Vermiculite (Exfoliated).—The Construction Products Div. of W. R. Grace & Co. at Muirkirk in Prince Georges County exfoliated South Carolina-mined vermiculite. Most of the production was used in insulating fill and Monokote fireproofing.

Reflecting the 14% decline in U.S. consumption of this material for insulation, the quantity of exfoliated vermiculite sold and used at this plant decreased 4.6% from 1984 levels and its unit value fell from $185 per short ton to $119 per ton.

METALS

Aluminum.—Eastalco Aluminum Co., a subsidiary of Alumax Inc., produced ingots and billets at its aluminum smelter near Buckeystown in Frederick County. Production at full capacity was 160,000 short tons annually. To offset continued declining prices and high inventory, the smelter's operating rate, which began the year at 87%, was cut to 75% in October where it remained through yearend. From 1984 levels, the quantity and value of production decreased an estimated 5.4%.

In November, Alumax requested a rehearing on the September 1 ruling by the Maryland Public Service Commission that allowed a public utility company to increase power cost for its Eastalco smelter. A rate increase from 24 mills to 24.8 mills per kilowatt hour had been granted, and an additional increase to 26.4 mills to cover charges associated with the startup of a new power station was under consideration.

Copper.—Kennecott closed its Baltimore rod mill for an indefinite period beginning on May 7. The producer met contractual commitments through June, but as of July 1, shipments stopped. The refinery had been shut down since mid-1983.

Iron and Steel.—Maryland's steelmakers continued to be impacted by worldwide overcapacity, reduced demand, and foreign imports. Bethlehem Steel, the Nation's third leading producer, operated one of its three U.S. integrated steel plants at Sparrows Point. In 1985, the company suffered a net loss of $196 million, its fourth consecutive yearly loss. Corporate losses for the last 4 years totaled more than $1.9 billion. Nevertheless, modernization of the ironmaking and steelmaking facilities at the Sparrows Point plant continued. The company's $260 million continuous caster was completed and scheduled for startup in early 1986. The 3-million-short-ton-per-year capacity caster would produce both slabs and bloom. Union officials estimated that this improved efficiency of steelmaking could also reduce employment by 1,500 workers at this Baltimore County steelmaker. Previously, Bethlehem Steel did not have a continuous caster at its Sparrows Point plant. In addition, the $32 million improvement and modernization of the 160-inch plate mill was nearing completion.

Automation, decreasing demand, and new technology have been responsible for many job losses at Sparrows Point. In 1985, just 8,600 workers produced 3.5 million tons of steel. At the plant's peak, there were 30,000 workers producing 8 million tons of steel.

Following an evaluation of its market, Copperweld Steel Corp. permanently closed its American Seamless Tubing Inc. subsid-

iary in Baltimore, resulting in the company exiting the extruded tube market. The plant, using purchased billets in its extruding process, had a capacity of 40,000 tons per year. When operating at full capacity in 1981, it employed between 225 and 250 workers. The closure affected about 50 workers, 40 of whom had been on indefinite layoff since July.

Specialty Steel.—Armco Inc.'s Specialty Steel Div. in Baltimore began commercial operation of its $6 million, two-strand horizontal continuous caster, the first in the United States to be used by an integrated specialty steelmaker. Its annual capacity was 40,000 tons. Also, coming on-stream in late 1985, the latest unit of Armco's modernization project at the Baltimore Works that began in 1981, was its $7 million automated pickling line with the capacity to process 80 tons per turn. The total project included a 50-ton electric arc furnace, a precision rotary forge, and the new two-strand horizontal caster. The Baltimore Works produced stainless bars, rod, wire, and semifinished products.

Eastmet Corp. ended production of stainless steel sheet and strip at its Eastern Stainless Steel Co. plant in Baltimore but continued to produce plate, which was more profitable. Just before yearend, the company laid off 450 employees, almost one-half its work force. Despite a prior reduction in wages, the company's losses increased throughout the year because of continuing competition from imports.

Reclaimed Metals and Materials.—National Ecology Inc. operated the Baltimore County Resource Recovery Facility at Cockeysville for Maryland Environmental Services and Baltimore County. Materials recovered and marketed from the plant, which regularly processed 700 short tons per day of municipal solid waste, included nonferrous metal, ferrous metal, and glass in addition to refuse-derived fuel (RDF), by far the principal product. Typically, 300 to 500 tons of prepared RDF per day was sold to the Baltimore Gas & Electric Co.'s Crane Power Station. Nonferrous metals recovery was very small. Typically, about 1 ton per day was sold in the spot market. Approximately 25 tons of ferrous metals per day, 90% to 95% pure, was extracted using two-stage magnetic separators, after the primary shredder. The magnetic fractions were sold to a local scrap dealer for 80% of the Philadelphia No. 2 bundle price for resale to Bethlehem Steel at Sparrows Point. Glass recovery was sold principally to fiberglass manufacturers. The Cockeysville plant, claimed to be one of the most successful and reliable resource recovery operations in the United States, had processed about 2 million tons of refuse since 1976 with a total downtime of only 4 days.

[1]State Mineral Officer (retired), Bureau of Mines, Pittsburgh, PA. For information contact L. Prosser, Bureau of Mines, Pittsburgh, PA.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Eastalco Aluminum Co. (Alumax Inc.).	5601 Manor Woods Rd. Frederick, MD 21701	Reduction plant	Frederick.
Cement:			
Portland:			
Coplay Cement Co., (Société des Ciments Français).	4120 Buckeystown Pike Lime Kiln, Box D Frederick, MD 21701	Quarry and plant.	Do.
Portland and masonry:			
Independent Cement Co. (St. Lawrence Cement Inc., Quebec, Canada).	Box 650 Hagerstown, MD 21740	____do_____	Washington.
Lehigh Portland Cement Co. (Heidelberger Zement AG).	Box L Union Bridge, MD 21791	____do_____	Carroll.
Slag:			
Blue Circle-Atlantic (Blue Circle Industries PLC, United Kingdom).	Box 6687 Sparrows Point, MD 21219	Plant (slag cement).	Harford.
Clays:			
Ball clay:			
Cyprus Industrial Minerals Co., Cyprus Mines Corp.	9420 Pulaski Highway Baltimore, MD 21220 Box 188 White Marsh, MD 21162	Pit and plant __	Baltimore.
Common clay and shale:			
Baltimore Brick Co. (Merry Co.).	9801 Rocky Ridge Rd. Rocky Ridge, MD 21778	Pits and plants _	Baltimore and Frederick.
Victor Cushwa & Sons Inc ___	Clearspring Rd. & Route 68N Box 160 Williamsport, MD 21795	Pit and plant __	Washington.

Table 5.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Clays —Continued			
Common clay and shale —Continued			
Lehigh Portland Cement Co	Box L Union Bridge, MD 21791	Pits and plants	Carroll and Frederick.
Maryland Clay Products Inc. (Borden Brick & Tile Co.).	7100 Muirkirk Rd. Beltsville, MD 20705	do	Frederick and Prince Georges.
Copper:			
Kennecott Refining Corp	Kenbo Rd. Curtis Bay, MD 21226	Refinery	Anne Arundel.
Gypsum:			
Byproduct:			
SCM Corp., SCM Pigments Div.	3901 Glidden Rd. Baltimore, MD 21226	Plant	Baltimore.
Calcined:			
National Gypsum Co., Gold Bond Building Products Div.	2301 South Newkirk St. Baltimore, MD 21224	do	Do.
USG Corp	500 Quarantine Rd. Box 3472 Baltimore, MD 21226	do	Do.
Iron and steel:			
Armco Inc., Stainless Steel Div	3501 East Biddle St. Box 1697 Baltimore, MD 21203	Mill	Do.
Bethlehem Steel Corp	Sparrows Point, MD 21219	Mill (integrated)	Do.
Eastern Stainless Steel Co., a division of Eastmet Corp.	7700 Rolling Mill Rd. Dundalk, MD 21222 Box 1975 Baltimore, MD 21203	Mill	Do.
Lime:			
S. W. Barrick & Sons Inc	Woodsboro, MD 21798	Quarry and plant.	Frederick.
Peat:			
Garrett County Processing & Packaging Corp.	RFD 1 Accident, MD 21520	Bog and plant	Garrett.
Sand and gravel:			
Construction:			
Charles County Sand & Gravel Co. Inc.	Waldorf Industrial Center Box 548 Waldorf, MD 20601	Pits and plant	Anne Arundel, Charles, St. Marys.
Eastern Aggregates Inc. (formerly J. E. Owens III Contracting Inc.).	10 South River Club House Rd. Harwood, MD 20776	Pits and plants	Anne Arundel and Prince Georges.
Genstar Stone Products Co	Executive Plaza 4 11350 McCormick Rd. Hunt Valley, MD 21031	Pit and plants	Baltimore.
Inland Materials Inc. (formerly Silver Hill Sand and Gravel Co.).	4714 St. Barnabus Rd. Temple Hills, MD 20748	do	Prince Georges.
Maryland Rock Industries (Florida Rock Industries Inc.).	Box 273 Leonardtown, MD 20650	Pit and plant	St. Marys.
York Building Products Co. Inc., Mason Dixon Sand & Gravel Div.	Pulaski Highway Perryville, MD 21403	do	Cecil.
Industrial:			
Harford Sands Inc	Box 210 40 Fort Hoyle Rd. Joppa, MD 21085	do	Harford.
Slag:			
Iron:			
Blue Circle-Atlantic (Blue Circle Industries PLC, United Kingdom).	Box 6687 Sparrows Point, MD 21219	Plant (slag cement).	Do.
Maryland Slag Co. (The Arundel Corp.).	Sparrows Point, MD 21219	do	Do.
Steel:			
C. J. Langenfelder & Sons Inc	8427 Pulaski Highway Baltimore, MD 21221	do	Do.
Stone:			
Crushed:			
The Arundel Corp	110 West Rd. Baltimore, MD 21204	Quarries and plants.	Baltimore, Frederick, Harford.
Genstar Stone Products Co	Executive Plaza 4 11350 McCormick Rd. Hunt Valley, MD 21031	do	Baltimore, Carroll, Frederick, Harford.
Maryland Materials Inc	Box W North East, MD 21901	Quarry and plant.	Cecil.
Rockville Crushed Stone Inc	Box 407 13900 Piney Meetinghouse Rd. Rockville, MD 20850	do	Montgomery.

Table 5.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Dimension:			
Patapsco Natural Stone Quarry Inc.	Marriottsville Rd. Marriottsville, MD 21104	Quarry and plant	Baltimore.
Stoneyhurst Quarries	Box 34463 8101 River Rd. Bethesda, MD 20817	do	Montgomery.
Weaver Stone Co	15027 Falls Rd. Butler, MD 21023	do	Baltimore.
Titanium dioxide (pigments):			
SCM Corp., SCM Pigments Div	3901 Glidden Rd. Baltimore, MD 21226	Chemical plant	Do.
Vermiculite (exfoliated):			
W. R. Grace & Co., Construction Products Div.	12340 Conway Rd. Beltsville, MD 20705	Plant	Prince Georges.

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 1985 was about $117 million. Mineral production and value increased for the third consecutive year, paralleling the continued strong demand for industrial minerals used in construction.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ---- thousand short tons	240	$1,212	265	$1,388
Lime ---- do.	171	12,426	159	10,935
Sand and gravel (construction) ---- do.	14,168	42,139	e14,900	e47,500
Stone:				
Crushed ---- do.	e8,400	e39,000	9,354	42,881
Dimension ---- do.	e57	e11,657	73	13,724
Combined value of gem stones, peat, and sand and gravel (industrial) ----	XX	898	XX	777
Total ----	XX	107,332	XX	117,205

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

Table 2.—Nonfuel mineral production in Massachusetts in 1984, by county[1]

County	Minerals produced in order of value
Barnstable	Sand and gravel.
Berkshire	Lime, sand and gravel.
Bristol	Sand and gravel.
Dukes	Do.
Essex	Do.
Franklin	Do.
Hampden	Do.
Hampshire	Do.
Middlesex	Do.
Nantucket	Do.
Norfolk	Sand and gravel, clays.
Plymouth	Do.
Worcester	Sand and gravel, peat.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Massachusetts business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	5,766	5,798	5,822
Total civilian labor force	do	2,978	3,049	3,061
Unemployment	percent	6.9	4.8	3.9
Employment (nonagricultural):				
Mining total	thousands	1.0	1.1	1.3
Manufacturing total	do	632.9	673.0	661.1
Primary metal industries	do	15.0	16.5	15.8
Stone, clay, and glass products	do	11.3	11.8	11.5
Chemicals and allied products	do	16.8	17.8	17.8
Petroleum and coal products[1]	do	1.4	1.5	1.5
Construction	do	82.6	96.4	108.8
Transportation and public utilities	do	118.2	123.3	126.5
Wholesale and retail trade	do	610.3	656.4	680.2
Finance, insurance, real estate	do	171.8	179.0	189.6
Services	do	704.3	751.3	779.3
Government and government enterprises	do	371.4	371.4	378.9
Total	do	2,692.5	[2]2,851.8	2,925.7
Personal income:				
Total	millions	$79,628	$88,114	$93,361
Per capita		$13,811	$15,198	$16,380
Hours and earnings:				
Total average weekly hours, production workers		39.9	40.1	40.7
Total average hourly earnings, production workers		$8.0	$8.5	$9.0
Earnings by industry:				
Farm income	millions	$180	$106	$126
Nonfarm	do	$57,335	$64,453	$70,366
Mining total	do	$152	$198	$189
Manufacturing total	do	$15,266	$17,329	$18,159
Primary metal industries	do	$331	$372	$377
Stone, clay, and glass products	do	$285	$327	$336
Chemicals and allied products	do	$497	$575	$602
Petroleum and coal products	do	$57	W	W
Construction	do	$2,815	$3,414	$3,865
Transportation and public utilities	do	$3,485	$3,684	$3,957
Wholesale and retail trade	do	$9,118	$10,463	$11,431
Finance, insurance, real estate	do	$3,927	$4,310	$5,084
Services	do	$14,916	$16,910	$18,800
Government and government enterprises	do	$7,393	$7,892	$8,604
Construction activity:				
Number of private and public residential units authorized[3]		23,007	29,288	39,193
Value of nonresidential construction[3]	millions	$1,106.2	$1,504.8	$1,910.7
Value of State road contract awards	do	$125.0	$228.6	$230.0
Shipments of portland and masonry cement to and within the State[4]	thousand short tons	1,111	1,336	1,440
Nonfuel mineral production value:				
Total crude mineral value	millions	$95.7	$107.3	$117.2
Value per capita		$17	$19	$20

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2]Data do not add to total shown because of independent rounding.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.
[4]Has no cement producing plants.

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

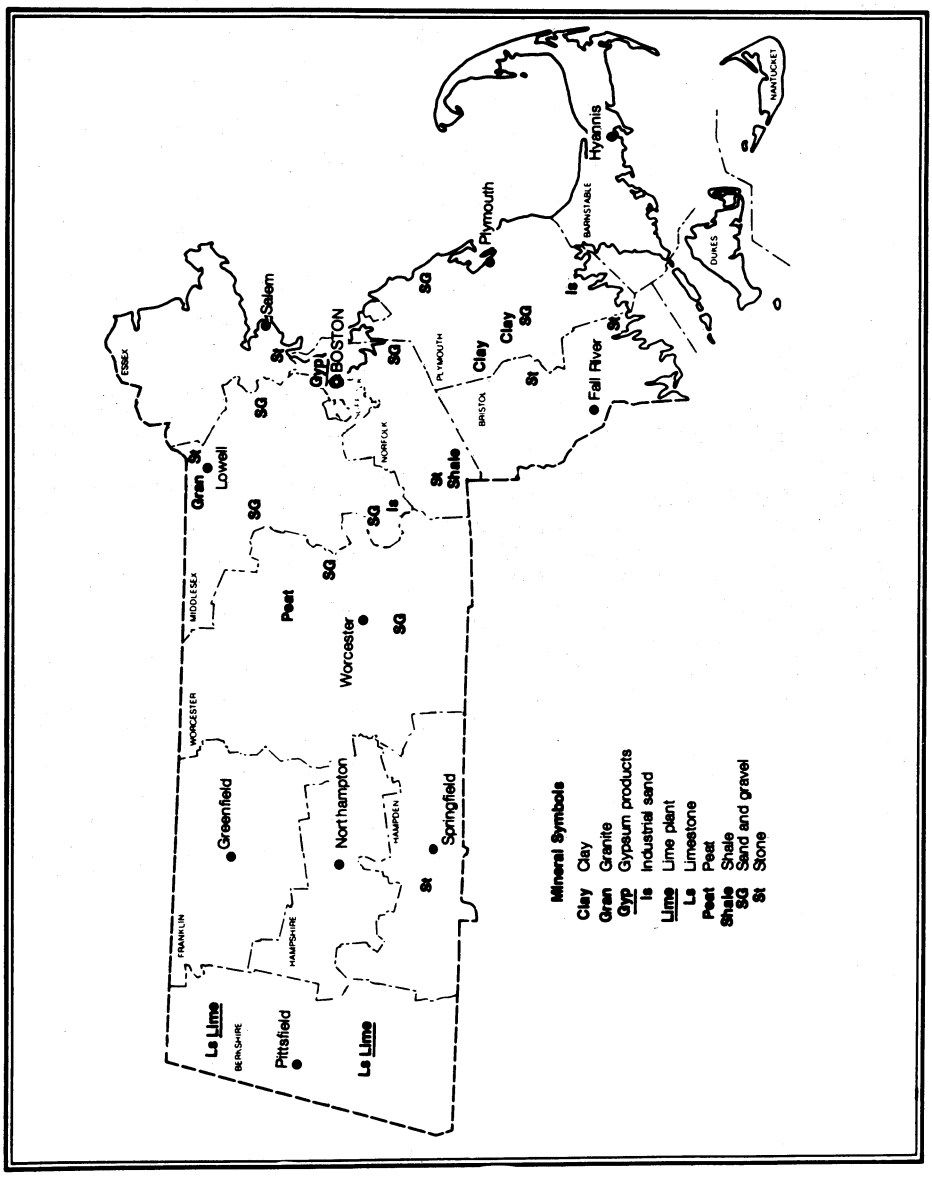

Figure 1.—Principal mineral producing localities in Massachusetts.

Legislation and Government Programs.—In December, Massachusetts became the sixth State to enact an acid rain control measure. The statute required a 30% reduction in sulfur dioxide emissions by January 1, 1989, if no Federal legislation is enacted to supersede the measure. Other States that passed acid rain control laws were Michigan, Minnesota, New Hampshire, New York, and Wisconsin.

Mining and mineral-related research continued in Massachusetts through State and Federally funded programs. The Massachusetts Institute of Technology (MIT), Cambridge, was 1 of 31 universities involved in research applicable to the minerals industry under the State Mining and Mineral Resources Research Institute Program Act (Public Law 98-409). The program, in its eighth year, required an increase in State funding in 1985. In connection with the Federal Generic Center Research Program, MIT participated in pyrometallurgy and respirable dust research projects. MIT also shared in a $5.9 million U.S. Department of Energy research program on coal and synthetic fuels, in the area of catalyst deactivation control in liquefaction.

The U.S. Geological Survey continued a mapping program of the inner Continental Shelf off the New England coast to identify locations and thicknesses of potential sand and gravel resources.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

In addition to the commodities listed in table 1, the production and value of some processed or manufactured mineral commodities were also surveyed by the U.S. Bureau of Mines. Graphite, gypsum, perlite, and vermiculite were shipped from domestic or foreign sources into Massachusetts. The combined value of these commodities added about $8 million to the State's economy. The companies operating these plants and their locations are included in the principal producers table.

Clays.—Production of 265,000 short tons of clays in 1985 was the third highest in State history. In 1969, 332,000 tons and in 1970, 284,000 tons of clay were produced. Similar to the late 1960's, strong demand for clay products used in construction from 1983 to 1985 resulted in higher than average production levels. For the 1968-70 period, clay production averaged about 290,000 tons annually; from 1983 to 1985, annual output averaged about 250,000 tons. In between these two periods (1971 to 1982), annual production averaged about 185,000 tons.

Lime.—Two companies in Berkshire County mined limestone for lime manufacture. These were the only two lime operations in the six-State New England region. The lime was marketed in the region and New York for use in the agriculture, chemical, and construction industries.

Peat.—Sterling Peat Co., Worcester County, was the State's and New England's only active peat producer in 1985. A small quantity of reed-sedge peat was mined and sold locally for agricultural use.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Development throughout the State and, in particular, in the coastal resort counties of Barnstable and Dukes, resulted in increased production for the second consecutive year. The estimated output of nearly 15 million short tons was an increase of 5% over that of 1984. Sales of sand and gravel rose 13%, or about $5.4 million over that of 1984. The unit price per ton (f.o.b. plant) of sand and gravel increased from $2.97 in 1984 to $3.19 in 1985, indicative of the strong demand by the construction industry. Nationally, sand and gravel prices rose from $2.90 per ton in 1984 to $3.05 per ton in 1985.

Industrial.—Two companies, one each in Middlesex and Plymouth Counties, produced industrial sand. The primary use for the material was sandblasting.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Output of 9.4 million short tons of crushed stone in 1985 was the highest in State history, surpassing the previous record high of 8.6 million tons in 1979. Demand from the construction indus-

try remained strong, and since 1983, housing starts increased 70%, and the value of State contract awards increased 84%.

About 70% of the stone produced was traprock (basalt) mined at 20 quarries in 9 counties primarily in central Massachusetts. Bituminous aggregate and unpaved road surfaces were the leading uses for the traprock.

Crushed granite was produced at three quarries in Bristol, Norfolk, and Plymouth Counties in the eastern part of the State. Leading uses for the granite were for bituminous aggregate and dense-graded road base.

Limestone was produced by three companies, all in Berkshire County in western Massachusetts. Two of the three quarries in the county were operated by the State's two lime manufacturers. The crushed limestone was also used for agricultural limestone, poultry grit, and filler.

Rhyolite was produced by one company in Middlesex County and sold primarily as fill.

Table 4.—Massachusetts: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	659	2,296
Coarse aggregate, graded:		
Concrete aggregate, coarse	601	2,980
Bituminous aggregate, coarse	1,573	8,415
Railroad ballast	449	1,625
Combined coarse and fine aggregates:		
Graded road base or subbase	800	3,735
Crusher run or fill or waste	456	2,563
Other construction[2]	2,044	9,994
Agricultural: Agricultural limestone	147	1,019
Special:		
Other miscellaneous[3]	554	3,074
Other unspecified[4]	2,069	7,179
Total[5]	9,354	42,881

[1]Includes granite, limestone, marble, traprock, and other crushed stone.
[2]Includes stone used in bituminous surface-treatment aggregate, unpaved road surfacing, filter stone, stone sand (concrete), stone sand (bituminous mix or seal), fine aggregate screen, and stone used for other construction maintenance purposes.
[3]Includes stone used in lime manufacture, flux stone, asphalt and other fillers or extenders, poultry grit and mineral food, and whiting or whiting substitute.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Dimension.—Nationally, Massachusetts ranked fifth in dimension stone production. Output of 73,000 short tons (877,000 cubic feet) was a 28% increase over that of 1984. Demand for granite curbing in bridge and street construction was the major reason for the increase.

Dimension granite was produced at seven quarries in Berkshire, Middlesex, and Plymouth Counties. Much of the granite was sold for curbing. One company in Berkshire County produced dimension marble, which was sold as rough blocks.

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[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.
[2]State geologist, Massachusetts Department of Environmental Quality, Boston, MA.

Table 5.—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.
Graphite (synthetic):			
Avco Corp	1275 King St., Box 9000 Greenwich, CT 06836	Plant	Middlesex.
The Stackpole Corp	Foundry Industrial Park Lowell, MA 01852	do	Do.
Gypsum (calcined):			
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Suffolk.
Lime:			
Lee Lime Corp.[2]	Marble St. Lee, MA 01238	Plant and quarry.	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:			
E. L. Dauphinais Inc	160 Worcester St., Box 488 North Grafton, MA 01536	Pits	Worcester.
Kimball Sand Co. Inc	Providence Rd., Box 29 Mendon, MA 01756	do	Do.
S. M. Lorusso & Sons Inc	331 West St. Walpole, MA 02081	do	Norfolk.
Rosenfeld Washed Sand & Stone Co.	Drawer E Milford, MA 01757	do	Worcester.
San-Vel Concrete Corp	Ayer Rd. Littleton, MA 01460	Pit	Middlesex.
Industrial:			
Holliston Sand Co. Inc	303 Lowland St., Box 97 Holliston, MA 01746	Pit	Do.
Whitehead Bros. Co	Box 259, River Rd. Leesburg, NJ 08327	Pit	Plymouth.
Stone:			
Crushed:			
John S. Lane & Son Inc	730 East Mountain Rd. Westfield, MA 01085	Quarries	Berkshire, Hampden, Hampshire.
S. M. Lorusso & Sons Inc	331 West St. Walpole, MA 02081	do	Middlesex, Norfolk, Suffolk.
Simeone Corp	1185 Turnpike St. Stoughton, MA 02072	do	Bristol and Norfolk.
Tilcon Inc	Box 114 Acushnet, MA 02743	Quarry	Bristol.
Trimount Bituminous Products Co.	1935 Revere Beach Parkway Everett, MA 02149	Quarries	Essex.
Dimension:			
H. E. Fletcher Co	West Chelmsford, MA 01863	Quarry	Middlesex.
Williams Stone Co. Inc	Box 278 East Otis, MA 01029	do	Berkshire.
Vermiculite (exfoliated):			
W.R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Hampshire.

[1]Also sand and gravel.
[2]Also stone.

The Mineral Industry of Michigan

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

By James J. Hill[1] and Wanda J. West[2]

Michigan's nonfuel mineral production, valued at $1.3 billion in 1985, decreased by nearly $61 million or 4% below the 1984 mineral value. Commodities decreasing the most in sales value were calcium chloride, 32%; industrial sand, 23%; salt, 20%; and bromine, lime, and iron oxide pigments, 18% each. Commodities increasing in sales value were peat, 25%; construction sand and gravel, 22%; and gypsum, 15%. Iron ore sales contributed the greatest amount to the State's overall mineral value, followed by portland cement and magnesium compounds.

Nationally, Michigan ranked sixth in value of nonfuel mineral production, accounting for approximately 6% of the U.S. total. The State ranked first in sales of calcium chloride, magnesium compounds, and peat; second in bromine, crude gypsum, and iron ore; third in construction sand and gravel; and fourth in portland cement and iron and steel slag.

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

Mineral		1984		1985	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	1,321	$5,052	1,477	$5,514
Gem stones		NA	15	NA	15
Gypsum	thousand short tons	1,534	10,304	1,772	11,883
Iron ore (usable)	thousand long tons, gross weight	13,263	W	12,629	W
Lime	thousand short tons	622	30,092	535	24,790
Peat	do.	227	4,341	282	5,414
Salt	do.	1,491	93,860	991	75,030
Sand and gravel:					
Construction	do.	36,071	76,540	e38,000	e93,000
Industrial	do.	3,400	33,060	3,345	25,469
Stone:					
Crushed	do.	e28,100	e92,000	30,685	95,953
Dimension	do.	e4	e129	4	113
Combined value of bromine, calcium chloride, cement, copper (1985), gold (1985), iodine, iron oxide pigments (crude), magnesium compounds, silver (1985), and values indicated by symbol W		XX	1,063,214	XX	1,010,672
Total		XX	1,408,607	XX	1,347,853

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

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

Table 2.—Nonfuel minerals produced in Michigan in 1984, by county[1]

County	Minerals produced in order of value
Alger	Sand and gravel (construction).
Allegan	Sand and gravel (construction), peat.
Alpena	Cement, clays, sand and gravel (construction).
Antrim	Sand and gravel (construction).
Arenac	Do.
Baraga	Do.
Barry	Do.
Bay	Cement, lime.
Benzie	Sand and gravel (construction).
Berrien	Sand (industrial), sand and gravel (construction).
Branch	Sand and gravel (construction).
Calhoun	Do.
Cass	Do.
Charlevoix	Cement, sand and gravel (construction).
Cheboygan	Sand and gravel (construction).
Chippewa	Do.
Clare	Do.
Clinton	Sand and gravel (construction), clays.
Delta	Sand and gravel (construction).
Dickinson	Do.
Eaton	Sand and gravel (construction), peat.
Emmet	Sand and gravel (construction).
Gogebic	Do.
Grand Traverse	Do.
Gratiot	Do.
Hillsdale	Do.
Houghton	Do.
Huron	Sand and gravel (construction), lime.
Ingham	Sand and gravel (construction), peat.
Ionia	Sand and gravel (construction).
Iosco	Gypsum, sand and gravel (construction).
Iron	Sand and gravel (construction).
Isabella	Do.
Jackson	Do.
Kalamazoo	Do.
Kalkaska	Do.
Kent	Sand and gravel (construction), gypsum.
Keweenaw	Sand and gravel (construction).
Lake	Do.
Lapeer	Sand and gravel (construction), peat, calcium chloride.
Leelanau	Sand and gravel (construction).
Lenawee	Do.
Livingston	Do.
Luce	Do.
Mackinac	Do.
Macomb	Do.
Manistee	Magnesium compounds, salt, bromine, sand and gravel (construction).
Marquette	Iron ore, sand and gravel (construction), iron oxide pigments.
Mason	Magnesium compounds, lime, bromine, sand (industrial), sand and gravel (construction).
Mecosta	Sand and gravel (construction), peat.
Menominee	Sand and gravel (construction).
Midland	Calcium chloride, magnesium compounds, bromine, iodine.
Missaukee	Sand and gravel (construction).
Monroe	Cement, clays, peat.
Montcalm	Sand and gravel (construction).
Muskegon	Sand (industrial), sand and gravel (construction).
Newaygo	Sand and gravel (construction).
Oakland	Sand and gravel (construction), peat.
Oceana	Sand (industrial), sand and gravel (construction).
Ogemaw	Sand and gravel (construction).
Ontonagon	Do.
Osceola	Do.
Oscoda	Do.
Otsego	Do.
Ottawa	Sand and gravel (construction), sand (industrial).
Presque Isle	Sand and gravel (construction).
Roscommon	Do.
Saginaw	Lime.
St. Clair	Salt, sand and gravel (construction).
St. Joseph	Sand and gravel (construction), peat.
Sanilac	Peat, lime, sand and gravel (construction).
Schoolcraft	Sand and gravel (construction).
Shiawassee	Peat, sand and gravel (construction), clays.
Tuscola	Sand (industrial), sand and gravel (construction), lime.
Van Buren	Sand (industrial), sand and gravel (construction).
Washtenaw	Sand and gravel (construction).
Wayne	Cement, lime, salt, sand (industrial), sand and gravel (construction), clays.
Wexford	Sand (industrial), sand and gravel (construction).
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Michigan business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	9,054	9,058	9,088
Total civilian labor force	do.	4,287	4,347	4,352
Unemployment	percent	14.2	11.2	9.9
Employment (nonagricultural):				
Mining total[1]	thousands	9.0	10.0	10.3
Metal mining[2]	do.	2.3	2.6	2.9
Nonmetallic minerals except fuels[2]	do.	2.5	2.7	2.7
Manufacturing total	do.	880.5	962.8	984.1
Primary metal industries	do.	49.5	53.6	51.7
Stone, clay, and glass products	do.	15.7	17.3	18.0
Chemicals and allied products	do.	39.8	40.7	40.9
Petroleum and coal products	do.	3.0	2.3	2.3
Construction	do.	86.5	92.7	98.7
Transportation and public utilities	do.	139.4	140.2	142.2
Wholesale and retail trade	do.	711.5	745.8	783.3
Finance, insurance, real estate	do.	151.4	154.4	161.3
Services	do.	675.0	708.0	745.3
Government and government enterprises	do.	569.8	567.2	579.9
Total[3]	do.	3,223.1	3,381.0	3,505.2
Personal income:				
Total	millions	$107,108	$117,661	$123,673
Per capita		$11,830	$12,989	$13,608
Hours and earnings:				
Total average weekly hours, production workers		42.5	43.2	43.1
Total average hourly earnings, production workers		$11.6	$12.2	$12.6
Earnings by industry:				
Farm income	millions	$394	$731	$761
Nonfarm	do.	$76,459	$84,901	$89,501
Mining total	do.	$393	$731	$761
Metal mining	do.	$87	$94	$104
Nonmetallic minerals except fuels	do.	$65	$74	$77
Oil and gas extraction	do.	$242	$289	$275
Manufacturing total	do.	$28,785	$33,373	$35,149
Primary metal industries	do.	$1,774	$1,915	$1,850
Stone, clay, and glass products	do.	$456	$528	$541
Chemicals and allied products	do.	$1,347	$1,428	$1,474
Petroleum and coal products	do.	$95	$93	$97
Construction	do.	$3,054	$3,349	$3,505
Transportation and public utilities	do.	$4,544	$4,766	$4,929
Wholesale and retail trade	do.	$11,085	$12,212	$12,889
Finance, insurance, real estate	do.	$3,172	$3,273	$3,641
Services	do.	$14,254	$15,749	$16,771
Government and government enterprises	do.	$10,944	$11,489	$11,908
Construction activity:				
Number of private and public residential units authorized[4]		21,638	27,872	37,592
Value of nonresidential construction	millions	$1,193.3	$1,815.4	$2,286.4
Value of State road contract awards	do.	$281.6	$221.5	$501
Shipments of portland and masonry cement to and within the State	thousand short tons	1,527	1,993	2,207
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,178.9	$1,408.6	$1,347.9
Value per capita		$130	$155	$148

[p]Preliminary. [r]Revised.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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.—Michigan Technological University (Michigan Tech) received a $5.75 million appropriation from the State to construct a pilot plant to test a new ironmaking process on a commercial scale. Developed by a Michigan Tech researcher, the patented process was being further developed by Pellet Technology Corp., 50% owned by Technology Development Corp., which is wholly owned by the Michigan Tech endowment fund. Pellets containing iron ore and carbon fines (coal or coke) are formed and hardened under steam pressure at temperatures much lower than the 2,400° F needed in conventional pellet furnaces. The carbon-bearing pellets are then melted in a hot-blast cupola furnace to produce various grades of iron, including ductile iron, gray iron, and conventional pig iron. Compared with conventional blast furnace methods, process savings were estimated between $60 to $70 per ton of hot metal. At yearend, Michigan Tech had narrowed its search for a plantsite to a location near Eagle Mills, about 3 miles east of the Marquette County Airport, close to rail service and raw materials. Pilot plant construction was to begin in early 1986.

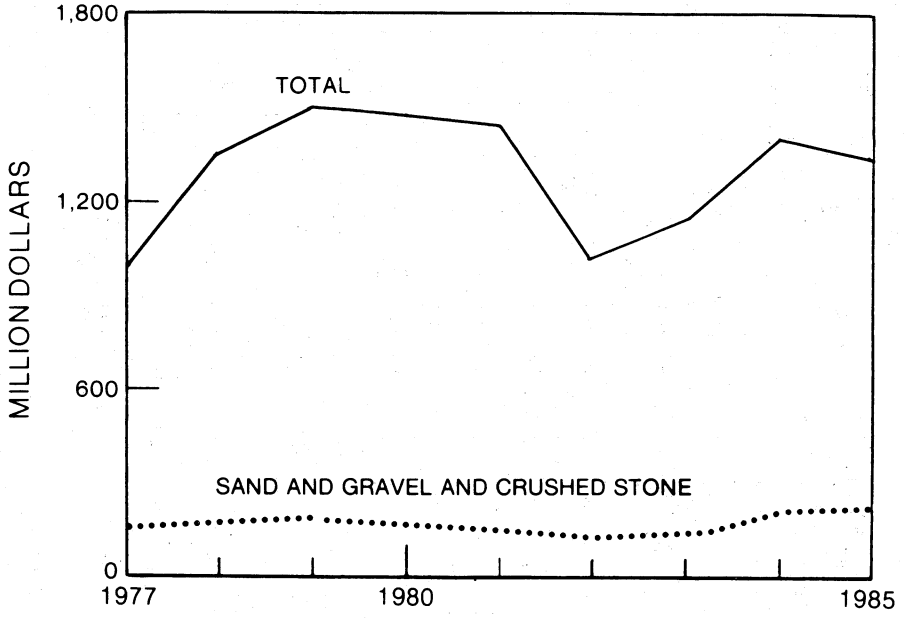

Figure 1.—Value of construction sand and gravel and crushed stone and total value of nonfuel mineral production in Michigan.

Depressed demand affected the iron and steel industry during 1985. Operating rates at the Empire and Tilden taconite mines, managed by Cleveland-Cliffs Iron Co., averaged about 86% and 70% of capacity, respectively, compared with 90% and 72% in 1984.[3]

The White Pine copper mine, idle since October 1982, was reopened in late November. Northern Copper Co., a company composed of members of the local United Steelworkers of America Union and former mine executives, purchased the mine in early November from Echo Bay Mines Ltd. of Alberta, Canada. The new owners plan to operate the mine under the name of Copper Range Co. (a name the mining operation has been historically identified with). The White Pine properties had been acquired by Echo Bay Mines when it purchased Copper Range from Louisiana Land and Exploration Co. in early January.

Callahan Mining Corp. began processing gold ore from its Ropes gold mine near Ishpeming in August. The firm converted the former Humboldt Mining Co. iron ore concentrator, which it purchased from Cleveland-Cliffs and the Rouge Steel Co., to process 2,000 tons of gold ore per day. Construction on the milling complex had begun in December 1984.

PPG Industries Inc. of Pittsburgh, PA, completed construction of a $5 million potash solution mining test facility in Hersey Township, Osceola County, in south-central Michigan and began testing the feasibility of the mining process. The tests, to be completed in 1986, will help determine whether a commercial potash extraction facility will be constructed.

Employment.—Michigan Employment Security Commission statistics showed that the State's average unemployment rate dropped from 11.2% in 1984 to 9.9% in 1985, indicating that the State's overall economy was still expanding. In the Upper Peninsula, the picture was not as bright; the average unemployment rate was 15.1% in 1985, up from 14.8% reported in 1984. Mining employment in the Upper Peninsula averaged about 2,700 persons during the year, fluctuating from a low of about 2,000 workers in September and October to a high of 3,000 in May, June, and August. In 1984, Upper Peninsula mining employment averaged 3,000 persons with a low of 2,700 workers in December and a high of 3,300 in May and June.

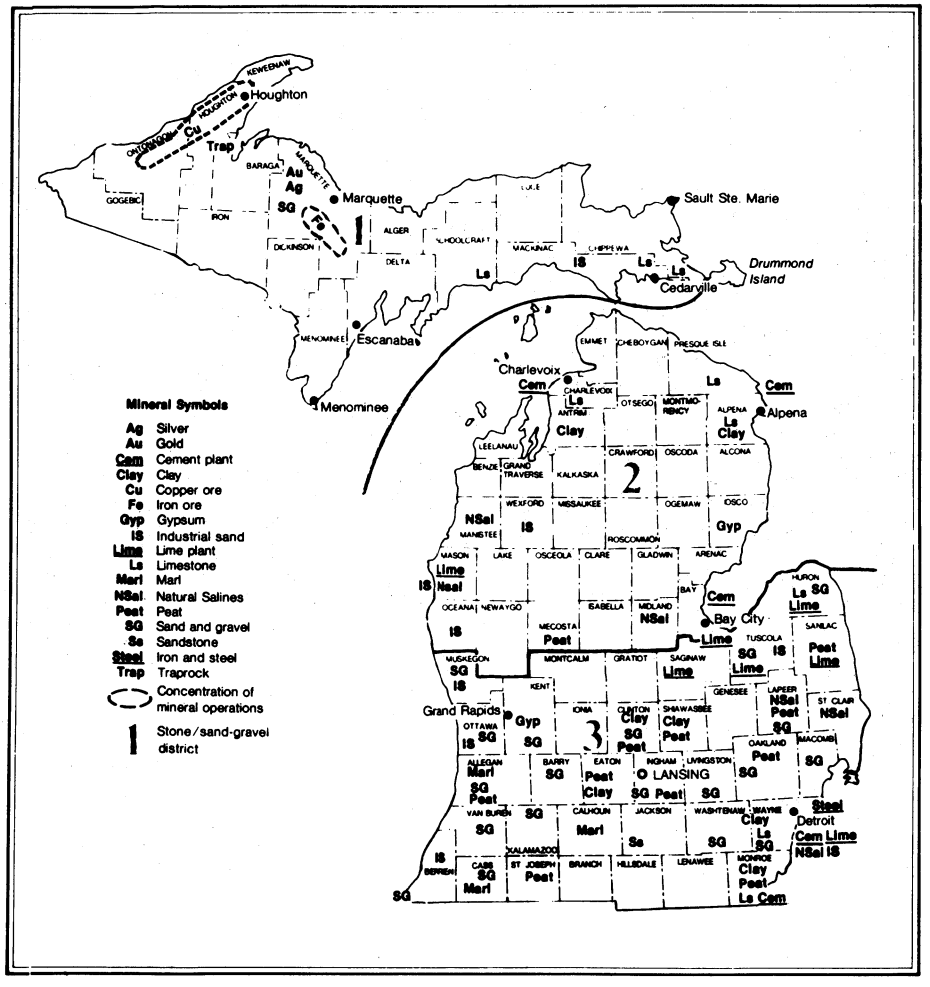

Figure 2.—Principal mineral producing localities in Michigan.

In November, the Michigan State AFL-CIO Northern Michigan Displaced Miners Assistance Project opened offices in Sault Ste. Marie to assist unemployed workers from Drummond Dolomite Inc. on Drummond Island; United States Steel Corp. in Cedarville; Inland Lime & Stone Co. in Gulliver; and other mining operations. Many of the workers had been laid off for 2 to 3 years and their jobs eliminated because of cutbacks in the quarry operations that supplied stone to the depressed steel industry.

The project offered assistance in job counseling, job search, relocation, and vocational-skill development through classroom and on-the-job training. The program was funded by a $1 million Federal grant funded by the U.S. Department of Labor's reserve fund—money set aside under the Job Training Partnership Act for special needs projects throughout the Nation.

Several mineral industry strikes were reported in the press during 1985.

Union workers at the White Pine mining complex were technically on strike most of the year until a new company was formed to purchase the complex from Echo Bay Mines in November. The strike began in August 1983.

Twenty-one workers at Bethlehem Steel Corp.'s Drummond Dolomite operations struck on April 15 over a contract renewal. The dispute was resolved on May 9.

Workers of the Oil, Chemical, and Atomic Workers Union ended a 2-month strike on July 31 at National Gypsum Co.'s facilities at Tawas City and National City. Involving about 93 hourly employees, the strike began on May 31 over a contract agreement.

American Aggregates Corp. reached an agreement with its workers on April 30 after they ratified a new 3-year contract that covered about 55 employees at 4 of its Michigan gravel mining sites. The union workers struck on April 8 over a disagreement on wage, pension, and health care benefits.

Exploration Activities.—On April 25, Michigan held its third metallic minerals lease sale, offering leases on 21,374.49 acres of State-owned mineral rights in four Upper Peninsula counties (Dickinson, Gogebic, Iron, and Marquette). Nine bidders registered for the sale with seven bidders placing successful bids for 15,440.15 acres of mineral lease rights. A summary of the sale follows:[4]

Successful bidder	Acres	Bonus bid
Amselco Exploration Inc	1,522	$12,286
Callahan Mining Corp	2,258	24,028
Cleveland-Cliffs Iron Co	559	1,677
Exmin Corp	2,081	26,752
Minatome Corp	4,774	5,723
Jack Murphy	3,076	18,585
Resource Exploration Inc	1,169	2,562
Total	[1]15,440	91,613

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

Bids ranged from $1.01 to $27.10 per acre with the highest bid offered for a 320-acre tract in Mansfield Township in Iron County. The average bid was $5.93 per acre, compared with an average bid of $4.76 per acre in 1984. A combination of the bonus bids, plus the first year's rental fee ($3.00 per acre) added $137,933.61 to the State coffers that will be distributed to the Heritage Trust Fund ($133,209.97) and Fish and Game Protection Fund ($4,723.64).

Six companies drilled 53 exploration holes on private and State lands in the Upper Peninsula during 1985. Total footage declined about 39% compared with footage drilled in 1984. Regulated by the State, drilling activity was reported in Dickinson, Gogebic, Iron, Marquette, and Menominee Counties. Most exploration activity focused on base and precious metals and diamonds. No discoveries were announced. Table 4 summarizes drilling activity in the Upper Peninsula.

Table 4.—Michigan: Metallic mineral exploration summary

	1983	1984	1985
Number of companies	7	8	6
Total holes drilled	39	83	53
Total footage drilled	8,754	15,007	9,117

Shipping.—The 1985 commercial navigation season on the Great Lakes began on April 1 with the opening of the American locks at Sault Ste. Marie and ended on January 2, 1986. The number of vessel passages for cargo carriers through the locks was 4,439, the lowest number in 10 years. The U.S. Army Corps of Engineers reported total tonnage through the locks at 74.1 million short tons, a decrease of almost 10% compared with the 82.4 million tons handled in 1984. Mineral commodities accounted for 76.4% of the 1985 total. Table 5 provides a statistical summary of mineral commodities passing through the locks in 1984 and 1985. Movement of some commodities on the Great Lakes was hampered by the closing of the St. Lawrence Seaway on October 14 for 24 days when a wall collapsed in a navigation lock on the Welland Canal. On November 29, the seaway closed for another 3 days when a freighter rammed a bridge on the St. Lawrence River near Montreal.

During 1985, the Corps of Engineers investigated the feasibility of constructing a new lock at Sault Ste. Marie. As recommended by the corps, the lock, to be built on the site of the existing Davis and Sabin locks, would be 1,294 feet long, 115 feet wide, and 32 feet deep. Approach channels to the lock would be deepened to 25.5 feet.

The lock would provide for safer and more economical movement of cargo and would be capable of handling the large carriers operating on the Great Lakes. Funds for the project would have to be appropriated by Congress.

Table 5.—Michigan: Mineral products shipped through the Sault Ste. Marie locks

(Short tons)

Commodity	1984	1985
Cement	467,512	501,931
Coal	11,446,950	12,419,324
Iron ore	40,763,507	39,492,771
Iron and steel (manufactured), pig iron	226,877	269,719
Potash	2,054,257	1,907,846
Salt	311,980	283,024
Scrap (ferrous)	76,395	54,248
Stone[1]	1,902,828	1,699,014
Total	57,250,306	56,627,877

[1]Includes broken stone, gravel, and sand.

Source: Corps of Engineers, Detroit District.

The Lake Carriers Association reported that 52.1 million long tons of iron ore moved across the Great Lakes during the 1985 shipping season, compared with 57.3 million tons of iron ore in 1984. About 37.3 million tons of iron ore was shipped from Lake Superior ports in 1985 and another 7.4 million tons from a Lake Michigan port. The rest of the iron ore shipments originated in eastern Canada.

Michigan iron ore was shipped from terminals at two ports—Chicago & Northwestern Transportation Co. Escanaba terminal on Lake Michigan and Lake Superior & Ishpeming Railroad Presque Isle terminal at Marquette on Lake Superior. Table 6 summarizes shipping activity at these ports.

Table 6.—Michigan: Salient iron ore shipping statistics

Year, port, and dock	Date of first shipment	Date of last shipment	Number of shipments	Total shipments (gross tons)	Average shipment (gross tons)	Largest shipment (gross tons)
1984:						
Marquette: LS&I Railroad	May 2	Dec. 27	198	4,457,341	22,512	31,510
Escanaba: C&NW Transportation Co	Mar. 8	Dec. 24	288	8,618,846	29,927	67,026
Total or average	-----	-----	486	13,076,187	26,906	67,026
1985:						
Marquette: LS&I Railroad	Apr. 3	Jan. 4[1]	209	5,071,106	24,264	59,331
Escanaba: C&NW Transportation Co	Mar. 28	Dec. 26	240	7,384,643	30,769	69,701
Total or average	-----	-----	449	12,455,749	27,741	69,701

[1]1986.

Source: Annual Reports of Lake Carriers' Association, 1984 and 1985.

The midyear lake freight rate from Marquette to lower lake ports was $6.11 per long ton. Lake freight charges from Escanaba to Lake Michigan ports was $4.45 per long ton and to Detroit and Lake Erie ports, $5.64 per long ton. These fees did not include loading, unloading, and dock charges.

Cleveland-Cliffs Steamship Co. continued to dispose of vessels in its inactive fleet. The ore carrier *Cliffs Victory* was sold to a New York firm for use in China. The steamers *Champlain* and *Cadillac* were sold to a Fort Lauderdale, FL, firm for scrap.

Legislation and Government Programs.—No legislation specifically related to nonfuel minerals was enacted into law during 1985. On September 30, Public Act No. 133 became law that created a 15-member Great Lakes and Water Resources Planning Commission for 2 years. The commission was charged with developing a comprehensive State water plan and recommending legislation or policy needed to promote the optimal use, management, and protection of the State's water resources.

The State Department of Natural Resources (DNR) developed policy for leasing nonmetallic minerals on State lands during the year. A lease document was created, and administrative rules were promulgated to govern the leasing process. Leases were to be sold at public auctions or issued directly to parties when in the best interest of the State. Leases were to be issued for a primary term of 10 years and to be continued thereafter as long as there was production of minerals or mineral products in paying quantities. A rental fee of $3.00 per acre was to be charged for the first through the fifth years of the lease. A minimum royalty of $10 per acre was to be charged for the sixth year of the lease, increasing $5.00 per acre per year through the 10 years of the lease. For the 10th year of the lease, and thereafter for the life of the lease, the minimum royalty would be $30.00 per acre. The lessee would also be required to pay a production royalty for minerals or mineral products produced on the leased premises. This royalty, depending on the commodity, ranged from 2% to 7%.

On the Federal level, the Michigan Wilderness Bill, H.R. 24, passed the House on September 17 and remained tied up in the Senate Committee on Agriculture at year-end. The House bill would designate about 3% of Michigan's national forest lands, or about 92,417 acres, as wilderness. A bill later introduced in the Senate would designate 81,660 acres as wilderness. All but one of the areas were in the Upper Peninsula.

The Michigan Geological Survey Division continued providing information on the State's geology and mineral resources to State and local officials and to the general public. During 1985, the Survey implemented an organizational change to become function oriented instead of program oriented. One organizational line, consisting of the Permits and Technical Evaluation Section and the Compliance and Field Administration Section, reports directly to the Assistant State Geologist. The other organizational line—the Geology Section, the Policy, Procedures, and Special Projects Unit, and the Geologic Information Systems Unit—reports to the State Geologist. Personnel with the Survey worked on State land exchanges and provided input and review of the U.S. Department of Energy's Crystalline Rock Project for disposal of high-level radioactive waste during the year. Regulatory functions in oil and gas, mineral wells, sand dune mining, and metallic and nonmetallic mineral leasing continued as in previous years.

Two researchers at Michigan Tech received a $416,798 grant from the U.S. Department of Energy to develop and demonstrate a static-tube flotation system for producing a superclean coal. The objective of the research, scheduled to run until 1988, was to demonstrate the potential of a Michigan Tech system to produce a superclean coal product having an ash content in the range of 0.4% to 1.0%; this range would make it economically competitive with a thermally equivalent petroleum-based product.

Michigan Tech received donations from two companies for its mining research program. Copper Range of White Pine donated two Wagner Scoop Tram vehicles, and Deutz Corp. of Atlanta, GA, donated an air-cooled diesel engine for use in the university's Experimental Mine in Hancock.

The U.S. Bureau of Mines provided $187,084 to the Mining and Mineral Resources Research Institute at Michigan Tech in fiscal year 1985. The funds assisted the institute's program for training engineers and scientists in mineral-related disciplines.

The U.S. Bureau of Land Management (BLM) released its final plan for surface and split-estate minerals on public domain lands in Michigan. The public domain tracts consist of 740 islands and 25 upland tracts, totaling approximately 3,200 acres scattered through 65 Michigan counties. These tracts were left in Federal ownership after the other, more desirable lands were placed in State or private ownership during settlement. The tracts include both surface and mineral-estate ownership. The split-estate minerals consist of numerous scattered tracts of Federal mineral estate under surface owned by the State, local governments, and private persons. The split-estate Federal mineral ownership totals approximately 136,000 acres.

The plan called for disposing of all remaining BLM-administered surface tracts

in the State, following resolution of title conflicts and site-specific land reports. All Federal mineral ownership remained available for exploration and development, except where legal restrictions, intergovernmental consistency requirements, administrative or congressional designations, or surface-resource sensitivity prohibit such activities.

For Federal mineral-estate holdings under State or local government or private surface, the plan defined management objectives based on mineral production potential. Management classes were defined for high, moderate, and low mineral production potential and for common variety mineral commodities.

The Federal Government distributed $1,114,750 to Michigan for its share of funds generated by activities (timbering, mineral leasing, recreation, user fees, etc.) on national forest land in fiscal year 1985. This figure compared with $1,213,250 in funds the State received in fiscal year 1984. Michigan's local governments received $1,277,249 in fiscal year 1985 funds as "payments in lieu of taxes" for Federal tax-exempt lands within their boundaries.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Bromine.—Michigan and Arkansas were the only States producing bromine in 1985. Major uses were for manufacturing chemicals, antiknock gasoline additives, fire retardants, and well drilling and completion fluids. Michigan's bromine was extracted from well brines in three counties. The Dow Chemical Co. operated plants in Mason and Midland Counties, and Morton Thiokol Inc. operated a plant in Manistee County. Production was estimated to have declined about 31%. The drop was related in part to Dow's announcement in 1984 that it planned to phase out its brine products operations at Midland and to consolidate them at Ludington. According to the Michigan DNR, Dow had 72 production wells, 36 injection wells to dispose of used brine, 17 solution mining wells in which water was pumped into salt formations and brine was withdrawn, and about 150 miles of pipeline. Because of environmental problems, Dow had agreed with Michigan officials to reduce its brine collection system to 25 production wells and 18 injection wells by midsummer.[5]

In November, Dow announced that it was offering an early retirement plan to salaried workers in hopes of trimming its worldwide operations by 2,500 jobs, including about 1,500 from the U.S. work force. The company hoped to eliminate the jobs by the end of January 1986. The action was stated as necessary because the performance of the industrial economy and the basic chemical business was below expectations and because a recovery had not occurred.[6]

Calcium Chloride.—Michigan ranked first of three States in producing calcium chloride. Production from well brines operated by Dow in Mason and Midland Counties and by Wilkinson Chemical Corp. in Lapeer County was estimated to have decreased about 30% during the year. Contributing to the decrease was the midyear closure of some Dow brine wells near Midland. The action was part of the company's announced plans to phase out its Midland brine operations and to concentrate them in Ludington.

Calcium chloride was used for concrete-set acceleration, road and pavement deicing, dust control and road base stabilization, oil and gas drilling, thawing bulk materials, and other miscellaneous uses.

Cement.—Michigan continued to rank fourth nationally in portland cement sales and seventh in masonry cement sales. Portland cement sales and value increased slightly during 1985, whereas sales and value of masonry cement dropped slightly. Five companies produced portland and masonry cement at four manufacturing plants and one grinding facility. All the plants produced Types I and II, general-use and moderate-heat portland cement and masonry cement. Other types of cement produced at one or more plants were Type III, high-early-strength; portland-pozzolan and/or portland blast furnace slag; and a waterproof portland. Approximately 7.4 million short tons of raw materials was consumed in manufacturing Michigan's cement. The St. Marys Cement Ltd. grinding plant at Wyandótte, Wayne County, reported no production during 1985.

Major sales of cement were to ready-mixed concrete companies (76%), concrete product manufacturers (13%), highway contractors (5%), and building material dealers (3%). Over 98% of the sales were shipped to consumers by truck. Cement shipments to

and within Michigan during 1985 included 2,103,000 short tons of portland cement and 104,000 tons of masonry cement—200,000 tons and 14,000 tons more, respectively, than in 1984.

Employees at two of Michigan's cement plants were working without a union contract at yearend. Dundee Cement Co.'s 151 hourly union plant workers were working under an implemented final offer instituted by the National Labor Relations Board after their contract expired on April 30, 1984.[7] Also, about 55 quarry workers at National Gypsum's Alpena plant had been working without a contract after it expired on April 30, 1984.

In June, National Gypsum sold the assets of its Huron Cement Div. eastern region to Allentown Cement Co., a Delaware corporation. The sale included plant facilities and quarries in Evansville, PA, and terminals at Bowie, MD, and Jersey City, NJ. The eastern region represented about 30% of National Gypsum's cement production capacity.

Later in the year, National Gypsum announced a plan to sell to LaFarge Corp. six Great Lakes cement distribution terminals and a 50% interest in a joint venture to operate seven other cement terminals owned by Huron Cement. In addition, LaFarge would receive options to purchase National Gypsum's remaining interest in the Huron terminals and certain assets at its Alpena cement plant. At yearend, the transaction had not received government approval.

Clays.—Nationally, Michigan ranked seventh in common clay and shale production. Continuing demands of the construction industry resulted in production and value increases of 12% and 9%, respectively. Clay was produced by seven companies in six counties. Alpena and Monroe Counties accounted for most of the State's output. Cement manufacturing consumed the greater part of the output, with lesser quantities used in manufacturing drain tile, face brick, flue linings, pottery, and sewer pipe.

Gem Stones.—Value of mineral specimens and semiprecious gem stones dealers and rockhounds collected was estimated to be $15,000. Agates, native copper, and petoskey stones (a fossil coral) were the most common specimens. Diamond exploration continued during 1985 with several companies acquiring leases at State lease sales, drilling kimberlite prospects, and conducting bulk sampling. No public announcements of diamond finds were made in 1985.

Gypsum.—Michigan climbed from third to second place in the national ranks of crude gypsum production in 1985. Continuing demand from the construction industry allowed producers to raise output about 16%, and value of sales increased 15%. Calcined gypsum increased 14%, and value of sales increased 29%. Crude gypsum was produced from underground mines in Kent County operated by Georgia-Pacific Corp. and Domtar Industries Inc.; and from surface mines in Iosco County by Michigan Gypsum Co., National Gypsum, and USG Corp. Georgia-Pacific and Domtar calcined gypsum at plants near their minesites. National Gypsum operated a wallboard plant south of National City, and USG shipped its crude to a plant in Detroit, Wayne County. Michigan Gypsum did not calcine its product. Gypsum was used mainly in wallboard manufacture, with lesser quantities used for agricultural purposes, building plaster, and cement manufacture.

Output from USG's Alabaster Mine and National Gypsum's Tawas Mine, both in Iosco County, ranked third and fifth, respectively, in the United States during 1985.

Hourly workers at National Gypsum's facilities at Tawas City and National City ended a 2-month contract dispute on July 31. During the strike, salaried employees operated the firm's facilities.

Iodine.—Dow continued extracting iodine from well brines at its Midland plant. Production was estimated to have declined when the company began to phase out operations and shut down some brine wells. Iodine was used in animal feed additives, catalysts, disinfectants, inks and colorants, pharmaceuticals, and stabilizers.

Iron Oxide Pigments.—Michigan ranked first of four States in shipping crude iron oxide pigments. All shipments originated from stockpiles at Cleveland-Cliffs' Mather Mine in Marquette County. Sales dropped about 19% during 1985.

Finished iron oxide pigments were produced by BASF Chemicals, Dyestuffs & Pigments Group, at a plant in Wyandotte, Wayne County. Major uses were for paint and coatings, inks, and plastics.

Lime.—Lime production declined about 14% during 1985, and Michigan dropped from 9th to 11th place nationally in output. Five companies produced quicklime at eight plants in seven counties. One company, Marblehead Lime Co., also produced hydrated lime at its plant in Wayne County. Michigan Sugar Co. operated the greatest number of plants with operations in Huron, Saginaw, Sanilac, and Tuscola Counties.

Wayne County, with two operations, led the State in production. Average value per ton of lime dropped $2.04. Lime was used in alkalies, steelmaking, sugar refining, and water treatment.

Magnesium Compounds.—Michigan continued to lead the Nation in magnesium compounds production. Dow had well brine operations in Mason and Midland Counties; Martin Marietta Corp., Magnesia Specialties Div., and Morton Thiokol each had a well brine operation in Manistee County. Although production declined about 17% during 1985, average value per ton increased about 29%. Difficulties in the steel industry contributed to the decline in sales of magnesia products.

Martin Marietta moved to improve its position in sales to agriculture and other industries by introducing several new products. Among them were a liquid-fertilizer ingredient for crop irrigation, an improved pellet binder for animal-feed supplements, and several dust-control agents.[8]

Peat.—Michigan led the Nation in peat production during 1985; output increased about 25% over that reported in 1984. Average value per ton of peat remained essentially the same as in 1984. Production was by 15 companies in 12 counties. The principal producing county was Sanilac, followed by Lapeer, Shiawassee, Oakland, and Clinton Counties. These counties collectively accounted for 88% of the State's output. The major type of peat mined was reed-sedge, followed by humus and sphagnum. About 73% of the sales was in packaged form. Most was used for general soil improvement.

Michigan Peat Co. announced a major expansion at its Minden City harvesting operation following completion of a new road in the area that was funded by a Small Cities Grant to Sanilac and Huron Counties and the Michigan Department of Transportation. The company planned to spend $200,000 on capital equipment and to create approximately 68 new jobs at the expanded peat operation.

In November, because Garrett Peat Industries Inc. failed to fulfill bonding and insurance requirements, the Michigan DNR terminated processing a direct peat mining lease on the 1,496-acre Dingman Marsh in Cheboygan County. The company forfeited about $40,000 in bonus money and rental fees to the State because of this action.

Perlite (Expanded).—Crude perlite mined in Western States was expanded by Harborlite Corp. at a plant in Vicksburg, Kalamazoo County, and by USG at a plant in River Rouge, Wayne County. Although sales dropped slightly during 1985, overall value of sales increased about 2%. Expanded perlite was used as a filler, filter aid, and for plaster aggregate.

Salt.—Michigan ranked seventh in 14 States in salt production. Sales decreased about 34% in 1985, partly because of the closure of one operation at yearend 1984. The average value per short ton of salt increased $12.77. Salt was produced by four companies in three counties, led by Manistee County. Salt was used in food and chemical processing, for ice control, and as table salt.

Diamond Crystal Salt Co. of St. Clair acquired the Salt Div. of Hardy Salt Co. during 1985. Assets transferred were Hardy's salt plants in Manistee, MI, and Williston, ND, and distribution centers in Minnesota, Missouri, Ohio, Utah, and Wisconsin.

International Salt Co. sold its Detroit Mine early in the year to Crystal Mines Inc. Crystal Mines resumed public mine tours and intended to seek State and Federal permits to convert the mine to a hazardous waste storage facility.

At yearend, Pennwalt Corp. closed its chlorine and caustic soda production plant at Wyandotte as part of a major restructuring program. Established in 1850, the operation had employed about 950 persons.

The Michigan DNR issued orders in March that would phase out all use of oilfield brine for dust and ice control by January 1, 1988. Officials said that 40 of Michigan's 83 counties, as well as some townships, used oilfield brine for ice and dust control. The ruling followed a State report declaring that the brine contained traces of cancer-causing chemicals such as benzene, toluene, and xylene.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel production in 1985 was estimated at 38 million short tons, or about 5% over 1984 levels. The increase can be attributed to the continuing high construction activity.

American Aggregates continued its legal fight with Highland Township, Oakland County, which began in 1977 over American Aggregates' attempt to have an 824-acre parcel it owned zoned for sand and gravel

extraction. A circuit court judge had ruled in favor of the township, stressing increased traffic, noise, decreased property values, and impacts on the township's property tax base. American Aggregates challenged the ruling in the Michigan Court of Appeals. A ruling on the case was expected in 1986.

Industrial.—Michigan ranked second in industrial sand output, following Illinois, the Nation's leading producer. Production dropped about 2%, reflecting lighter demand by the foundry, glass, and oil markets. Average value of sales dropped almost 22% because of declines in the price of sand for nearly all use categories. The largest percentage of industrial sand produced in the State was for foundry use. Eight companies mined sand at 12 locations in 8 counties. Ottawa and Berrien Counties, respectively, led the State's production, accounting for nearly one-half of the total. Most of the State's industrial sand was shipped to consumers by truck.

Sand Products Corp. reached a milestone in September when the first Great Lakes freighter arrived to receive a load of sand at its operations in Brevort, Mackinac County. The company had been developing the site since 1965 to process and ship sand to foundries in the lower Great Lakes region. The company had spent several million dollars to develop the sand mine, processing plant, storage facilities, and shipping terminal. Twelve persons were employed at the Brevort Mine.

Slag—Iron and Steel.—Michigan continued to rank fourth nationally in sales of processed iron and steel slag. Edward C. Levy Co. processed slag in Wayne County from the steel mills of McLouth Steel Products Corp.; the Great Lakes Steel Div. of National Steel Corp., and Rouge Steel. Most of the processed slag was sold for road base and fill material; lesser quantities were sold for concrete aggregate, asphaltic concrete aggregate, and lightweight concrete aggregate. Miscellaneous uses, listed in order of quantities used, were for concrete products, roofing, pozzolanic cement manufacture, mineral wool, and railroad ballast.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Nationally, Michigan ranked 15th of 49 States in crushed stone production. Production and value increased 9% and 4%, respectively. Crushed stone was mined by 29 companies in 21 counties at 36 quarries. Limestone and dolomite accounted for more than 99% of all sales. Small quantities of marl and traprock were produced. Quarries in Chippewa, Mackinac, and Schoolcraft Counties of the Upper Peninsula and Alpena, Charlevoix, and Presque Isle Counties in the northern Lower Peninsula accounted for 78% of the State's total production.

Table 7.—Michigan: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	240	908
Filter stone	500	1,959
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,596	4,685
Bituminous aggregate, coarse	394	1,211
Bituminous surface-treatment aggregate	648	2,423
Railroad ballast	617	2,164
Fine aggregate (-3/8 inch):		
Stone sand, concrete	85	216
Stone sand, bituminous mix or seal	507	1,528
Screening, undesignated	225	503
Combined coarse and fine aggregates:		
Graded road base or subbase	2,966	6,756
Unpaved road surfacing	1,229	4,953
Other construction[2]	664	2,100
Agricultural: Agricultural limestone	444	1,759
Chemical and metallurgical:		
Cement manufacture	6,146	14,250
Lime manufacture	5,801	18,222
Flux stone	6,265	21,674
Special:		
Other miscellaneous[3]	127	380
Other unspecified[4]	2,233	10,261
Total[5]	30,685	95,953

[1]Includes limestone, dolomite, marl, traprock, and other crushed stone.
[2]Includes stone used in terrazzo and exposed aggregate, crusher run, and other construction purposes.
[3]Includes stone for chemical, disinfectant, waste material, poultry grit and mineral food, and other uses not listed.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

In 1985, the U.S. Bureau of Mines began compiling crushed stone production statistics by districts for some States. Table 8 presents end-use data for crushed stone produced in the three Michigan districts that are outlined in figure 2.

Table 8.—Michigan: Crushed stone sold or used by producers in 1985, by use and district

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	401	1,762	276	756	62	349
Coarse aggregate, graded	600	2,306	1,470	3,576	1,184	4,601
Fine aggregate (-3/8 inch)	614	1,844	117	146	84	256
Combined coarse and fine aggregates	292	1,009	3,131	6,798	1,336	5,603
Other construction	--	--	--	--	100	400
Agricultural limestone	227	731	--	--	217	1,028
Cement manufacture	--	--	5,008	10,654	1,138	3,596
Lime manufacture	W	W	W	W	--	--
Flux stone	W	W	W	W	--	--
Chemical stone	W	W	--	--	--	--
Other miscellaneous	3,728	14,268	8,441	25,933	27	75
Other unspecified[1]	56	84	78	237	2,099	9,940
Total	5,918	22,004	18,521	48,100	[2]6,246	25,848

W Withheld to avoid disclosing individual company proprietary data; included with "Other miscellaneous."
[1]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[2]Data do not add to total shown because of independent rounding.

In October, Bethlehem announced it would put up for sale its subsidiary, Drummond Dolomite, with quarry operations on Drummond Island. About 86 persons were employed at the operation, which had been in existence for 40 years. Operations were to continue with no change in plans for the regular winter shutdown and reopening in midspring 1986.

Dimension.—Onaway Stone Co. and Inwood Stone Products Co. quarried limestone in Presque Isle and Schoolcraft Counties, respectively, that was sold primarily for building and other construction uses. Sandstone was produced at Jude Stone Quarry in Jackson County for curbing use.

Sulfur (Recovered).—Byproduct sulfur, 16% less than in 1984, was recovered at the petroleum refining operations of Marathon Oil Corp. in Wayne County and Shell Western E&P Inc. in Manistee County. Average value per metric ton of sulfur sold increased $27.08. Most of the sulfur recovered was used in the manufacture of sulfuric acid. Total Petroleum Inc. did not report sulfur recovery from its refinery in Gratiot County in 1985.

Vermiculite (Exfoliated).—W. R. Grace & Co. exfoliated crude vermiculite shipped in from other States. Sales increased about 3% during 1985. Value per short ton increased about 8% or $15.60. In order of quantity of sales, vermiculite was used for agricultural purposes, block insulation, fireproofing, loose-fill insulation, and concrete and plaster aggregates.

METALS

Abrasives (Manufactured).—Steel shot and grit were manufactured by three companies: Abrasive Materials Inc. at Hillsdale, Hillsdale County; Ervin Industries Inc. at Adrian, Lenawee County; and Metaltec Steel Abrasives Co. at Canton, Wayne County. Abrasive Materials was the lone producer of cut wire shot. Steel shot and grit sales declined about 4%, whereas cut wire shot sales increased 28%. Manufactured abrasives were used primarily by the automotive, foundry, and steel industries.

Copper, Gold, and Silver.—Production at White Pine copper mine in the Upper Peninsula began on November 25, the first time in 3 years, when an 11-worker crew began mining after several weeks of training and mine preparation. About 250 workers were on the payroll at that time. The mine had been purchased by Northern Copper earlier in the month from Echo Bay Mines of Alberta, Canada. Northern Copper, a company formed as a vehicle for purchasing the mine, consisted of former mine executives, laid-off employees, and members of the local United Steelworkers of America Union. The company will operate under the name Copper Range, a name the mining operation has been historically identified with. Echo Bay Mines purchased Copper Range from Louisiana Land and Exploration in January.

The union mine workers signed a 5-year contract that put the average wage at $8.50

per hour, about $3.00 per hour below the average wage for all miners. The contract called for miners to work under an incentive system that included bimonthly pay for above-average production, profit sharing when the mine began making money, and an employee stock ownership plan that owned 70% of the operation. This level of stock ownership will go down to 50% when stock is sold on the open market.

The mine smelter was to start up in early 1986 when mine production reached levels that could sustain its operation. Expected to produce 60,000 tons of copper and 1.3 million troy ounces of silver per year, the mine had about 39 years of reserves.

In 1985, about 4,900 troy ounces of gold and 3,300 ounces of silver were sold from Callahan Mining's Ropes gold mine near Ishpeming.[9] This gold production was the first credited to Michigan since 1937 when less than 100 ounces of gold was sold. Production had been reported in the years spanning 1887-1901, 1933-34, and 1937. According to Government records, which date back to 1845, cumulative gold production in Michigan was 33,417 ounces up to 1985.

Silver production had not been reported in the State since 1982 when the White Pine copper mine suspended operations.

On October 18, Callahan Mining held an official dedication ceremony for its Ropes gold mining complex. The company began developing the mining complex in 1983 and was expected to have a total investment of about $23 million when a new shaft on the property is completed in 1986. The first doré bullion from the property was poured on September 20.

Iron Ore.—Michigan continued to rank second, behind Minnesota, in iron ore shipments. Taconite shipments from Cleveland-Cliffs' operations on the Marquette Range declined about 5% during the year, as the steel industry continued to suffer from low demand and competition from foreign imports. As in the past several years, Cleveland-Cliffs' Empire and Tilden Mines were the only active taconite operations in Michigan, operating at 86% and 70% capacity, respectively.[10]

Table 9.—Michigan: Usable iron ore[1] produced (direct shipping and all forms of concentrates), by range

(Thousand long tons, gross weight, unless otherwise specified)

Year	Marquette Range	Menominee Range (Michigan part)	Gogebic Range (Michigan part)	Total		
				Gross weight		
				Ore	Iron content	Iron content (percent)
1854-1980	507,606	316,157	[2]249,625	1,073,388	NA	NA
1981	15,508	75	--	15,583	10,020	64.3
1982	6,874	--	--	6,874	4,426	64.4
1983	9,339	--	--	9,339	6,024	64.5
1984	12,982	--	--	12,982	8,374	64.5
1985	12,479	--	--	12,479	8,052	64.5
Total	564,788	[3]316,232	[3]249,625	1,130,645	NA	NA

NA Not available.
[1]Exclusive after 1905 of iron ore containing 5% or more manganese.
[2]No production after 1979.
[3]Distribution by range partly estimated before 1906.

The Empire Mine was shut down for 7 weeks beginning September 1 because two partners in the operation, LTV Steel Corp. and Inland Steel Co., were unable to handle the ore they had originally been scheduled to receive. The Tilden Mine was shut down for approximately 1-1/2 months beginning on June 15, after a major fire partly destroyed the pellet plant's main conveyor system.

Iron and Steel.—Michigan ranked fourth of 11 States in pig iron shipments. Shipments were about 4.8 million short tons in 1985, compared with 5.1 million tons in 1984, a decline of nearly 6%. The steel industry continued to invest in new technology and to cut costs in an effort to battle foreign imports and maintain customers.

McLouth Steel completed its $50 million capital-investment program by installing a new computer for its hot-strip mill and an external iron desulfurizer for its blast furnace to produce cleaner steel. The firm also completed a major rebuild of its electrical

furnaces and installed a new metallurgical station.

National Steel announced that it would upgrade its Great Lakes Steel Div. mill in Detroit by installing a second continuous caster, a ladle metallurgy system, and other support facilities. To be completed in mid-1987, the caster will be a two-strand unit with an annual capacity of 2.2 million short tons.

Ford Motor Co. officials announced that they would put their Rouge Steel facility up for sale because of steel industry overcapacity and problems and losses the firm was suffering on its steel operations. The plant had been offered for sale in 1983, but talks with a Japanese consortium interested in purchasing the plant were suspended.

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[1]State Mineral Officer, Bureau of Mines, Minneapolis, MN.
[2]Editorial assistant, Bureau of Mines, Minneapolis, MN.
[3]Cleveland-Cliffs Iron Co. 1985 Annual Report. P. 6.
[4]Michigan Natural Resources Commission. Agenda, Natural Resources Commission, May 15-17, 1985. P. 92.
[5]The Mining Journal (Marquette, MI). Dow To Close Brine Well Network. May 4, 1985.
[6]Detroit Free Press. Dow Plans To Cut 2,500. Nov. 20, 1985.
[7]Evening News (Monroe, MI). Dundee Cement Co., Union Still at Odds. Sept. 4, 1985.
[8]Martin Marietta Corp. 1985 Annual Report. P. 12.
[9]Callahan Mining Corp. 1985 Annual Report. P. 5.
[10]Work cited in footnote 3.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Aetna Cement Corp., a subsidiary of Lake Ontario Cement Ltd.	Box 80 Essexville, MI 48732	Grinding plant	Bay.
Dundee Cement Co., a division of Holderbank Financiere Glaris SA.[1 2]	Box 122 Dundee, MI 48131	Quarry, clay pit, plant	Monroe.
Medusa Cement Co., Medusa Corp., a subsidiary of Crane Co.[1 2]	Box 5668 Cleveland, OH 44101	Quarry and plant Clay pit	Charlevoix. Antrim.
National Gypsum Co., Huron Cement Div.[1 2]	4000 Town Center Suite 2000 Southfield, MI 48075	Quarry, clay pit, plant	Alpena.
St. Marys Peerless Cement Co, a division of St. Marys Cement Ltd.	9333 Dearborn St. Detroit, MI 48209	Plant	Wayne.
Clays:			
Grand Ledge Clay Products Co	Box 66 Grand Ledge, MI 48131	Clay pits and plant	Clinton and Eaton.
F. W. Ritter Sons Co	12670 North Dixie Hwy. South Rockwood, MI 48179	Clay pit and plant	Monroe.
Charles J. Rogers Inc	Box 3080 Melvindale, MI 48122	Clay pit	Wayne.
U.S. Brick Co., Michigan Div., a subsidiary of Canada Brick Co.	3820 Serr Rd. Corunna, MI 48817	Clay pit and plant	Shiawassee.
Copper:			
Copper Range Co.[3]	Box 100 White Pine, MI 49971	Underground mine, concentrator, smelter, refinery.	Ontonagon.
Gold:			
Callahan Mining Corp.[3]	6245 North 24th St. Phoenix, AZ 85016	Underground mine and mill.	Marquette.
Gypsum:			
Domtar Industries Inc	Box 1670 Grand Rapids, MI 49501	Underground mine and plant.	Kent.
Georgia-Pacific Corp	133 Peachtree St., NE. Atlanta, GA 30303	do	Do.
Michigan Gypsum Co	Box 6280 Saginaw, MI 48608	Open pit mine	Iosco.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	Open pit mine and plant.	Do.
USG Corp	101 South Wacker Dr. Chicago, IL 60606	Open pit mine Plant	Do. Wayne.
Iron ore:			
Cleveland-Cliffs Iron Co.[4]	504 Spruce St. Ishpeming, MI 49849	Open pit mines and plants.	Marquette.
Iron and steel:			
McLouth Steel Products Corp	300 South Livernois Ave. Detroit, MI 48217	Plant	Wayne.
National Steel Corp., Great Lakes Steel Div.	Tecumseh Rd. Ecorse, MI 48229	do	Do.
Rouge Steel Co., a subsidiary of Ford Motor Co.	3001 Miller Rd. Dearborn, MI 48121	do	Do.
Lime:			
Detroit Lime Co., a subsidiary of Edward C. Levy Co.	9300 Dix Ave. Dearborn, MI 48120	do	Do.
The Dow Chemical Co., Ludington Div	2020 Dow Center Midland, MI 48640	do	Mason.
Marblehead Lime Co., a division of General Dynamics Corp.	300 West Washington St. Chicago, IL 60606	Plants	Wayne.
Michigan Sugar Co	Box 1348 Saginaw, MI 48605	do	Huron, Saginaw, Sanilac, Tuscola.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Peat:			
Al-Par Peat Co	9551 Krouse Ovid, MI 48866	Bog and plant	Shiawassee.
Balzer Peat Products Inc	9698 Coleman Rd. Haslett, MI 48840	do	Clinton.
Fletcher & Rickard	25800 Haas Rd. New Hudson, MI 48165	do	Oakland.
Hyponex Corp	2013 South Anthony Blvd. Fort Wayne, IN 46803	Bogs and plants	Lapeer and Shiawassee.
Michigan Peat Co	Box 66388 Houston, TX 77266	do	Sanilac.
Perlite (expanded):			
Harborlite Corp	Box 458 Escondido, CA 92025	Plant	Kalamazoo.
USG Corp	101 South Wacker Dr. Chicago, IL 60606	do	Wayne.
Salines (natural):[5]			
The Dow Chemical Co	2020 Dow Center Midland, MI 48640	Brine wells and plants	Mason and Midland.
Martin Marietta Corp., Magnesia Specialties Div.	Executive Plaza II Hunt Valley, MD 21030	Brine wells and plant	Manistee.
Morton Thiokol Inc	110 North Wacker Dr. Chicago, IL 60606	do	Do.
Salt:			
Diamond Crystal Salt Co	916 South Riverside St. Clair, MI 48079	do	St. Clair.
Morton Salt Co., a division of Morton Thiokol Inc.	110 North Wacker Dr. Chicago, IL 60606	do	Do.
Sand and gravel:			
Construction (1984):			
American Aggregates Corp	Drawer 160 Greenville, OH 45331	Pits and plants	Kalamazoo, Livingston, Macomb, Oakland.
Blount Materials Corp	Box 1468 Saginaw, MI 48605	do	Oakland and Osceola.
Holloway Sand & Gravel Co. Inc	29250 Wixom Rd. Wixom, MI 48096	do	Lapeer, Oakland, Washtenaw.
Edward C. Levy Co.:			
Lyon Sand & Gravel Co	8800 Dix Ave. Detroit, MI 48209	do	Oakland.
Milford Sand & Gravel Co	do	do	Do.
Bill Smith Sand & Gravel Inc	Box 23 Otsego, MI 49078	do	Allegan, Delta, Huron, Kalamazoo, Tuscola.
Whittaker & Gooding Co	5800 Cherry Hill Rd. Ypsilanti, MI 48197	do	Lapeer, Oakland, Washtenaw.
Yerington Construction Co	1055 North Shore Dr. Benton Harbor, MI 49022	do	Barry, Berrien, Cass, Kalamazoo, Van Buren.
Industrial:			
Construction Aggregates Corp	Box 68 Ferrysburg, MI 49409	do	Ottawa.
Manley Bros. of Indiana Inc	Box 538 Chesterton, IN 46304	Pit and plant	Berrien.
Nugent Sand Co. Inc	Box 1209 Muskegon, MI 49443	Pits and plants	Muskegon.
Ottawa Silica Co., Michigan Silica Div.	Box 577 Ottawa, IL 61350	Pit and plant	Wayne.
Sand Products Corp	1938 First National Bldg. Detroit, MI 48226	do	Oceana.
Sargent Sand Co	Box 6280 Saginaw, MI 48603	Pits and plants	Mason, Tuscola, Wexford.
Unimin Corp	258 Elm St. New Canaan, CT 06840	Pit and plant	Berrien.
Slag—iron and steel:			
Edward C. Levy Co	8800 Dix Ave. Detroit, MI 48209	Plants	Wayne.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Crushed:			
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.
Rockwood Stone Inc	Box 113 Rockwood, MI 48173	Quarries and plants	Monroe and Wayne.
United States Steel Corp., Michigan Limestone Operations.	Rogers City, MI 49779	do	Mackinac and Presque Isle.
Marl:			
Poehlman & Son	Route 2 Cassopolis, MI 49031	Pit	Cass.
Traprock:			
Houghton County Road Commission.	Box 269 Hancock, MI 49930	Quarries and plant	Houghton.
Dimension:			
Limestone:			
Inwood Stone Products Co	Box 24 Cooks, MI 49817	Quarry	Schoolcraft.
Onaway Stone Co	715 Three Mile Rd. Traverse City, MI 49684	do	Presque Isle.
Sandstone:			
Jude Stone Quarry Co	338 Austin Rd. Napoleon, MI 49261	do	Jackson.
Sulfur (recovered):			
Marathon Oil Corp	1300 South Fort St. Detroit, MI 48217	Elemental sulfur recovered as a byproduct of oil refining.	Wayne.
Shell Western E&P Inc	Box 1523 Houston, TX 77251	do	Manistee.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Processing plant	Wayne.

[1]Also clays.
[2]Also crushed limestone.
[3]Also silver.
[4]Also iron oxide pigments.
[5]Includes bromine, calcium chloride, 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 J. Hill[1] and Wanda J. West[2]

Minnesota's nonfuel mineral production was valued at $1.5 billion in 1985, down about 8% compared with the $1.7 billion value reported in 1984. Most of the decline was attributable to the $131.2 million drop in value of iron ore shipments. Lime and crushed stone production values also declined in 1985. For the first time since 1913, no shipments of manganiferous iron ore from the Cuyuna Range were reported. Value of sales increased for clays, peat, construction and industrial sand and gravel, and dimension stone. Minnesota ranked fifth among the States in value of nonfuel mineral production, accounting for nearly 7% of the U.S. total. The State ranked 1st in iron ore production, 6th in sales of peat, and 10th in sales of both construction sand and gravel and dimension stone.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$5	NA	$5
Iron ore (usable)—thousand long tons, gross weight	35,602	1,561,516	34,977	1,430,353
Manganiferous ore—short tons	68,019	W	--	--
Peat—thousand short tons	24	W	34	1,720
Sand and gravel:				
Construction—do	22,612	49,087	e25,000	e55,500
Industrial—do	W	W	884	16,910
Stone:				
Crushed—do	e8,900	e25,800	7,756	22,601
Dimension—do	e39	e13,369	37	13,598
Combined value of clays, lime, and values indicated by symbol W	XX	26,470	XX	7,271
Total	XX	1,676,247	XX	1,547,958

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

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

Table 2.—Nonfuel minerals produced in Minnesota in 1984, by county[1]

County	Minerals produced in order of value
Aitkin	Peat, sand and gravel (construction).
Anoka	Sand and gravel (construction).
Becker	Do.
Beltrami	Do.
Benton	Do.
Blue Earth	Do.
Brown	Clays, sand and gravel (construction).
Carlton	Peat, sand and gravel (construction).
Carver	Sand and gravel (construction).
Cass	Do.
Chippewa	Do.
Chisago	Do.
Clay	Lime, sand and gravel (construction).
Clearwater	Sand and gravel (construction).
Cook	Do.
Cottonwood	Do.
Crow Wing	Sand and gravel (construction), manganiferous ore.
Dakota	Sand and gravel (construction).
Dodge	Do.
Douglas	Do.
Freeborn	Do.
Goodhue	Do.
Hennepin	Do.
Houston	Do.
Hubbard	Do.
Itasca	Iron ore, sand and gravel (construction).
Jackson	Sand and gravel (construction).
Kanabec	Do.
Kandiyohi	Do.
Kittson	Do.
Koochiching	Do.
Lac qui Parle	Do.
Lake	Do.
Lake of the Woods	Do.
Le Sueur	Sand (industrial), sand and gravel (construction).
Lincoln	Sand and gravel (construction).
Lyon	Do.
McLeod	Do.
Mahnomen	Do.
Marshall	Do.
Martin	Do.
Meeker	Do.
Mille Lacs	Do.
Morrison	Do.
Mower	Do.
Murray	Do.
Nicollet	Do.
Norman	Do.
Olmsted	Do.
Otter Tail	Sand and gravel (construction), peat.
Pennington	Sand and gravel (construction).
Pine	Do.
Polk	Lime, sand and gravel (construction).
Pope	Sand and gravel (construction).
Ramsey	Do.
Red Lake	Do.
Redwood	Clays, sand and gravel (construction).
Renville	Lime, sand and gravel (construction).
Rice	Sand and gravel (construction).
Rock	Do.
Roseau	Do.
St. Louis	Iron ore, sand and gravel (construction), peat.
Scott	Sand (industrial), sand and gravel (construction).
Sherburne	Sand and gravel (construction).
Sibley	Do.
Stearns	Do.
Steele	Do.
Stevens	Do.
Swift	Do.
Todd	Do.
Wabasha	Do.
Wadena	Do.
Washington	Sand and gravel (construction), sand (industrial).
Watonwan	Sand and gravel (construction).
Wilkin	Do.
Winona	Do.
Wright	Do.
Yellow Medicine	Do.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Minnesota business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	4,145	4,163	4,193
Total civilian labor force	do.	2,176	2,229	2,234
Unemployment	percent	8.2	6.3	6.0
Employment (nonagricultural):				
Mining total[1]	thousands	8.4	9.4	8.3
Metal mining[2]	do.	6.5	7.4	6.4
Nonmetallic minerals except fuels[3]	do.	1.5	1.6	W
Manufacturing total	do.	346.3	373.7	374.9
Primary metal industries	do.	5.5	6.3	6.2
Stone, clay, and glass products	do.	8.5	8.5	7.7
Chemicals and allied products[3]	do.	7.6	8.1	8.6
Petroleum and coal products[3]	do.	1.7	1.6	1.6
Construction	do.	60.4	67.6	71.0
Transportation and public utilities	do.	92.8	96.9	98.7
Wholesale and retail trade	do.	430.3	455.8	466.9
Finance, insurance, real estate	do.	101.2	106.1	110.8
Services	do.	392.4	416.6	434.0
Government and government enterprises	do.	286.6	293.7	301.5
Total	do.	1,718.4	1,819.8	1,866.1
Personal income:				
Total	millions	$49,919	$57,728	$59,068
Per capita		$12,043	$13,385	$14,087
Hours and earnings:				
Total average weekly hours, production workers		39.7	40.3	40.3
Mining and quarrying[2]		35.1	38.5	39.4
Metal mining[2]		33.5	37.4	38.5
Total average hourly earnings, production workers		$9.6	$9.8	$10.0
Mining and quarrying[2]		$12.23	$12.94	$12.96
Metal mining[2]		$13.22	$13.82	$13.84
Earnings by industry:				
Farm income	millions	$406	$1,396	$1,236
Nonfarm	do.	$36,071	$40,092	$42,897
Mining total	do.	$331	$383	$349
Metal mining	do.	$211	$242	$218
Nonmetallic minerals except fuels	do.	$41	$47	$49
Manufacturing total	do.	$9,044	$10,136	$10,692
Primary metal industries	do.	$151	$185	$182
Stone, clay, and glass products	do.	$200	$214	$212
Chemicals and allied products	do.	$209	$241	$257
Petroleum and coal products	do.	$72	$72	$73
Construction	do.	$2,132	$2,517	$2,665
Transportation and public utilities	do.	$2,928	$3,223	$3,386
Wholesale and retail trade	do.	$6,616	$7,274	$7,648
Finance, insurance, real estate	do.	$2,293	$2,488	$2,863
Services	do.	$7,222	$8,098	$8,915
Government and government enterprises	do.	$5,313	$5,785	$6,184
Construction activity:				
Number of private and public residential units authorized[4]		24,810	26,698	28,611
Value of nonresidential construction[4]	millions	$1,045.8	$1,311.6	$1,441.5
Value of State road contract awards	do.	$272.0	$262.7	$433.8
Shipments of portland and masonry cement to and within the State[5]	thousand short tons	1,162	1,213	1,459
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,455.0	$1,676.2	$1,548.0
Value per capita		$351	$403	$369

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Minnesota Department of Economic Security.

[3]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

[5]Has no cement-producing plants.

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

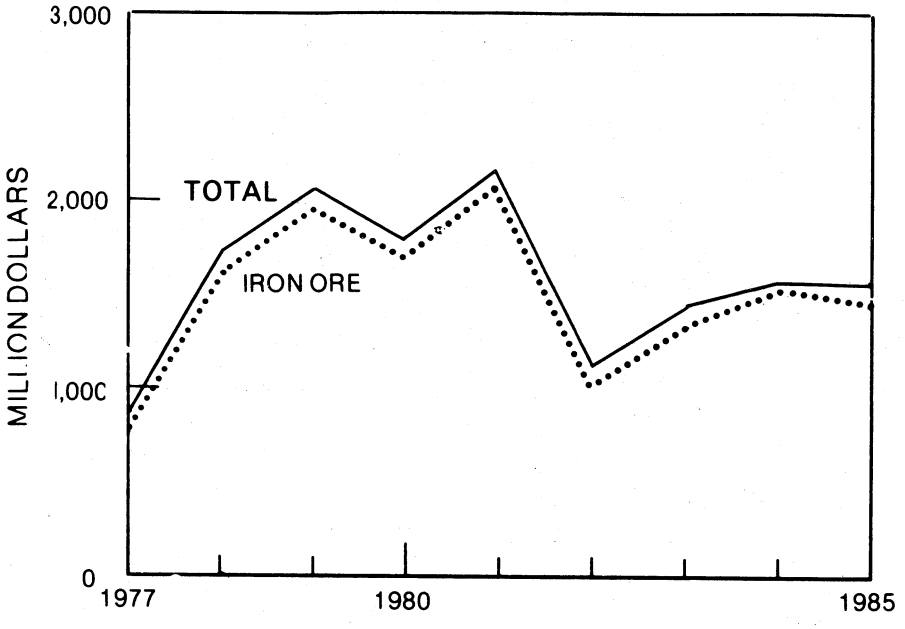

Figure 1.—Value of iron ore shipments and total value of nonfuel mineral production in Minnesota.

Trends and Developments.—Minnesota's taconite industry continued to suffer cutbacks and layoffs because of plant overcapacity and weak demand for U.S. steel products that in part were supplanted by lower cost foreign imports. All taconite companies operating on the Mesabi Range experienced some downtime, either for maintenance or because of the need to adjust inventories to meet the demands of steel company partners.

Butler Taconite Co. in Nashwauk was permanently closed on June 29 after one of its co-owners, Wheeling-Pittsburgh Steel Corp. (W-P), filed for protection under chapter 11 of the Federal bankruptcy law on April 16. The Butler operation, which had employed 450 workers and had an annual capacity of 2.7 million long tons of pellets, was jointly owned by W-P (24.5%), Inland Steel Co. (38%), and M. A. Hanna Co. (37.5%), which also managed the project.

In February, the State of Minnesota, United States Steel Corp. (USS), and Korf Engineering GmbH of the Federal Republic of Germany applied for $94.8 million in Federal grants and loans to finance a demonstration plant to produce up to 300,000 short tons of high-purity iron per year through a coal reduction process developed by Korf and Voest-Alpine AG of Austria. The plant, which was to be near USS' Minntac plant in Mountain Iron, would use taconite from Minnesota sources and domestic coal instead of coke to produce molten iron at lower costs with less air and water pollution than conventional methods. Korf tested the process in November 1984 at its plant in Kehl, Federal Republic of Germany, with 3,000 tons of taconite from the Minntac plant and coal from West Virginia and successfully produced 750 tons of direct-reduced iron. A response to the proposal, which had been submitted to the U.S. Department of Energy under its Clean Coal Technology Program, was expected in 1986.

Development work on another ironmaking process continued during 1985. The Mesabi Metal project, supported by Pickands Mather & Co., Westinghouse Electric Corp., Minnesota Power, and State funds provided through the Iron Range Resources & Rehabilitation Board (IRRRB), was testing a new "plasma smelting" process to produce molten metal using Minnesota iron ore concentrates and domestic coal or peat.

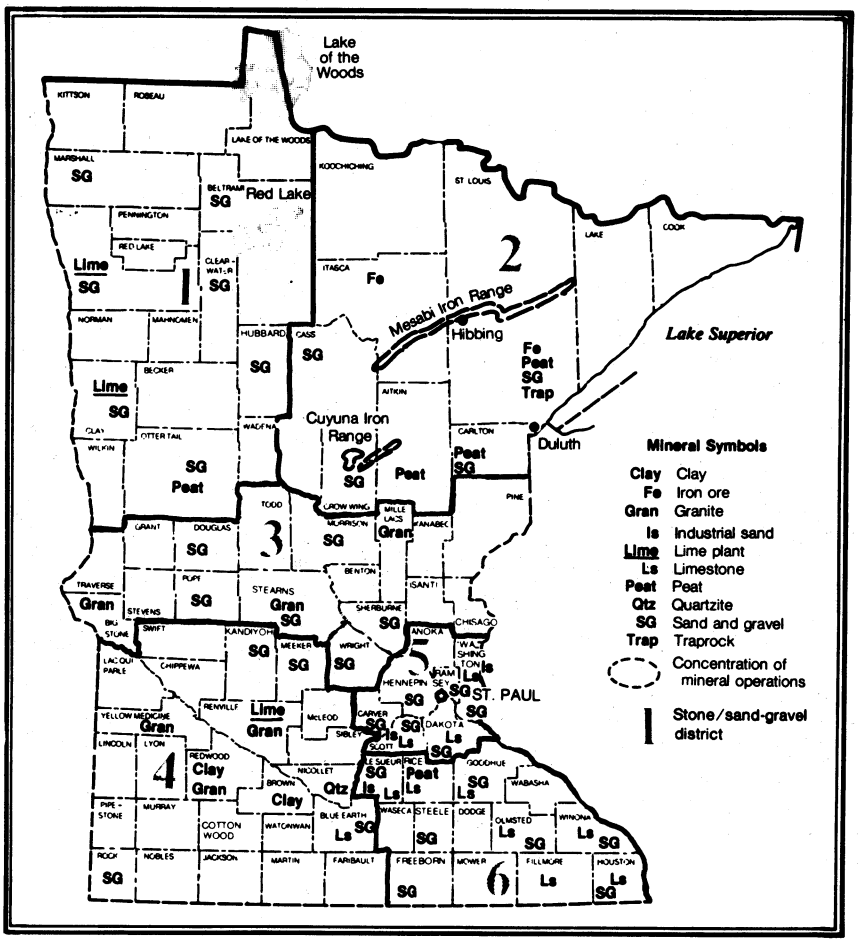

Figure 2.—Principal mineral producing localities in Minnesota.

Three phases of the five-phase project were completed by the end of 1985. Phase 1 confirmed the technology for making pig iron; phase 2 developed the technology for low-carbon products; and phase 3 determined equipment operability as related to production rate, performance, and operating specifications. The next phases of the project were to be feasibility studies for the development of a 100,000-short-ton-per-year semicommercial demonstration plant intended to lead to the technology for scaleup to a 400,000-ton commercial plant in 1988-90.[3]

Demand for aggregate products was spotty during 1985. The northern part of the State, especially the iron range, remained relatively dormant because of economic conditions in the iron mining industry and a decline in construction activity. The southern part of the State experienced problems because of the poor farm economy. When agriculture is depressed, farmers make few, if any, property improvements and spend very little in nearby communities, which in turn, put all possible civic expenditures on "hold."

A bright spot in the aggregate demand picture was the Twin Cities metropolitan area. The value of building permits issued in the seven-county area hit an all-time high—$2.6 billion—setting a record high for

the third consecutive year. This was a 24% increase over 1984's record high of $2.1 billion. Permit values for all types of housing increased 18% over 1984 values, to $1.3 billion. The value of permits for commercial construction jumped 37% from 1984 to 1985, for a total of $535 million. New industrial construction increased 46% for a total value of $225 million, making 1985 the second highest year on record for industrial construction.[4]

In response to a concern for future availability of aggregates in the expanding Twin Cities area, the 1984 State legislature established an advisory committee on aggregate resources for the seven-county metropolitan area. The 15-member committee consisted of representatives of the aggregate industry, local governments, citizens, the Metropolitan Council, and the commissioners of the Departments of Natural Resources and Transportation. The committee was charged to determine (1) the sufficiency of existing data on aggregate resources in the area, (2) the need to protect the resources and the level of protection, and (3) the method of such protection. Findings of the committee, presented to the legislature in late 1985, indicated an unencumbered aggregate resource of 4.6 billion tons, a magnitude not requiring legislation for broad-scale protection at the present time. The committee did recommend legislative actions that would assist local governments in developing standards in planning for mining and in regulating mining operations.[5]

Employment.—According to statistics published by the Minnesota Department of Economic Security, average annual employment in the total mining sector declined nearly 11% compared with 1984 figures. Employment ranged from a low of 13,300 workers in February to 18,000 workers in August and September. Average annual employment in metal mining dropped nearly 14% in 1985. The number of workers ranged from a low of 4,000 in January to a high of 7,900 workers in April when all of the State's taconite mines were on-stream. Average hourly wages for the total mining sector was $12.96, a very slight increase over 1984 wages. Wages in metal mining averaged $13.84 per hour, also a very slight increase over 1984 figures. The average number of weekly hours worked improved for both groups, 39.4 hours for total mining and 38.5 hours for metal mining.

Exploration Activities.—During 1985, Minnesota held its ninth mineral lease sale for copper, nickel, and associated minerals, offering leases on 735,000 acres of land in seven counties in the northern part of the State. Leases were awarded to 14 mining companies and 1 individual on 68,515 acres of mineral rights in Aitkin, Carlton, Itasca, Koochiching, Lake, Pine, and St. Louis Counties. Kerr-McGee Corp. was awarded the largest number of leases (35) on 16,480 acres of land. Normin Mining Co., a subsidiary of Boise Cascade Corp., was awarded the second largest number of leases (33) covering 14,337 acres. Others awarded large lease holdings were Meridian Minerals Co. (9,536 acres) and Lehmann Exploration Management (6,748 acres). No lands within 1-3/4 miles of the Voyageurs National Park were included because of concerns raised by the National Park Service and several environmental groups.

The Federal Land Bank of St. Paul, a part of Farm Credit Services, began seeking bids on 3.2 million acres of mineral rights in Michigan, Minnesota, North Dakota, and Wisconsin in an effort to generate funds to alleviate income losses because of bad loans caused by the poor farm economy. The agency acquired the mineral rights through land foreclosures, and, when tracts of land were resold, retained 50% of the mineral rights. Offerings were made on 506,000 acres of mineral rights in Minnesota, mostly in the southeastern and east-central parts of the State. All bids received by the agency were found to be unsuitable.

In June 1984, Transcontinent Oil of Denver had requested leases on about 350,000 acres of land in the Superior National Forest as part of the wildcat oil play on the Midcontinent Rift that stretches from Kansas to Michigan. Near yearend, the company withdrew its request, citing poor results of preliminary exploration efforts and declining oil prices.

Exploration activity in the State focused on copper-nickel, diamonds, and gold, with the major emphasis on gold. As many as 18 companies were registered in the State to conduct exploration drilling at some time during 1985. Seven companies actually drilled holes, completing 36 holes in 5 counties for a total of 17,518 feet. The Department of Natural Resources (DNR) drilled five holes under its mineral potential evaluation program in three counties for a total of 6,467 feet. Table 4 summarizes drilling activity in 1985.

Table 4.—Minnesota: Exploration drilling in 1985, by county

County	Number of drill holes	Total footage drilled	Company or agency
Aitkin	3	5,444	Minnesota Department of Natural Resources.
Crow Wing	1	782	Do.
Itasca	12	5,091	Duval Corp. and Meridian Minerals Co.
Koochiching	1	512	Newmont Mining Corp.
Lake of the Woods	3	2,077	Houston Oil & Minerals Co.
Roseau	3	2,454	Houston Oil & Minerals Co. and Newmont Mining Corp.
St. Louis	18	7,625	Amoco Minerals Co., Kerr-McGee Corp., Minnesota Department of Natural Resources, St. Joe Minerals Co.
Total	41	23,985	

Source: Minnesota Department of Natural Resources, Division of Minerals, Hibbing, MN.

The DNR also drilled 19 holes totaling 2,058.5 feet in its overburden sampling program during the year. Using a Rotasonic drill to recover relatively undisturbed samples of overburden, the DNR tested 12 locations in Koochiching County and 7 locations in St. Louis County. Heavy minerals were concentrated from samples at various intervals in the core and analyzed for gold and other metals. Visible flakes of gold were observed in several of the samples.

Researchers at the University of Minnesota's Mineral Resources Research Center found significant levels of chromium and the platinum-group metals (PGM) when reexamining core drilled into the Duluth Gabbro complex by a State mineral lessee several years ago on land about 10 miles southeast of Ely. The discovery was made in conjunction with DNR geologists in a mineral potential evaluation project funded by the Minerals Division of the DNR. The study identified a 7-foot layer of rock at a depth of 2,400 feet containing 3.9% of chromium metal and peak PGM assays over 9 grams per ton (0.27 troy ounce per ton). Although both levels of mineralization were below those presently being mined, the finds were deemed significant and were expected to stimulate further exploration activity.

Legislation and Government Programs.—Several pieces of legislation related to mining or mineral resources were enacted into law during 1985. Chapter 13 of the Laws of Minnesota 1985 provided funds for the following mineral-related projects:

1. $1 million to the direct-reduction demonstration project of Korf, which was developing a pilot project at the USS Minntac plant in Mountain Iron. The money was contingent upon a $1 million grant from non-State sources.

2. $3.9 million the first year of the funded biennium budget and $3.95 million the second year to the DNR for minerals management, of which $200,000 per year was for copper-nickel test drilling, $160,000 for minerals research, and $550,000 for direct-reduction research.

3. $645,700 the first year and $657,700 the second year for peat management, which included a temporary staff for peat development and a detailed peat survey, environmental monitoring, and reclamation fieldwork.

4. $301,400 the first year and $301,500 the second year for mine land reclamation. The DNR and the IRRRB were directed to study the adequacy of present laws protecting the public from hazards of existing mining excavations, open pits, shafts, or caves, and the law provided for fences, barriers, or notices posted around certain mining areas.

5. $75,000 per year to the DNR-operated Hibbing Core Repository to conduct accelerated analysis of mineral potential in the region.

The law also contained language clearing the way for the IRRRB to sell Wilderness Valley Peat Farms near Zim to the Natural Resources Research Institute (NRRI) at the University of Minnesota—Duluth. All State peat research will be coordinated by NRRI at the facility.

Chapter 14, the Omnibus Tax Bill, under Article 10—Mining Tax, included measures that (1) provided that beginning with taxes payable in 1986, taconite production taxes would go directly to the eligible counties and to the IRRRB instead of through the

State's general fund; (2) eliminated the 1-cent production tax distribution to the State and provided for a production tax distribution to townships having more than 75% of their January 2, 1982, assessed value in iron ore; (3) reduced the occupation and royalty tax rates on taconite and natural ores to 14.5% on ores produced in 1986 and 14% on ores produced in 1987 and thereafter; and (4) allowed producers of natural iron ore to deduct property taxes paid on mine property in determining the taconite occupation tax due.

Chapter 194 authorized municipalities to encourage and promote public and private development of mined underground space and contained regulations governing the use of the mined space.

Chapter 300 made the following changes in the special tax laws:

1. Clarified the computation of gross earnings tax for company-owned taconite railroads.
2. Clarified labor credit procedures.
3. Modified the taconite production tax distribution.
4. Reduced occupation and royalty tax rates for ore.
5. Clarified the process of taconite aid guaranty phaseout.

The Minnesota Geological Survey continued its research programs on the State's geology and mineral and water resources. Quaternary geologic studies were ongoing in southeastern and central Minnesota. A project to evaluate the potential for subsurface sedimentary manganese deposits in near-shore Cretaceous sedimentary rocks in the southwestern part of the State was initiated. Cretaceous strata on the iron range was also being remapped. Twenty-one shallow coreholes were drilled in the southern part of the Cuyuna Iron Range and westward along the trend of the Great Lakes Tectonic Zone to obtain basic geologic information that will be integrated in a map of the southern part of the Animikie Basin. The map was expected to be completed in 1986.

Mapping was initiated in one 7-1/2-minute quadrangle in the southern part of the Duluth Complex and in several quadrangles in the northern part of the State where gold exploration was under way.

Publications released by the Minnesota Geological Survey in 1985 included Report of Investigations 33, "Sedimentology of the Middle Ordovician Platteville Formation, Southeastern Minnesota"; Information Circular 22, "Analytical Results of the Public Geologic Sample Program, 1983-85 Biennium"; Miscellaneous Map 54, "Quaternary Geologic Map of the Minneapolis-St. Paul Urban Area, Minnesota"; and Miscellaneous Map 57, "Bedrock Geologic and Topographic Maps of the Minneapolis-St. Paul Urban Area, Minnesota."

The Minnesota Legislature awarded the State's NRRI at the University of Minnesota—Duluth a $2.3 million operating budget for 1985-87. Created by the legislature in 1983, the NRRI conducts research on bioproducts, energy, minerals, and water in order to promote employment through the economic development of the State's natural resources in an environmentally acceptable manner. During 1985, the NRRI released a comprehensive cost study of Minnesota's taconite industry, which offered several alternatives that could make Mesabi Range taconite pellets competitive with foreign imports. Other research projects included seeking ways to utilize taconite tailings, finding substitutes for the use of bentonite as a taconite pellet binder, and improving the marketing of Minnesota's peat.

The Federal Government distributed $903,250 to Minnesota for its share of funds generated by activities (mineral leasing, recreation, timbering, user fees, etc.) on national forest lands in fiscal year (FY) 1985. This compares with $795,000 in funds the State received in FY 1984. Minnesota's local governments received $889,120 in FY 1985 funds as "payments in lieu of taxes" for Federal tax-exempt lands within their boundaries.

The U.S. Bureau of Mines expended about $1.3 million for contracts, grants, equipment, and services by Minnesota firms in FY 1985. The Bureau also distributed $280,700 to the Mineral Resources Research Center at the University of Minnesota, Twin Cities, as part of a program to assist the research institute's efforts to train engineers and scientists in mineral-related disciplines.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Minnesota continued to lead the Nation in the production of iron ore, accounting for 71% of all usable iron ore shipped from mines in the United States. Shipments dropped about 2% during 1985 because of slack demand in the steel industry and the continuing flood of foreign steel imports. Value of iron ore shipments registered a greater decline, about 8%, because of lower pricing in the extremely competitive taconite pellet market. All of the State's production came from the Mesabi Range—Itasca and St. Louis Counties. Eight companies reported shipments from taconite operations, and two natural iron ore properties were active during the year. Shipments were also made from stockpiles at nine other locations. Butler Taconite in Nashwauk, owned jointly by M. A. Hanna, Inland Steel, and W-P, was closed permanently on June 29 following W-P's filing under chapter 11 bankruptcy laws.

Table 5.—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)
1981	1,698	49,327	51,025	63.7	2,719	47,457	50,176	94.6
1982	527	23,372	[2]23,898	64.7	752	22,963	23,715	96.8
1983	865	25,390	26,255	64.4	1,113	29,586	30,699	96.4
1984	853	35,844	36,697	64.7	1,193	34,409	35,602	96.7
1985	1,462	33,448	34,910	64.2	1,458	33,519	34,977	95.8

[1]Exclusive of ore containing 5% or more manganese.
[2]Data do not add to total shown because of independent rounding.

All taconite operations reported some downtime during 1985, either for maintenance or because of the inability of steel company partners to take additional pellets. Hibbing Taconite Co. was down for the greatest length of time in 1985, except for Butler Taconite, which was permanently closed, as shown in the following table:

Managing company	Mine	Number of days shut down[1]	Operating period in 1985
M. A. Hanna Co	Butler Taconite	[2]246	Mar.3-June 29.
Do	National Steel	21	Jan. 1-Apr. 5; Apr. 28-Dec. 31.
Inland Steel Mining Co	Minorca	134	Feb. 24-June 29; Aug. 4-Nov. 16.
Oglebay Norton Co	Eveleth Mines	105	Jan. 1-June 29; Oct. 13-Dec. 31.
Pickands Mather & Co	Erie Commercial	92	Mar. 3-Nov. 30.
Do	Hibbing Taconite	142	Mar. 17-Oct. 25.
Reserve Mining Co	Peter Mitchell	14	Jan. 1-June 29; July 14-Dec. 31.
United States Steel Corp	Minntac	71	Jan. 13-June 29; July 28-Nov. 30.

[1]Includes downtime for maintenance.
[2]Includes 185 days following permanent closure of Butler Taconite on June 29.

Approximately 91% of Minnesota's iron ore shipments was transported on Great Lakes carriers to consumers. The remainder was hauled by rail to the point of use. Table 6 summarizes Minnesota iron ore loadings at various ports.

Published freight rates, including rail and water, to transport iron ore from the Mesabi Range to lower lake ports ranged from $12.40 to $13.79 per gross ton at midyear.[6]

Table 6.—Salient statistics for ports shipping Minnesota iron ore

Year, port, and dock	Date of first shipment	Date of last shipment	Number of shipments	Total shipments (gross tons)	Average shipment (gross tons)	Largest shipment (gross tons)
1984:						
Duluth, MN: DM&IR	Apr. 4	Dec. 13	289	7,763,650	26,864	61,475
Silver Bay, MN: Reserve	Apr. 12	Dec. 14	62	3,628,156	58,519	62,470
Superior, WI: Burlington-Northern	Apr. 4	Dec. 22	283	11,149,768	39,398	61,378
Taconite Harbor, MN: Erie	Apr. 10	Dec. 12	136	3,399,398	24,996	60,499
Two Harbors, MN: DM&IR	Mar. 27	Nov. 12	143	6,804,947	47,587	61,699
Total or average	----	-----	913	32,745,919	35,866	62,470
1985:						
Duluth, MN: DM&IR	Apr. 2	Dec. 15	209	6,132,547	29,342	63,401
Silver Bay, MN: Reserve	Apr. 7	Dec. 14	57	3,426,100	60,107	64,188
Superior, WI: Burlington-Northern	Apr. 5	Dec. 22	201	8,506,371	42,320	63,231
Taconite Harbor, MN: Erie	Apr. 5	Dec. 21	172	4,971,963	28,907	62,262
Two Harbors, MN: DM&IR	Apr. 3	Dec. 21	195	8,719,429	44,715	63,440
Total or average	----	-----	834	31,756,410	38,077	64,188

Source: Annual Reports of Lake Carriers' Association, 1984 and 1985.

INDUSTRIAL MINERALS

Clays.—Production and value of clays increased in 1985. Ochs Brick & Tile Co. continued to mine common clay from a pit in Brown County and a kaolin-rich clay from a pit in Redwood County to support its brick manufacturing operation near Springfield, Brown County. Schmidt Construction Co. began mining a kaolin-type clay near Redwood Falls, Redwood County. In July, the first shipment of the material was made to Northwestern States Portland Cement Co.'s Mason City, IA, plant for its use in manufacturing cement. The clay was shipped on Minnesota Valley Transportation Co.'s rail line to Minneapolis where it was switched to Chicago & Northwestern Transportation Co. tracks for the haul to Mason City. Plans called for about 65,000 to 100,000 short tons of clay per year to be shipped to the Iowa plant. Resources were expected to last about 12 years.

Gem Stones.—Hobbyists collected minor quantities of semiprecious gem stones, principally agates, for handmade jewelry and personal collections. Gem materials were found chiefly along the north shore of Lake Superior, along the Mississippi River, in gravel pits, and at various sites on the State's iron ranges. Total value of the material collected was estimated at $5,000.

Several local newspapers carried accounts of Exmin Corp. leasing lands in Morrison, Todd, and Wadena Counties to explore for diamonds. No announcements of discoveries were made during the year.

Lime.—Lime output increased slightly over that of 1984. All lime produced in the State was manufactured from limestone obtained from out-of-State sources and was consumed in sugar refining operations owned by two companies. American Crystal Sugar Co. operated plants at Moorhead, Clay County, and Crookston and East Grand Forks, Polk County. Southern Minnesota Sugar Coop. operated a plant in Renville County. Lime consumption in the State, from all domestic sources, totaled 183,000 short tons of quicklime and 17,000 short tons of hydrated lime.

Peat.—Five companies reported production of hypnum, reed-sedge, and sphagnum peat from four northern counties during 1985. Another company, Eli Colby Co., harvested peat from a Rice County bog in southern Minnesota and trucked it to its Iowa plant for processing. Production from this operation was included in Iowa's statistics.

Sales and attendant value increased markedly over those of 1984; however, the increase did not alter Minnesota's sixth-place ranking among peat producing States. Commercial sales were primarily in packaged form for horticultural use, but a substantial amount was consumed in tests to determine the feasibility of its use as a fuel.

Research to improve peat harvesting techniques and to develop an expanded and more diverse market for the product was conducted by several entities during 1985, including the Minnesota DNR, IRRRB, the University of Minnesota—Duluth, Bemidji State University, and the Minnesota Peat Association. The latter is an organization formed in 1984 by producers and buyers of peat products and representatives of government agencies to promote the peat industry.

Most of the research was conducted under a multifaceted program funded by $2 million appropriated by the 1983 legislature for peat programs during the 1983-85 biennium, with an additional $2.4 million from the Federal Government and private sources. The bulk of the funds went for large-scale experiments, including combustion tests sponsored by the DNR and IRRRB at several industrial plants and municipal buildings in northeastern Minnesota. Peat used in the tests was produced at a project developed by a Swedish firm, Rasjo Torv, and operated by its subsidiary Great Lakes Peat Products Co. in St. Louis County. Combustion test results varied, and although they indicated that peat could burn well in boilers designed for coal, Minnesota's peat, in most cases, could not currently compete on a large scale with other energy fuels. Transportation costs and, to a lesser degree, a problem handling the peat were cited as two of the obstacles in the widespread development of peat as a fuel. Other work conducted under the program included studies to determine the costs of preparing a peat bog and the environmental effects of peat harvesting and a survey of the State's peat resources that outlined potential development sites.

Peatrex Ltd., a company established in 1982 to produce and market horticultural peat in Carlton County, was purchased in August by VAPO, Finland's largest peat producer specializing in worldwide peat development and production. Limited production at the Cromwell operation, which will continue to operate under the Peatrex name, was expected to begin during the summer of 1986 with full production anticipated for 1988.

A unique use of peat began at Floodwood in September when a new firm, MAT Inc., started producing mats made of peat, textile, and wood fibers for use in growing grass and other plants.

Perlite (Expanded).—Crude perlite ore mined in Western States was expanded at a plant near Cloquet in Carlton County. Conwed Corp., owner of the facility since it began perlite-expanding operations in the late 1960's, sold the plant in August to USG Acoustical Products Co., a subsidiary of USG Corp. Although the plant was closed for 25 days following the sale, full production resumed in early September, and the output of expanded perlite was nearly the same as that of 1984. The expanded perlite material was used in the manufacture of acoustical ceiling tile at the site. Late in the year, USG announced plans to spend $3.5 million to $5 million on expanding its ceiling tile operations in the next 3 years, mostly at the Cloquet operation.[7]

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel production and value were estimated to have increased 11% and 13%, respectively, in 1985.

In April, J. L. Shiely Co., St. Paul, acquired the aggregate-related assets of the Cemstone Products Co., Lakeland. In the same transaction, Cemstone acquired the assets of Shiely Concrete Materials Co., a wholly owned subsidiary of J. L. Shiely, including four ready-mixed concrete plants in the Twin Cities metropolitan area and a delivery fleet.

Industrial.—Sand for industrial purposes was produced by three companies during 1985. Minnesota Frac Sand Co. had operations in Scott County, Unimin Corp. in Le Sueur County, and Twin City Silica Ltd. in Washington County. Value increased about 4% during the year, although production dropped about 2%.

Major sales were for hydraulic fracturing, glass manufacture, and foundry applications. Depressed oil prices affected sales of sand used in oil well stimulation during 1985. About 87% of the State's output of industrial sand was shipped to consumers by truck.

Slag—Iron and Steel.—Steel slag from North Star Steel Co.'s St. Paul mill was processed by International Mill Service Co. Most of the product was sold for construction purposes.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Granite, limestone, quartzite, sandstone, and traprock were quarried and crushed by 36 companies at 78 sites in 20 of the State's 87 counties. Production decreased 13% in quantity and 12% in value compared with the 1984 output.

In 1985, the U.S. Bureau of Mines began compiling crushed stone production statistics by districts for some States. Table 8 presents end-use data for crushed stone produced in the six Minnesota districts that are outlined in figure 2.

Table 7.—Minnesota: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	176	618
Coarse aggregate, graded:		
Concrete aggregate, coarse	374	1,282
Bituminous surface-treatment aggregate	126	456
Railroad ballast	827	2,089
Fine aggregate (-3/8 inch): Screening, undesignated	11	36
Combined coarse and fine aggregates:		
Graded road base or subbase	1,915	5,026
Unpaved road surfacing	415	1,028
Crusher run or fill or waste	46	106
Other construction[2]	423	1,515
Agricultural: Agricultural limestone	255	821
Special:		
Other miscellaneous[3]	618	2,385
Other unspecified[4]	2,569	7,238
Total[5]	7,756	22,601

[1]Includes dolomite, granite, limestone, quartzite, sandstone, and traprock.
[2]Includes stone used in bituminous aggregate (coarse), macadam, filter stone, stone sand (concrete), stone sand (bituminous mix or seal), and stone used for other construction and maintenance purposes.
[3]Includes stone used in lime manufacture, other fillers or extenders, poultry grit and mineral food, and roofing granules.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Table 8.—Minnesota: Crushed stone sold or used by producers in 1985, by use and district

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	--	--	W	W	(1)	(1)
Coarse aggregate, graded	--	--	W	W	(1)	(1)
Fine aggregate (-3/8 inch)	--	--	--	--	(1)	(1)
Combined coarse and fine aggregates	--	--	--	--	(1)	(1)
Other construction	--	--	--	--	--	--
Agricultural limestone	--	--	--	--	--	--
Lime manufacture	--	--	--	--	--	--
Other miscellaneous	--	--	--	--	--	--
Other unspecified[2]	--	--	--	--	--	--
Total	--	--	W	W	2,015	5,160

Use	District 4		District 5		District 6	
	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	W	W	46	701	30	72
Coarse aggregate, graded	W	W	264	879	(3)	(3)
Fine aggregate (-3/8 inch)	W	W	(4)	(4)	(3)	(3)
Combined coarse and fine aggregates	W	W	1,505	3,801	827	1,978
Other construction	--	--	--	--	132	475
Agricultural limestone	W	W	(4)	(4)	169	570
Lime manufacture	--	--	--	--	(4)	(4)
Other miscellaneous	--	--	590	2,263	--	--
Other unspecified[2]	W	W	397	1,049	1,215	3,679
Total	W	W	2,802	8,693	2,373	6,774

W Withheld to avoid disclosing company proprietary data.
[1]Withheld to avoid disclosing company proprietary data; included in "Total."
[2]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[3]Withheld to avoid disclosing company proprietary data; included with "Other construction."
[4]Withheld to avoid disclosing company proprietary data; included with "Other unspecified."

Granite, which accounted for 25% of the State's crushed stone production, was quarried by three companies in Big Stone, Stearns, and Yellow Medicine Counties. Most of the output was used for railroad ballast. Stearns County had the largest production.

Limestone was mined in 15 counties by 32 companies at 71 quarries. Counties leading production were Scott, Washington, and Olmsted. J. L. Shiely was the State's largest producer. Limestone accounted for 73% of the State's crushed stone production. Most of the State's limestone output was used for dense road base. Agricultural limestone sales remained at a reduced level because of the continuing farm slump in the State.

Crushed quartzite, containing over 95% silica, was produced by New Ulm Quartzite Quarries Inc. in Nicollet County at the only outcropping of this kind of stone in the State. Most of the output was used in concrete aggregate. The company began operating a new plant during 1985 with a rated annual capacity of approximately 500,000 short tons. Material previously classified as byproducts would be converted into a wide variety of marketable products to be sold in 13 States.[8]

One company produced crushed traprock in St. Louis County. The major use was for bituminous aggregate.

Dimension.—Minnesota ranked 10th of 36 States in sales of dimension stone.

Granite dimension stone was marketed, mainly as cut stone and monumental stone, by two companies with operations in Big Stone, Mille Lacs, Redwood, Renville, and Stearns Counties. The material was mined at seven quarries; Stearns County led the State's production.

Three companies marketed rough, cut, and sawed limestone for construction and architectural purposes during 1985. Operations were in Blue Earth, Le Sueur, and Winona Counties.

Table 9.—Minnesota: Dimension stone[1] sold or used in 1985, by use

Use	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Dressed stone:			
Ashlars and partially squared pieces	22,520	276	$9,277
Slabs and blocks	1,630	20	W
Billiard tabletops	436	5	W
Other[2]	12,222	149	4,322
Total	36,808	450	[3]13,598

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes granite and limestone.
[2]Includes rough blocks and irregular-shaped stone for building and construction and monumental purposes; and dressed stone for monumental purposes, flagging, and value indicated by symbol W.
[3]Data do not add to total shown because of independent rounding.

Sulfur (Recovered).—Elemental sulfur was recovered as a byproduct at two oil refineries in the Twin Cities area. Koch Refining Co., a division of Koch Industries Inc., began work in May on a $200 million expansion of its refinery in the Pine Bend area of Dakota County. The project was expected to be completed over the next 3 to 5 years and would increase the refinery's production capacity by approximately 50%. A new sulfur recovery unit was scheduled for construction in the later phases of the expansion.

Vermiculite (Exfoliated).—Vermiculite from sources in the Western United States was exfoliated at a plant in Minneapolis by W. R. Grace & Co. Sales increased slightly over those of 1984. The exfoliated product was used primarily for block and loose-fill insulation, with lesser amounts, in descending order of quantity used, for fireproofing, horticultural applications, and for concrete and plaster aggregates.

[1]State Mineral Officer, Bureau of Mines, Minneapolis, MN.
[2]Editorial assistant, Bureau of Mines, Minneapolis, MN.
[3]Biwabik Times. Mesabi Metal—A Revolutionary Steelmaking Process. Sept. 26, 1985.
[4]Metropolitan Council of the Twin Cities Area. Construction Sets Records. Metro Monitor, v. 8, No. 1, May 1986.
[5]———. Protecting Aggregate Resources in the Twin Cities Metropolitan Area. Pub. No. 10-85-104, Sept. 1985, 54 pp.
[6]Skillings' Mining Review. Rail and Lake Freight Rates on Iron Ore and Pellets Per Gross Ton. V. 74, No. 30, July 27, 1985, p. 34.
[7]News-Tribune & Herald (Duluth). Cloquet Plant at Full Production for USG. Oct. 2, 1985, p. 7B.
[8]Rock Products. Byproducts Call for New Plant. V. 88, No. 5, May 1985, pp. 60-61.

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 plant	Brown and Redwood.
Iron ore:			
M. A. Hanna 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.
LTV Steel Co., Northwest Ore Div.:	Box 196 Aurora, MN 55705		
McKinley Extension		Mine and concentrator.	Do.
Oglebay Norton Co.:	1100 Superior Ave. Cleveland, OH 44114		
Eveleth Mines		Mine, concentrator, agglomerator.	Do.
Pickands Mather & Co.:	1100 Superior Ave. Cleveland, OH 44114		
Erie Commercial		do	Do.
Hibbing Taconite Co		do	Do.
Pittsburgh Pacific Co.:	2521 1st Ave. Hibbing, MN 55746	Stockpile shipments from seven properties.	Do.
Reserve Mining Co.:	Silver Bay, MN 55614		
Peter Mitchell		Mine and primary crusher.	Do.
Silver Bay plant		Concentrator and agglomerator.	Lake.
Rhude & Fryberger Inc.:	Box 66 Hibbing, MN 55746		
Plummer-Diamond		Mine and plant	Itasca.
Rana		Stockpile shipments.	St. Louis.
Sharon Culver		do	Do.
United States Steel Corp., Minnesota Ore Operations:	Box 417 Mountain Iron, MN 55768		
Minntac		Mine, concentrator, agglomerator.	Do.
Lime:			
American Crystal Sugar Co	101 North 3d St. Moorhead, MN 56560	Plants	Clay and Polk.
Southern Minnesota Sugar Coop	Box 500 Renville, MN 56284	Plant	Renville.
Peat:			
Eli Colby Co	Box 248 Lake Mills, IA 50450	Bog	Rice.
Great Lakes Peat Products Co	2159 Berkley St. Paul, MN 55105	Bog and processing plant.	St. Louis.
Michigan Peat Co	Box 66388 Houston, TX 77266	do	Carlton.
Peat Resources Inc	700 North Lilac Dr. Golden Valley, MN 55422	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):			
USG Acoustical Products Co., a subsidiary of USG Corp.	Arch St. Cloquet, MN 55720	Plant	Carlton.
Sand and gravel:			
Construction (1984):			
Arsenal Sand & Gravel Co	Box 2707 New Brighton, MN 55112	Pit and plant	Ramsey.
Barton Sand & Gravel Co	10633 89th Ave. North Osseo, MN 55369	Pits and plants	Benton, Dakota, Hennepin, Sherburne, Washington.
Fischer Construction Co. Inc	6801 West 150th St. Apple Valley, MN 55124	Pit and plant	Dakota.
C. S. McCrossan Inc	Box 322 Osseo, MN 55369	do	Hennepin.
North Star Concrete Co	Box 167 Mankato, MN 56001	Pits and plants	Le Sueur and Nicollet.
J. L. Shiely Co	1101 North Snelling Ave. St. Paul, MN 55108	Pit and plant	Washington.
Stommes Construction Co	Route 4 St. Cloud, MN 56301	do	Stearns.
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 Ltd	499 Cottage Grove Dr. Woodbury, MN 55125	do	Washington.
Unimin Corp	258 Elm St. New Canaan, CT 06840	Pits and plants	Le Sueur.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Crushed:			
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 Inc.	Box 829 Sioux Falls, SD 57102	do	Big Stone.
J. L. Shiely Co	1101 North Snelling Ave. St. Paul, MN 55108	do	Stearns.
Limestone:			
Bryan Rock Products Inc	Box 215 Shakopee, MN 55379	do	Scott.
Kappers Construction Co. Inc.	133 South Broadway Spring Valley, MN 55975	Quarries and plants	Fillmore.
Edward Kraemer & Sons Inc.	1000 West Cliff Rd. Burnsville, MN 55337	Quarry and plant	Dakota.
Mankato Aglime & Rock Co	Box 254 Mankato, MN 56001	do	Blue Earth.
Mathy Construction Co., Patterson Quarries Div.	Route 3, Box 15 St. Charles, MN 55972	Quarries and plants	Olmsted, Wabasha, Winona.
Midwest Asphalt Corp., River Warren Aggregates Inc.	Box 338 Hopkins, MN 55343	Quarry and plant	Scott.
Quarve & Anderson Co	2430 Marion Rd. SE. Rochester, MN 55901	Quarries and plants	Dodge, Goodhue, Olmsted, Wabasha, Winona.
J. L. Shiely Co	1101 North Snelling Ave. St. Paul, MN 55108	do	Scott and Washington.
Quartzite:			
New Ulm Quartzite Quarries Inc.	Route 5, Box 21 New Ulm, MN 56073	Quarry and plant	Nicollet.
Traprock (basalt):			
Arrowhead Blacktop Co	Box 6568 Duluth, MN 55806	do	St. Louis.
Dimension:			
Granite:			
Cold Spring Granite Co	Cold Spring, MN 56320	Quarries	Big Stone, Mille Lacs, Renville.
Do		Quarries and plant	Stearns.
View Quarry Co., a division of Rex Granite Co.	Box 924 St. Cloud, MN 56302	Quarry and plant	Redwood.
Limestone:			
Biesanz Stone Co. Inc	Box 768 Winona, MN 55987	do	Winona.
Minnesota Quarries Inc	Box 1358 Mankato, MN 56002	do	Blue Earth.
Vetter Stone Co	Route 5, Box 41 Mankato, MN 56001	Quarries and plant	Blue Earth and Le Sueur.
Sulfur (recovered):			
Ashland Petroleum Co., a division of Ashland Oil Inc.	Box 391 Ashland, KY 41101	Elemental sulfur recovered as a by-product of oil refining.	Washington.
Koch Refining Co., a division of Koch Industries Inc.	Box 2302 Wichita, KS 67201	do	Dakota.
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] Maylene E. Hubbard,[2] and Alvin R. Bicker[3]

The value of Mississippi's nonfuel mineral production in 1985 was $102.8 million, an increase of 10.4% over that of 1984. The increase in value continued for the third straight year an upward trend. Mississippi's overall economic recovery remained one of the weakest in the Southeast.

Total value, although higher than in 1984, was still below the peak years of 1978 through 1980. The increased output was attributed to an increase in nonresidential construction activities, which peaked before midyear, then fell sharply, and at yearend barely exceeded the year's beginning rate.[4] Mississippi ranked 38th nationally in value of industrial minerals produced. It ranked second nationally in the production of fuller's earth, and third in ball clay and bentonite. Major commodities produced were cement, clays, sand and gravel, and stone.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	r 2 1,274	r 2 $10,366	1,558	$34,864
Sand and gravel (construction) do	12,205	34,955	e 13,400	e 42,000
Stone (crushed) do	e 2,000	e 5,800	1,582	4,282
Combined value of cement, clays (ball clay and fuller's earth, 1984), and sand and gravel (industrial)	XX	r 42,016	XX	21,647
Total	XX	r 93,137	XX	102,793

eEstimated. rRevised. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes ball clay and fuller's earth; value included with "Combined value" figure.

Table 2.—Nonfuel minerals produced in Mississippi in 1984, by county[1]

County	Minerals produced in order of value
Adams	Sand and gravel (construction).
Benton	Clays.
Bolivar	Sand and gravel (construction).
Carroll	Do.
Clay	Do.
Copiah	Do.
DeSoto	Do.
Forrest	Do.
George	Do.
Hancock	Do.
Harrison	Do.
Hinds	Sand and gravel (construction), clays.
Holmes	Sand and gravel (construction).
Itawamba	Do.
Jackson	Sand (industrial).
Jasper	Sand and gravel (construction).
Jones	Clays.
Kemper	Do.
Lafayette	Sand and gravel (construction).
Lauderdale	Do.
Lee	Do.
Lincoln	Sand and gravel (construction), clays.
Lowndes	Cement, sand and gravel (construction), clays.
Marion	Sand and gravel (construction).
Marshall	Clays.
Monroe	Clays, sand and gravel (construction).
Noxubee	Clays.
Panola	Clays, sand and gravel (construction).
Pearl River	Sand and gravel (construction).
Perry	Do.
Pike	Do.
Stone	Do.
Tate	Do.
Tippah	Clays.
Tishomingo	Sand (industrial).
Walthall	Sand and gravel (construction).
Warren	Do.
Washington	Do.
Wayne	Do.
Winston	Clays.
Yalobusha	Sand and gravel (construction).
Yazoo	Do.
Undistributed[2]	Stone (crushed).

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Trends and Developments.—Mississippi's employment in the minerals sector is tied closely to construction activities. Mining employment remained relatively stable in 1985. The overall State unemployment rate for the year was 10.3%, down from the 1984 rate of 10.8%.

The State's energy sector is not expected to soon recover from depressed 1985 levels. Compared with that of 1984, oil and gas production decreased 16% and 7%, respectively. Severance tax collections reflected the dismal state of the industry, and tax revenues were expected to drop substantially in 1986. Severance taxes received from oil and gas companies accounted for about 20% of Mississippi's tax receipts.[5]

Table 3.—Indicators of Mississippi business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	2,583	2,598	2,613
Total civilian labor force	do.	1,064	1,074	1,121
Unemployment	percent	12.6	10.8	10.3
Employment (nonagricultural):				
Mining total[1]	thousands	8.8	9.1	8.9
Nonmetallic minerals except fuels[2]	do.	.7	.8	.8
Oil and gas extraction	do.	8.1	8.4	8.1
Manufacturing total	do.	204.7	218.7	221.2
Primary metal industries[2]	do.	3.3	3.9	4.1
Stone, clay, and glass products	do.	5.7	6.1	5.6
Chemicals and allied products	do.	6.5	6.8	6.5
Petroleum and coal products	do.	2.1	2.1	2.1
Construction	do.	36.2	37.1	36.2
Transportation and public utilities	do.	38.6	39.1	39.6
Wholesale and retail trade	do.	165.2	173.6	177.4
Finance, insurance, real estate	do.	33.5	34.2	35.6
Services	do.	124.6	125.8	130.3
Government and government enterprises	do.	181.1	183.2	188.6
Total	do.	[3]792.8	820.8	837.8
Personal income:				
Total	millions	$21,258	$23,010	$24,004
Per capita		$8,231	$8,855	$9,187
Hours and earnings:				
Total average weekly hours, production workers		40.1	40.6	40.6
Total average hourly earnings, production workers		$6.7	$6.9	$7.2
Earnings by industry:				
Farm income	millions	$310	$665	$513
Nonfarm	do.	$14,343	$15,456	$16,379
Mining total	do.	$245	$256	$252
Nonmetallic minerals except fuels	do.	$12	$14	$15
Oil and gas extraction	do.	$233	$243	$237
Manufacturing total	do.	$3,691	$4,078	$4,294
Primary metal industries	do.	$75	$91	$99
Stone, clay, and glass products	do.	$110	$121	$115
Chemicals and allied products	do.	$156	$174	$178
Petroleum and coal products	do.	$91	$94	$96
Construction	do.	$891	$884	$889
Transportation and public utilities	do.	$1,034	$1,110	$1,172
Wholesale and retail trade	do.	$2,372	$2,553	$2,671
Finance, insurance, real estate	do.	$651	$692	$777
Services	do.	$2,373	$2,607	$2,825
Government and government enterprises	do.	$2,973	$3,164	$3,390
Construction activity:				
Number of private and public residential units authorized[4]		9,770	11,638	8,757
Value of nonresidential construction[4]	millions	$205.9	$304.1	$323.1
Value of State road contract awards	do.	$202.0	$235.2	$242.0
Shipments of portland and masonry cement to and within the State	thousand short tons	767	850	815
Nonfuel mineral production value:				
Total crude mineral value	millions	$89.7	$93.1	$102.8
Value per capita		$35	$36	$39

[p]Preliminary. [r]Revised.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

The entire 243-mile-long Tennessee-Tombigbee Waterway was opened to commercial traffic on January 15, 1985. More than 500,000 tons of commerce moved through the three southernmost locks on the waterway in 1984, and economists had predicted that 27.3 million tons of commodities would be shipped during the first year the entire waterway was open.[6] Shipping fell far short of expectations, however, with only 1.7 million tons moving through the waterway during 1985. The waterway has stimulated industrial development along the Tennessee and Tombigbee Rivers according to Tennessee-Tombigbee Waterway Development Authority officials, who are optimistic that use of the waterway will increase over the next 12 months. Lower transportation costs offered by Tennessee-Tombigbee have already greatly expanded the markets of commodities from the waterway corridor such as stone and bentonite, which are mined in Mississippi. Nine ports are operational along the waterway, eight developments under construction, and seven more have been proposed.

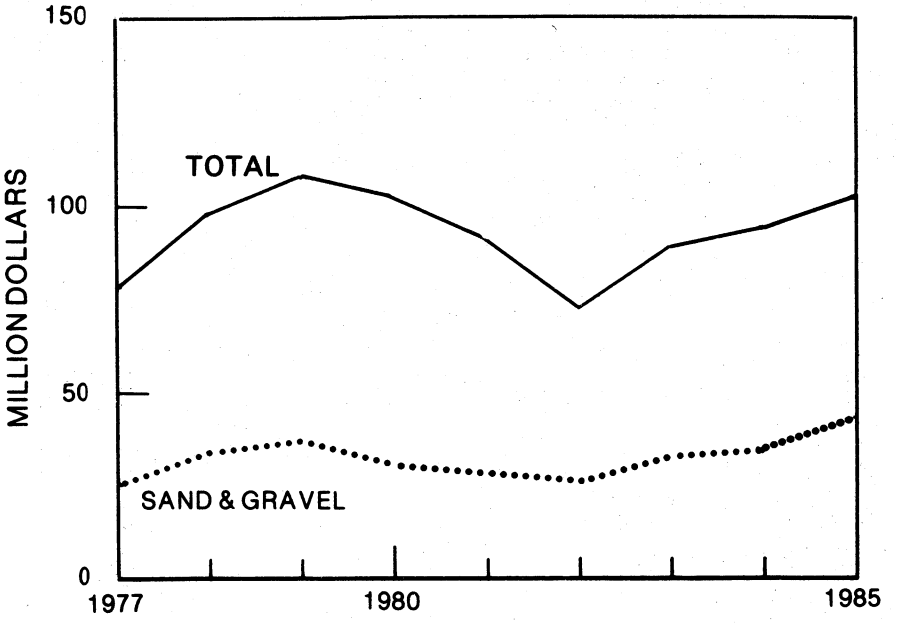

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Mississippi.

An $8 million expansion at Kerr-McGee Chemical Corp.'s titanium dioxide plant at Hamilton, begun late in 1984, was expected to be completed in 1986. The Hamilton facility consists of titanium dioxide, electrolytic manganese, and chemical plants, and the expansion will increase production to 72,000 tons per year. The company's synthetic rutile plant at Mobile, AL, was expanded during 1985 to satisfy outside sales and meet feedstock requirements at Hamilton.[7]

During fiscal year 1985, 225,215 tons of ilmenite from Australia was imported through the Port of Gulfport, a significant increase over that of 1984. The ilmenite was destined for E. I. duPont de Nemours & Co. Inc.'s titanium dioxide operations at Pass Christian.

Two newly formed businesses in Mississippi were partially financed by Japanese interests. Vicksmetal Corp., Vicksburg, started operation of a new $2 million electrical steel sheet processing plant, which was financed by Hitachi Cable America Ltd. and Hayakawa Densen Kogyo Co. of Himeji City, Japan.

In April, New Mexico Potash Corp., a wholly owned subsidiary of Vertac Chemical Corp., purchased Hobbs-Carlsbad Potash Mining Co. in New Mexico from Kerr-McGee Chemical. About 25% of the potash produced at the mine will be used at Vertac's potassium nitrate facility in Vicksburg.

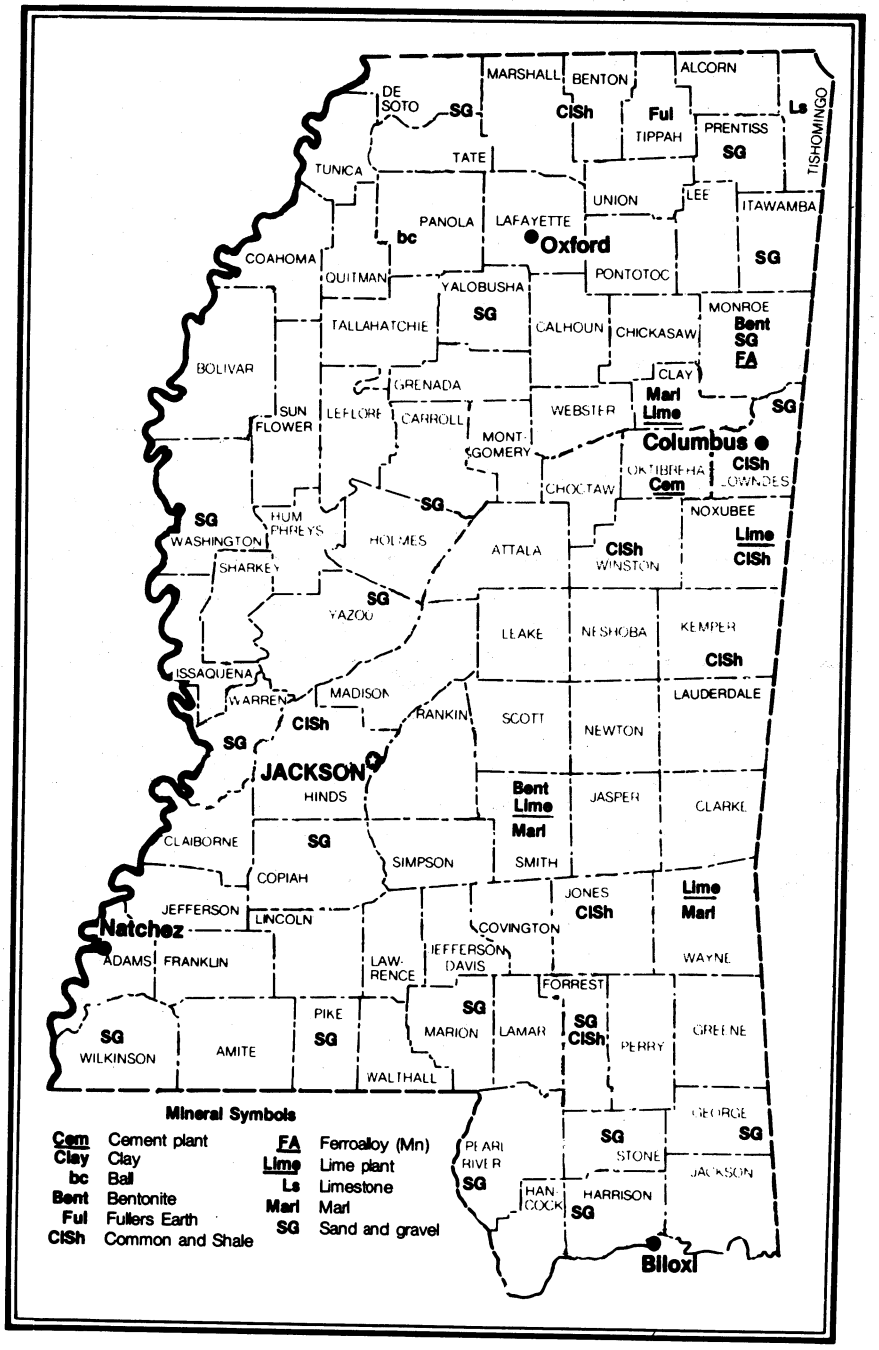

Figure 2.—Principal mineral producing localities in Mississippi.

Legislation and Government Programs.—The Mississippi Bureau of Geology and Energy Resources continued investigation of the geology and mineral resources of the State during the year. The Surface Section continued field investigations in Tishomingo County and preparations for a report on Cretaceous fossils from the Coffee Sand Formation. Bulletin 124 on the geology and mineral resources of Newton County was completed and published. The Subsurface Section of the Bureau maintained the Sample and Core Library and published a catalogue of available cores. Regional mapping continued, and two smaller scale mapping projects were initiated. The Bureau's Environmental Section continued projects in areas of magnetic intensity and mapping of structural features, economic geology, area surface geology, and assisted in drilling a number of stratigraphic test wells. The Ground-Water Section completed or suspended the gathering of ground water data in Alcorn and Tishomingo Counties. The number of water wells logged decreased by approximately 45%. The Mineral Lease Section continued to lease State-owned property and process applications for geophysical permits. Income from leasing royalty and permit activities totaled $1,615,313, a significant increase over that of the prior fiscal year. The Surface Mining Section indicated a small decrease in applications for new mining permits.

The Mississippi Mineral Resources Institute (MRI) continued mineral resources investigations during the year, including exploration and evaluation of heavy minerals and shell off the Mississippi coast, utilization of natural zeolites, and several energy-related studies involving both lignite and oil and gas. Funded projects included petrographic examination of sands and gravels in Adams and Wilkinson Counties, petrology and diagenesis of sandstones in the Black Warrior Basin, and sandstone petrology of the Tuscaloosa Formation.

The institute purchased a research vessel from the University of Georgia to be used in Mississippi waters for mainly seismic and sampling work.

MRI issued a total of 16 publications, 9 of which were energy related. The other publications included "Application of Mississippi Clays to the Manufacture of Fatty Acid Dimers," "The Distribution and Correlation of Shallow Aquifers in Southeastern Mississippi," "Trend Surface Analysis of Heavy Mineral Distributions Offshore of the Mississippi Sound Barrier Island Chain," "Environmental Investigation of a Solar Refrigerator Using Natural Zeolite," "A New Stratigraphic System, Geologic Evolution and Potential Economic Sand Resources in the Mississippi Sound Area, Mississippi-Alabama," "Zeolite Determination & Geothermometry Interpretations Associated with Volcanic Rocks in Oil Fields in Northwestern Mississippi," and "The Economic Feasibility of Marketing Mississippi Gravel in Beaumont, Texas."

The institute continued a program designed to aid in the commercialization of minerals in the State. The U.S. Bureau of Mines allotted $147,000 to the institute to foster and support graduate education in mineral sciences and engineering.

An $8.5 million industrial development bond issue was authorized for major expansion of the Port of Pascagoula for additional wharf and berthing capacity. Pascagoula ranks as Mississippi's major seaport, handling approximately 90% of the State's foreign trade.

The issue of offshore oil and gas revenues from Federal leases to be shared with Mississippi and other coastal States under Section 8(g) of the Outer Continental Shelf Lands Act of 1978 was not settled in 1985. Section 8(g) required the Secretary of the Interior to offer the Governor of the affected State the opportunity to enter into a fair and equitable agreement concerning the disposition of revenues generated by a Federal lease within 3 miles of the seaward boundary of the State containing pools of oil and gas that underlie both State and Federal waters. The two major elements requiring agreement were what revenues should be divided and what percentage was appropriate.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Industrial minerals accounted for all of Mississippi's nonfuel mineral production in 1985. Commodities produced included cement, clays, sand and gravel, and crushed stone.

Cement.—United Cement Co., in the east-central part of the State in Artesia, Lowndes County, was the only cement producer in Mississippi. The company's primary output was portland cement, with minor amounts of masonry cement. Portland and masonry cement shipments

decreased slightly while unit prices remained about the same.

Raw materials used in cement manufacture included anhydrite, chalk, gypsum, iron ore, limestone, and sand. The gypsum and iron ore were shipped in from out-of-State while the remaining raw materials were mined locally. The calcareous rock used had a sufficient clay and/or alumina content to eliminate the need for clay. The raw material was crushed and ground and then slurried to the kiln where it was fired with finely ground coal. After grinding with gypsum, the cement was shipped to Southeastern States.

Chromium.—Corhart Refractories Co. Inc., Pascagoula, was one of three plants sold by Corning Glass Works in 1985. The newly formed company, composed of a private investment firm and existing management of the refractory products firm, will continue to operate under its existing name and supply refractories to Corning. Corhart imported chrome ore from the Republic of South Africa for the production of refractories. The primary use was in the form of chromite to make refractory bricks for lining metallurgical furnaces.

Clays.—Mississippi's clay industry consisted of 17 companies operating 24 mines in 12 counties, primarily in the northern and northeastern parts of the State. Ball clay, bentonite, common clay, and fuller's earth were produced in Mississippi. Total clay output decreased from that of 1984, while value increased. The State ranked second nationally in output of fuller's earth and third in ball clay and bentonite. Output of ball clay and fuller's earth increased while that of bentonite and common clay decreased.

Common clays were mined at 17 pits, primarily in Hinds, Kemper, and Noxubee Counties. Major uses were for brick, concrete block, and highway surfacing. Output was 850,706 short tons compared with 1,045,938 tons (revised) in 1984.

Ky-Tenn Clay Co., in Panola County, was the only producer of ball clay in the State. The clay was processed for a variety of ceramic uses, and output and value increased over that of 1984.

Mississippi's bentonite producers, American Colloid Co., Harshaw-Filtrol Partnership, and International Minerals & Chemical Corp. (IMC), operated four surface mines in Monroe County. Demand decreased and remained relatively low. American Colloid's new $3.5 million acid activation plant at Aberdeen started production late in the year. Six grades of acid-activated clay are being produced.

Filtrol's expansion of its clay acid-activating facility at Jackson, which doubled capacity at a cost of over $1 million, was completed during the year. The calcium montmorillonite was mined from a number of surface pit operations that used opencast dragline mining methods, and was then shipped by rail from Monroe County to Jackson for processing.

Production and value of fuller's earth increased over that of 1984; however, unit prices decreased. Two companies, IMC and Oil-Dri Production Co., mined fuller's earth from open pits in Tippah County. The clay was processed at nearby plants. A variety of granular and powdered absorbent mineral products were produced for consumer products and for factories and automotive service establishments as industrial oil absorbents.

Table 4.—Mississippi: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Bentonite		Ball clay, fuller's earth		Common clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1981	285	7,060	W	W	649	2,028	1,218	23,309
1982	232	6,063	W	W	330	1,212	805	21,181
1983	241	5,952	W	W	943	2,694	1,446	23,846
1984[r]	228	6,385	W	W	1,046	3,981	[1]1,274	[1]10,366
1985	198	6,106	W	W	851	3,292	1,558	34,864

[r]Revised. W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Excludes withheld data.

Nitrogen.—Cargill Inc., Chevron Chemical Co., and Mississippi Chemical Corp. produced anhydrous ammonia during 1985. Total rated annual capacity of the three facilities was 991,000 short tons.

Perlite (Expanded).—Mississippi ranked first nationally in the output of expanded perlite. Manville Products Corp., Natchez, and the U.S.G. Corp., Greenville, expanded perlite shipped in from New Mexico. Production and value increased over that of 1984.

Sand and Gravel.—Mississippi produced both construction and industrial sand and gravel in 1985. Total production was estimated to have increased over that of 1984. Operations in the State remained relatively small with no operation producing over 1 million tons in 1985.

Construction.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. The data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel remained the leading commodity in value among the nonfuel minerals produced in Mississippi. Production and value increased over that of 1984; unit prices also increased. The increase was basically due to road maintenance activities.

The Mississippi State Highway Department issued requirements during the year for utilization of 40% to 50% limestone or granite in nonskid surfaces, replacing crushed gravel. Demand for limestone and granite will increase as the demand for crushed gravel decreases. With only one stone producer in Mississippi, any increase in demand will not significantly affect Mississippi's mineral output. Twenty-two out-of-State stone producers had their product approved for use in Mississippi.

River Aggregate Co., Hernando, completed its first year of operation with an average production of 500 short tons per hour, of which about 60% was concrete sand and 40% was gravel gradations. The raw material meets the specifications of the highway departments in the three States—Arkansas, Mississippi, and Tennessee—in which the aggregates are marketed. The plant is a few miles south of the Mississippi-Tennessee border and was developed in late 1984 to meet the growing market for construction materials in the greater Memphis, TN, area. River Aggregate is a subsidiary of River Cement Co. of Memphis, TN, and the plant was designed to handle a 600-ton-per-hour feed.

Industrial.—Sand for industrial uses was produced by two companies in Jackson and Tishomingo Counties. Both output and value increased.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone production decreased over 20% from that of 1984; unit prices also decreased. The completion of the Tennessee-Tombigbee Waterway reduced local market demands and production subsequently dropped. Plans to ship stone to the gulf by the waterway were temporarily shelved as the demand along the gulf was being oversupplied from quarries up the Mississippi River and from foreign sources.

In 1985, seven companies produced limestone and marl at nine quarries in seven counties. Unit prices decreased from $2.90 in 1984 to $2.71 in 1985.

Table 5.—Mississippi: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Combined coarse and fine aggregates: Other construction[2]	614	1,968
Agricultural: Agricultural limestone	199	1,037
Special: Other miscellaneous[3]	770	1,277
Total	[4]1,582	4,282

[1]Includes limestone.
[2]Includes concrete aggregate (coarse), bituminous aggregate (coarse), graded road base or subbase, bituminous surface-treatment aggregate, unpaved road surfacing, riprap and jetty stone, and fine aggregate (screening).
[3]Includes cement manufacture production reported without a breakdown by end use and estimates for nonrespondents.
[4]Data do not add to total shown because of independent rounding.

Sulfur (Recovered).—Mississippi ranked fourth in the Nation in output of recovered sulfur. Sulfur sold or used in 1985 totaled 565,000 metric tons, valued at $62.2 million, a decrease of 25.1% in shipments and 16.4% in value from that of 1984. Production of recovered sulfur from refinery and natural gases 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.

METALS

Primary metal production, while not a significant industry in the State, contributed economically to the State. The major portion of Mississippi's extractive mineral industry was nonmetallic, but a significant metals industry existed, dependent on out-of-State raw materials. Shipments of ferroalloys increased 7.0% while value increased 14.3%. Kerr-McGee operated an electrolytic manganese facility at Hamilton utilizing pyrolusite from Gabon, West Africa. According to the Mississippi Research and Development Center (MRDC), 8 companies produced gray iron castings, 6 produced steel castings, 11 produced aluminum castings, and 8 produced brass castings. There were three secondary nonferrous smelters in the State according to MRDC.

Mississippi Steel Co.'s minimill at Jackson was purchased by Birmingham Steel Corp. in August. It is the only minimill in Mississippi and the largest supplier of reinforcing bar in Mississippi and Louisiana.[8]

LTV Steel Co. closed its cold-finished bar operations in Gulfport in September for an indefinite period. The closing was the result of low demand.[9] Vicksmetal, a new joint venture of Sumitomo Corp. of America and Sumitomo Corp. of Japan, started operation in May. The plant processed electrical steel sheet and was constructed at a cost of almost $2 million.

Oxford Wire & Cable Services Inc. began manufacturing wire harness in Oxford in December. The company was financed by Japanese interests.

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[2]Editorial assistant, Bureau of Mines, Tuscaloosa, AL.
[3]State geologist, Bureau of Geology and Energy Resources, Jackson, MS.
[4]Business Trends. South Central Bell Telephone Company. Feb. 1986.
[5]Federal Reserve Bank of Atlanta. Economic Review. Feb. 1986, p. 78.
[6]Daily Corinthian (Corinth). Waterway Posts Slow First Year. Jan. 21, 1986.
[7]Industrial Minerals. Kerr-McGee Corporation. No. 212, May 1985, p. 17.
[8]Birmingham News. Newly Public Birmingham Steel Has Glowing Profits. Feb. 7, 1986.
[9]American Metal Market. LTV's Cold-Finished Plants to Idle in Pa., Iowa, Miss. Aug. 20, 1985.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
United Cement Co	Box 185 Artesia, MS 39736	Plant	Lowndes.
Clays:			
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.
Presley Construction Inc	Box 46 Shuqualak, MS 39361	Mines	Noxubee.
Sand and gravel (1984):			
American Sand & Gravel Co	Box 272 Hattiesburg, MS 39401	Stationary plant	Forrest.
Blain Gravel Co	Box 278 Mount Olive, MS 39119	Stationary plants	Clay, Copiah, Itawamba, Marion.
Hammett Gravel Co	Box 207 Lexington, MS 39095	Mines and plants	Holmes, Marion, Pike.
Stone (crushed):			
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]

The value of nonfuel minerals produced in Missouri increased from $731.9 million in 1984 to $734.9 million in 1985. The State ranked ninth in the Nation, down from eighth in 1984.

In 1985, 12 nonfuel minerals were produced in the State, 7 industrial minerals and 5 metals. Industrial minerals accounted for 64% of the total value; metals, 36%. The State ranked first nationwide in the production of fire clay and lead, and was second in zinc; third in barite, crude iron oxide pigments, and lime; fourth in fuller's earth; fifth in copper; and sixth in portland cement, silver, and crushed and broken stone.

Crushed stone was Missouri's leading mineral product and accounted for about 22% of the total nonfuel mineral value. Recoverable lead output increased by 33%, or nearly 92,700 metric tons, in 1985, but total value fell 0.5%.

Per capita value of nonfuel mineral production was $146, compared with the national average of $98.

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

Mineral	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
Barite thousand short tons	W	W	47	$2,791
Cement:				
Masonry do	143	$7,033	139	6,630
Portland do	3,981	178,225	3,669	159,757
Clays[2] do	1,575	14,666	1,545	10,271
Copper (recoverable content of ores, etc.) metric tons	5,818	8,575	13,410	19,797
Gem stones	NA	10	NA	10
Iron ore thousand long tons	1,370	W	1,110	W
Lead (recoverable content of ores, etc.) metric tons	278,329	156,766	371,008	155,955
Sand and gravel:				
Construction thousand short tons	7,967	19,364	e7,500	e20,000
Industrial do	614	8,129	535	7,330
Silver (recoverable content of ores, etc.) thousand troy ounces	1,401	11,406	1,635	10,044
Stone (crushed) thousand short tons	e41,600	e137,000	50,646	162,097
Zinc (recoverable content of ores, etc.) metric tons	45,458	48,707	49,340	43,908
Combined value of clays (fuller's earth), iron oxide pigments (crude), lime, stone (dimension), and values indicated by symbol W	XX	142,016	XX	136,370
Total	XX	731,897	XX	734,960

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

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

[2]Excludes fuller's earth; value included with "Combined value" figure.

Table 2.—Nonfuel minerals produced in Missouri in 1984, by county[1]

County	Minerals produced in order of value
Adair	Sand and gravel (construction).
Atchison	Do.
Audrain	Clays.
Bollinger	Sand and gravel (construction).
Boone	Do.
Butler	Sand and gravel (construction), clays.
Callaway	Clays, sand and gravel (construction).
Camden	Sand and gravel (construction).
Cape Girardeau	Cement, sand and gravel (construction), clays.
Carroll	Sand and gravel (construction).
Clark	Do.
Clay	Do.
Cole	Do.
Cooper	Do.
Crawford	Clays.
Daviess	Sand and gravel (construction).
Douglas	Do.
Franklin	Do.
Gasconade	Clays, sand and gravel (construction).
Gentry	Sand and gravel (construction).
Greene	Lime.
Howard	Sand and gravel (construction).
Howell	Do.
Iron	Lead, zinc, silver, copper.
Jackson	Cement, sand and gravel (construction).
Jefferson	Sand (industrial), sand and gravel (construction).
Lafayette	Sand and gravel (construction).
Lewis	Do.
Lincoln	Do.
Livingston	Clays.
McDonald	Sand and gravel (construction).
Macon	Do.
Madison	Do.
Maries	Clays.
Miller	Sand and gravel (construction).
Monroe	Clays.
Montgomery	Clays, sand and gravel (construction).
Morgan	Sand and gravel (construction).
Nodaway	Do.
Oregon	Do.
Osage	Clays.
Ozark	Sand and gravel (construction).
Pemiscot	Do.
Perry	Do.
Phelps	Do.
Pike	Cement, clays, sand and gravel (construction).
Platte	Clays.
Pulaski	Sand and gravel (construction).
Ralls	Cement, clays.
Reynolds	Lead, zinc, silver, copper.
Ripley	Sand and gravel (construction).
St. Charles	Clays.
St. Francois	Lime, sand and gravel (construction).
Ste. Genevieve	Do.
St. Louis	Sand (industrial).
St. Louis City	Do.
Scott	Do.
Stoddard	Clays, sand and gravel (construction).
Taney	Sand and gravel (construction).
Texas	Do.
Warren	Clays, sand and gravel (construction).
Washington	Iron ore, lead, zinc, barite, silver, copper, sand and gravel (construction), iron oxide pigments.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Trends and Developments.—In 1985, the lead industry continued its decline; both consumption and prices had dropped in recent years, and some mines had been shut down before their ore bodies were entirely depleted. Lead imports from foreign countries had been competing strongly with domestic firms, and markets had been changing and shrinking. Lead consumption by the battery and gasoline industries had fallen markedly. A new use for lead by the asphalt industry had been tested.

Employment.—According to the Missouri Department of Labor and Industrial Relations, the unemployment rate in the State was 5.8% in October 1985 compared with

Table 3.—Indicators of Missouri business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	4,963	5,001	5,029
Total civilian labor force	do.	2,347	2,373	2,472
Unemployment	percent	9.9	7.2	6.4
Employment (nonagricultural):				
Mining total[1]	thousands	6.3	6.1	6.4
Metal mining[2]	do.	2.0	1.4	W
Nonmetallic minerals except fuels[2]	do.	2.6	2.8	3.0
Coal mining[2]	do.	1.6	W	W
Oil and gas extraction[2]	do.	.2	W	.1
Manufacturing total	do.	405.4	433.8	429.3
Primary metal industries	do.	12.4	13.7	12.8
Stone, clay, and glass products	do.	11.0	11.3	11.0
Chemicals and allied products	do.	27.6	28.6	29.3
Petroleum and coal products[2]	do.	1.1	1.2	1.5
Construction	do.	74.7	85.7	94.8
Transportation and public utilities	do.	132.7	136.6	142.3
Wholesale and retail trade	do.	463.7	488.5	509.8
Finance, insurance, real estate	do.	111.8	116.2	120.7
Services	do.	419.3	444.1	462.5
Government and government enterprises	do.	323.2	321.8	330.7
Total[3]	do.	1,937.0	2,032.7	2,096.5
Personal income:				
Total	millions	$56,895	$62,352	$66,605
Per capita		$11,463	$12,469	$13,244
Hours and earnings:				
Total average weekly hours, production workers		39.9	40.5	40.2
Total average hourly earnings, production workers		$8.9	$9.3	$9.6
Earnings by industry:				
Farm income	millions	$82	$602	$804
Nonfarm	do.	$41,206	$45,407	$48,719
Mining total	do.	$290	$323	$327
Metal mining	do.	$70	$58	$60
Nonmetallic minerals except fuels	do.	$56	$65	$74
Coal mining	do.	$76	$95	$101
Oil and gas extraction	do.	$87	$105	$92
Manufacturing total	do.	$9,783	$10,996	$11,626
Primary metal industries	do.	$364	$411	$406
Stone, clay, and glass products	do.	$265	$289	$292
Chemicals and allied products	do.	$903	$969	$1,050
Petroleum and coal products	do.	W	$41	$61
Construction	do.	$2,473	$2,933	$3,138
Transportation and public utilities	do.	$4,215	$4,512	$4,776
Wholesale and retail trade	do.	$7,249	$7,888	$8,392
Finance, insurance, real estate	do.	$2,385	$2,568	$2,963
Services	do.	$8,644	$9,627	$10,470
Government and government enterprises	do.	$5,976	$6,372	$6,837
Construction activity:				
Number of private and public residential units authorized[4]		18,728	25,017	27,236
Value of nonresidential construction[4]	millions	$875.6	$1,008.4	$1,232.7
Value of State road contract awards	do.	$364.0	$390.0	$401.0
Shipments of portland and masonry cement to and within the State	thousand short tons	1,420	1,698	1,774
Nonfuel mineral production value:				
Total crude mineral value	millions	$725.9	$731.9	$735.0
Value per capita		$146	$146	$146

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]Data may not add to totals shown because of independent rounding.
[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

6.4% in 1984. With all employment sectors included, the employment rate in Missouri had been increasing, even into the usual downturn season that begins in October.

For most of the last 5 years, Washington County led the State in unemployment; the rate peaked at 37.9% in February 1985. Washington County mines and mills were the source of the State's barite, and the three surviving companies did not operate above 25% of capacity.

Environment.—The Missouri Department of Natural Resources and county officials worked on controls to prevent illegal dumping in abandoned minesites. Two possibly suitable sanitary landfill sites in the old Tri-State mining district, one near Baxter Springs and the other near Galena, Cherokee County, KS, were awaiting a final decision at yearend 1985.

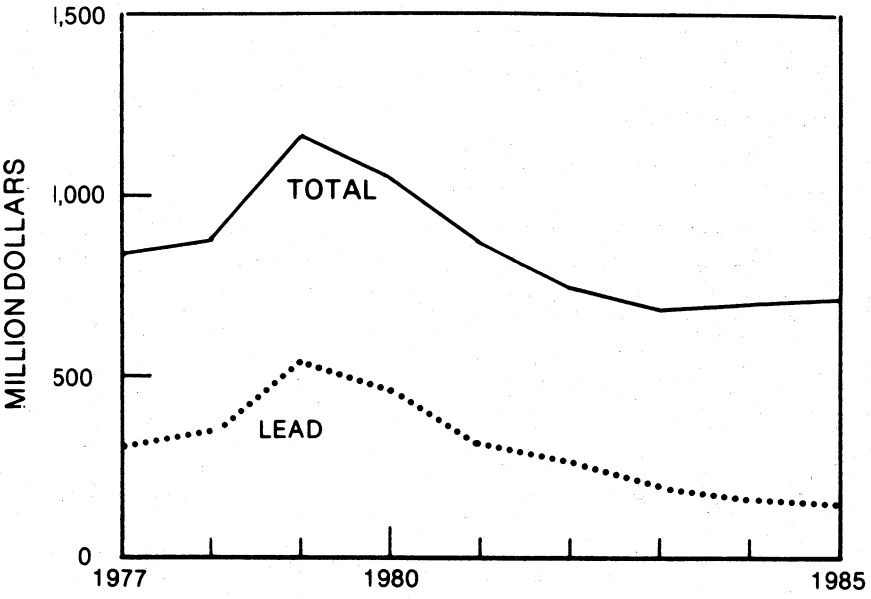

Figure 1.—Value of lead and total value of nonfuel mineral production in Missouri.

The State issued a report titled "Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites in Missouri," as required under amendments to the State's 1977 Hazardous Waste Management Law,[3] parts of which were known as Missouri's superfund law.

Tests on Jefferson County children, financed by St. Joe Lead Co., showed that the average blood-lead level in children residing near the Herculaneum primary lead smelter dropped to 8 micrograms in 1985 from 16.6 micrograms in 1975. Any reading under 25 micrograms was considered safe.

Exploration Activities.—Strategic and critical minerals, including those known to be in Missouri's geologic environment, were the focus of a study and report by the U.S. Geological Survey (USGS),[4] in cooperation with the Missouri Division of Geology and Land Survey.

In mid-1985, Falconbridge Ltd., a Canadian cobalt producer, reached an agreement with Anschutz Corp. to conduct a major exploration program at the Madison Mine at Fredericktown, Madison County. A decision on whether or not to mine was to be made by yearend 1986.

Newmont Mining Corp., Falconbridge, of Toronto, Canada, and St. Joe Minerals Corp. maintained exploration offices in Missouri, but there was little exploration activity except for the Falconbridge drilling program at the Madison Mine in search for cobalt, copper, and nickel. A few other companies still had land positions but were virtually inactive.

On October 10, 1984, St. Joe Minerals entered into an agreement with United States Steel Corp. (USS) to assume all rights and title to two preference right lease applications for two prospecting permits on 3,743 acres of land in the Winona Ranger District, Mark Twain National Forest. USS filed for the leases on November 16, 1983, following discoveries of ore-grade mineralized zones on two areas for which it held prospecting permits. The permits would have expired in November 1983, so a lease was needed to hold the ground for development drilling. In late February 1985, the U.S. Forest Service decided to make an environmental assessment before issuing a lease because of the proximity of the proposed lease area to the Current River in the Ozark's National Scenic River Ways (National Park Service, U.S. Department of the Interior) and the Eleven Point National Scenic River (Forest Service, U.S. Department of Agriculture).

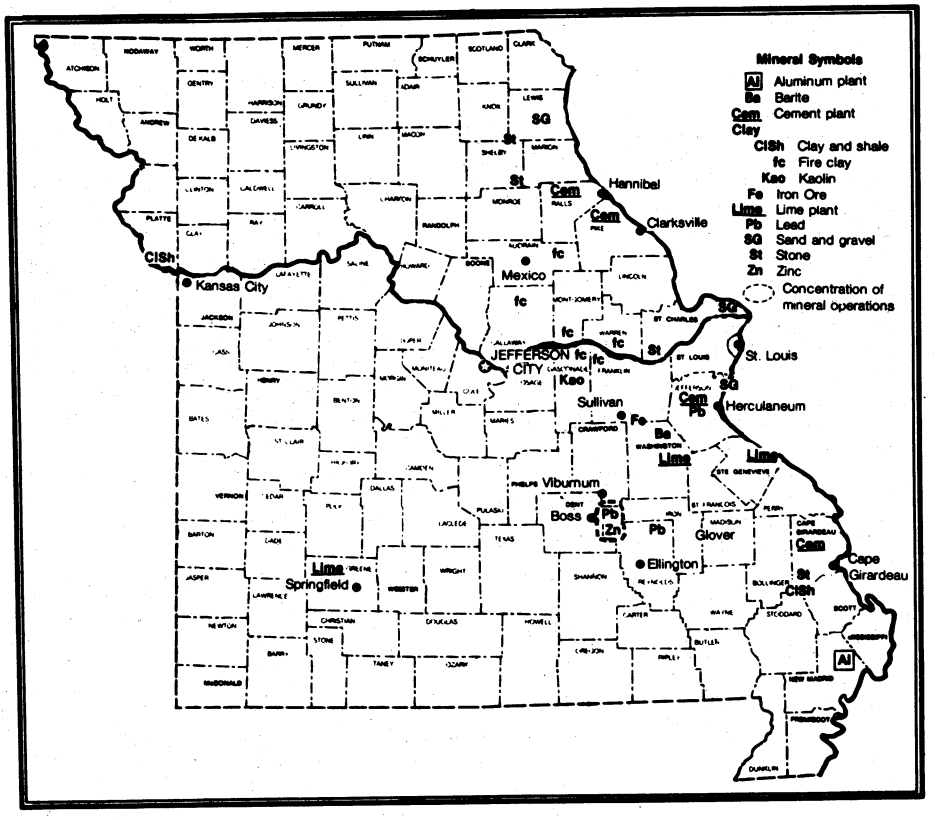

Figure 2.—Principal mineral producing localities in Missouri.

Legislation and Government Programs.—The Springfield 1° by 2° Quadrangle 5-year study was completed by the Missouri Department of Natural Resources, Division of Geology and Land Survey, and the USGS. The mineral resource study revealed that the 1,500-square-mile area in the Ozarks had a marginal to high potential for discovery of a wide variety of mineral deposits. The uppermost Cambrian units, the Potosi and Eminence Dolomites, were considered more favorable for lead and zinc mineralization than were the Bonneterre Dolomite and Lamotte Sandstone, the main hostrocks in southeastern Missouri.

Lead, nickel, silver, zinc, and other metallic minerals could be present in deeper sedimentary layers, down to depths of as much as 1,500 feet below the surface. In older basement rocks potential may exist for other types of metallic ore deposits, but data were too sparse to be definitive. At the surface there was also a potential for industrial and construction materials, such as

crushed stone, building stone, construction sand and gravel, and some components of cement.[5]

Seven alternative management plans for the 1.5-million-acre Mark Twain National Forest were proposed by the U.S. Forest Service in draft reports issued March 1985. Opponents contended that the Forest Service's preferred alternative plan put a premium on dispersed recreation and solitude and would sharply reduce acreages previously open to exploration, hunting, mining, and timbering. The final version of the Forest Service plan was to be issued in June 1986.

The Missouri Geological Survey planned to expand its core repository facility, which housed core from approximately 500 holes, representing approximately 350,000 feet of core. Starting in 1982, the economic climate in the metal industry led to a virtual termination of industry exploratory drilling programs, and existing cores assumed an added importance. As the depressed economic climate continued, many exploration offices were closed and companies were forced to discard core. In Missouri, 58 entities, representing energy, metals, and industrial minerals companies and government agencies, donated 1,663 cores, or 1.5 million feet of core, to the Missouri Geological Survey repository.

Scientists at the U.S. Bureau of Mines Rolla Research Center sought methods to recover cobalt, nickel, and other metal values from Missouri lead ore concentrates[6] and to describe the best available technology for their recovery. Missouri ores were the only domestic cobalt resource being mined. A continuous flotation unit completed at Cominco American Incorporated's Magmont concentrator in June recovered as much as 65% of the cobalt found in the mill tailings and from 60% to 90% of the other valuable metals, such as copper, lead, silver, and zinc.[7]

Approximately 3.6 million pounds of cobalt could become available annually from Missouri lead ores. The system, while technically feasible, was not currently economic. In recent times, Missouri lead ores had been at a competitive disadvantage on the world market because they averaged only about one-half the coproduct and byproduct values of lead ores found in other major lead producing and exporting nations.

Recycling zinc from flue dust for electrogalvanizing was another U.S. Bureau of Mines research objective done in cooperation with the University of Missouri—Rolla in 1985.[8]

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Copper, iron, lead, silver, and zinc were produced from eight mines during 1985. AMAX Lead Co. of Missouri, ASARCO Incorporated, Cominco American, Pea Ridge Iron Ore Co. (a subsidiary of St. Joe Minerals), and St. Joe Minerals were the operating companies. AMAX operated its Buick Mine (ownership shared with a Homestake Mining Co. subsidiary), Iron County; Asarco, its new West Fork Mine, Reynolds County; Cominco American, its Magmont Mine (ownership shared with Dresser Industries Inc.), Iron County; Pea Ridge, its Pea Ridge iron mine, Washington County; and St. Joe Minerals, its Casteel, Fletcher, Viburnum No. 28, and Viburnum No. 29 Mines, Iron, Reynolds, and Washington Counties.

In addition to lead smelters and refineries in Iron and Jefferson Counties and the iron ore pellet plant in Washington County, Missouri also had a primary aluminum smelter in New Madrid County. All mines and plants were in southeastern Missouri.

Aluminum.—Noranda Aluminum Inc. became a part of the Cleveland Group of a new SBU (strategic business unit) called Noranda Manufacturing Inc. The parent company was Noranda Inc., Toronto, Canada.

Cooling fluid used for the electrical system at Noranda Aluminum's New Madrid smelter froze in January's subzero weather and combined with high winds to shut down a 66,000-metric-ton-per-year potline. By July 1, the three-potline smelter was operating at 68.2% of its 204,000-metric-ton capacity. Noranda Aluminum further curtailed smelting operations the first week in November. The November shutdown, which affected 118 employees, was caused by the low selling price of aluminum ingot. In December, Noranda Aluminum restarted a potline and boosted output by 63,500 metric tons, bringing annual capacity to 172,000 metric tons per year, a total reduction of about 17.5% from the beginning of 1985.

Cobalt.—The U.S. Bureau of Mines announced a new process that extracted co-

balt from Missouri lead ore wastes. (See "Legislation and Government Programs.")

Columbium and Tantalum.—Mallinckrodt Inc. of St. Louis announced that its long-term tolling arrangement with NRC Inc. to convert columbium and tantalum raw materials into columbium oxide and potassium fluotantalate would not be renewed in 1986. Mallinckrodt represented about one-third of the domestic tantalum raw material processing capacity. The firm indicated that its plant could be forced to shut down if new tolling arrangements could not be made.

Copper.—St. Joe Minerals' Casteel Mine produced 45% of the copper from Viburnum Trend mines. In decreasing order of output, Casteel was followed by Buick, Magmont, Viburnum No. 28, Fletcher, Viburnum No. 29, and West Fork Mines. Asarco's West Fork, the newest copper producer in the State, contained 13,550,000 metric tons of ore reserves, grading 0.04% copper, according to the company's 1985 10K Annual Report to the Securities and Exchange Commission.

Iron Ore.—The sole underground iron ore mine in the United States was operated by Pea Ridge, a subsidiary of St. Joe Minerals, in turn, a subsidiary of Fluor Corp. Pea Ridge is in northwest Washington County.

The annual capacity of the Pea Ridge mining facility was 2.5 million long tons of ore, and that of the plant, 1.6 million long tons of iron ore pellets.[9]

During fiscal year 1985, Pea Ridge operated at a slightly lower utilization rate than in fiscal year 1984, owing to reduced customer demand. Pea Ridge shipped 1.03 million long tons of olivine-enriched pellets (compared with 1.28 million long tons in 1984) containing 1.80% MgO. The pellets, with an iron content of approximately 65%, represented about 93% of total product shipments by Pea Ridge. Chemical enrichment of the pellets, used in blast furnaces, proved successful in lowering steel production costs. In addition, 54,687 long tons of other iron oxide products also were shipped.[10]

Pea Ridge also produced heavy-medium magnetite for coal washing, ceramic-grade iron oxide for use in ceramic magnets and crude iron oxide pigments, and hematite for use as additives in cement manufacturing and drilling muds.

Iron ore mined in fiscal years ending October 31, 1985, 1984, and 1983, amounted to 1.72, 1.89, and 1.16 million long tons, respectively. Grades were 44%, 45%, and 45.8% magnetic iron for 1985, 1984, and 1983, respectively. St. Joe Minerals' managers estimated that as of October 31, 1985, proven ore reserves (ore having a grade of at least 45% magnetic iron) in the Pea Ridge ore body were approximately 164.9 million long tons, containing approximately 56% magnetic iron.

Lead.—Missouri's mines accounted for 89.6% of the Nation's total lead output in 1985, compared with an 86.3% (revised) share in 1984. Total mine production of recoverable lead from the State's seven lead mines increased 33% from that of 1984 but was more than 9% lower than 1983 production.

A potential new market under development was the use of lead diamyldithiocarbamate to slow the oxidation of paving asphalts, reducing their tendency to crack and, possibly, doubling service life. By June 1985, three practical road trials were in progress in the United States and Canada. This application could eventually represent an additional 50,000 metric tons of domestic lead consumption in the 1990's.[11]

AMAX-Homestake employees, members of United Steelworkers of America, who had struck the Buick complex on June 1, 1984, and signed a new contract December 29, returned to work in January 1985. The new 37-month contract, which was to expire January 31, 1988, provided for a closed shop and maintained seniority rights; the miners accepted a $3 per hour cut in wages and benefits, including medical benefits, shift differential, and weekend premiums.

In 1985, AMAX-Homestake increased Buick Mine ore production by about 725,000 metric tons, and the joint venture partners mined and milled 2.08 million metric tons of ore, compared with 1.36 million metric tons in 1984. The average ore grade was 6.9% lead and 1.4% zinc, compared with 8.1% lead and 1.8% zinc at Buick in 1984. Buick Mine was the Viburnum Trend's largest producer of recoverable lead. The Buick Mine and mill also produced 42,712 metric tons of zinc concentrates, with a zinc content of 58.29%, according to AMAX's 1985 10K Annual Report.

Owing to depressed conditions in the base-metal industry, AMAX-Homestake revised Buick's mining plan and reduced the production rate to 1.5 million metric tons per year to cut costs. The firm also reduced its reserve estimates to 18.1 million metric tons, grading 8.0% lead and 2.2% zinc, reported at yearend 1985, down from

32.7 million metric tons, grading 5.6% lead and 1.4% zinc, reported for 1984.

The principal areas to be mined were held under long-term Federal mineral leases. The term of the principal lease was to expire in 2013. Royalty payments of 5% were paid to the U.S. Bureau of Land Management.[12]

The AMAX-Homestake smelter, although closed for maintenance and inventory adjustment from October 21 to December 2, treated 177,880 metric tons of lead concentrates (with a lead content of 77.29%) and produced 118,712 metric tons of refined lead.

Early in the year, Asarco kept its Glover smelter in Iron County working three shifts, using 200 salaried and hourly workers to process the lead concentrates from Cominco American's Magmont Mine. The smelter had enough capacity—95,300 metric tons per year—to handle ore from Magmont and Asarco's own new West Fork Mine, when it opened in September. West Fork zinc concentrates were sold.[13]

In its 1985 10K Annual Report, Asarco stated that Glover's higher than capacity production in 1985 resulted from uninterrupted operations and minimal downtime for repair and maintenance. Glover's output was 112,039 metric tons of lead bullion, up 43% from that of 1984 (during the last quarter of 1984, workers had struck the Glover smelter).

Following completion of the West Fork Mine underground crushing system, initial production was limited to 25% to 30% of capacity, but was to increase to 40% of capacity in 1986. At the 30% rate, West Fork supplied about 2,700 metric tons of lead concentrates per month to the Glover smelter and refinery. Full production of 46,300 metric tons per year was expected to be reached by mid-1987 or whenever lead prices improved significantly.

Total estimated cost of the West Fork Mine and mill development was $77 million. Design capacities included 6,800 metric tons of zinc and 125,000 ounces of silver per year.[14]

West Fork Mine had ore reserves of 13.5 million metric tons, grading 0.04% copper, 5.5% lead, 1.2% zinc, and 0.30 ounce of silver per ton, according to Asarco's 1985 10K Annual Report.

The last two of the 1984 mine labor disputes in the Viburnum Trend were settled on February 23, when agreements were reached between the United Steelworkers of America and the Nation's second and third largest lead mines, the closed Milliken, owned by Ozark Lead Co., and the Magmont, operated by Cominco American.

At the Magmont Mine, the new contract was to extend through May 31, 1988. Though similar to Ozark Lead's labor contract settlement, Magmont's contract entailed a wage cut of $0.54 per hour and the loss of some fringe benefits and cost-of-living adjustments.

Ore production at Magmont in 1985 reached an all-time high of 1,041,000 metric tons, and productivity improved to a record high 24.4 metric tons per worker-shift. At yearend, 180 employees were on the payroll, compared with 182 in 1984.

According to Cominco Ltd.'s 1985 annual report, the Magmont Mine produced 100,300 metric tons of lead concentrates, 28,100 metric tons of zinc concentrates, and 1,100 metric tons of copper concentrates.

Average ore grade in 1985 was 7.51% lead, 1.9% zinc, and 0.3% copper, compared with 7.1% lead, 2.1% zinc, and 0.2% copper in 1984. More than 40% of Magmont's total ore production was extracted from the Magmont West extension.

Measured and indicated ore reserves at Magmont Mine were stated to be 6.3 million metric tons containing 6.5% lead, 1.1% zinc, and 0.4 ounce of silver per ton in 1985, compared with 7.2 million metric tons containing 6.5% lead, 1.2% zinc, and 0.4 ounce of silver per ton in 1984. Reductions in reserves resulted from increased mining costs and lower metal prices.

Although Ozark Lead's Milliken Mine had been closed for economic reasons since March 4, 1983, about 100 workers still in the area who belonged to the United Steelworkers of America signed a 3-year contract February 23, in which they agreed to significant wage and fringe-benefit concessions. In return, the company agreed to extend the callback rights for most of its laid-off workers should the mine reopen.[15]

The new contract reduced wages by $3.60 per hour and eliminated cost-of-living adjustments. Union members also accepted a reduced medical plan and a partial loss of other benefits. The new contract extends through February 29, 1988. The new average wage was to be $8.86, compared with the former average of $12.40 per hour. Ozark Lead was a unit of Kennecott, a subsidiary of Standard Oil Co. of Ohio.

St. Joe Minerals, a fully owned subsidiary of Fluor, recently moved its headquarters to

Clayton, St. Louis County, from New York City, NY. The St. Joe Lead Co. Div. operated four mines and two mills in southeastern Missouri and was the Nation's largest integrated producer of lead, accounting for 38% of all lead mined in the United States in 1985. Brushy Creek Mine and mill, closed during the 7-month-long strike that ended December 9, 1984, and was not reopened in 1985.

In the fiscal year ending October 31, 1985, St. Joe Lead mined 3.2 million metric tons of ore, averaging 5.08% lead, compared with 2.7 million metric tons averaging 4.76% lead in fiscal year 1984. The 1985 mine output was 20% higher than that of 1984 but 23% lower than that of 1983. Viburnum No. 29 produced the largest amount of recoverable lead, followed by Fletcher, Casteel, and Viburnum No. 28 Mines.

About 60% of St. Joe Lead's ore bodies was held under Federal mineral leases.

St. Joe Lead focused on improving production efficiency and enhancing mine flexibility, thereby reducing the costs of both feed materials and production during 1985.

A prolonged labor dispute at St. Joe Lead's mines was settled in the first quarter of 1985, and the United Steelworkers of America union was decertified at the Southeast Mining and Milling Div. of St. Joe Lead. The old contract expired April 30, 1985; Herculaneum workers rejected a proposal by the company but agreed to continue to work while negotiations with their Teamsters Union continued.

The labor force at St. Joe Lead's Missouri mines was reduced nearly 40%, partly resulting from closure of the Brushy Creek Mine in April 1984 at the beginning of the strike.

Most concentrates produced at the St. Joe Lead mills were shipped to the company's lead smelter at Herculaneum, Jefferson County. Those two operating mills had an aggregate daily capacity of 15,400 metric tons of ore. The lead smelter had an annual capacity of approximately 204,000 metric tons of refined lead—about 34% of domestic primary refined lead capacity.

St. Joe Lead completed development of a new mine, the Casteel (formerly Viburnum No. 35), in fiscal year 1985. The total cost of the mine development project, begun in 1980 and including expansion of the Viburnum mill, was approximately $31.5 million.[16]

St. Joe Minerals' posted price for lead metal was 26 cents per pound on November 1, 1984; 19 cents in November 1985; and 19.5 cents on December 31, 1985.

Table 4.—Missouri: Tenor of lead ore milled and concentrates produced in 1985

Total material	metric tons	6,433,712
Metal content of ore:[1]		
Copper	percent	0.24
Lead	do.	5.89
Zinc	do.	.92
Concentrates produced and average content:		
Copper	metric tons	35,302
Average copper content	percent	28.41
Lead	metric tons	506,397
Average lead content	percent	74.35
Zinc	metric tons	92,408
Average zinc content	percent	57.61

[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)
1981	389,721	$313,870	87.5	445,535	$358,821
1982	474,460	267,150	92.6	512,516	288,579
1983	409,280	195,620	91.1	r449,295	r214,745
1984	278,329	156,766	r86.3	r322,677	r181,745
1985	371,008	155,955	89.6	413,955	174,008

rRevised.

Silver.—Production in 1985 was 1,635,301 troy ounces of silver from 6,433,712 metric tons of lead ore, compared with 1,401,070 troy ounces from 4,748,910 metric tons of lead ore in 1984. The seven Missouri lead mines accounted for 4% of the Nation's silver output in 1985. From 1981 through 1985, Missouri lead mines produced 9,463,950 troy ounces of silver.

The Buick Mine was the leading silver producer, followed, in decreasing order, by Magmont, Viburnum No. 29, Casteel, Fletcher, Viburnum No. 28, and West Fork Mines.

Table 6.—Missouri: Mine production (recoverable) of silver, copper, lead, and zinc

	1983	1984	1985
Mines producing: Lode	8	7	7
Material sold or treated: Lead ore thousand metric tons	7,303	4,749	6,434
Production:			
Quantity:			
Silver troy ounces	2,021,343	1,401,070	1,635,301
Copper metric tons	7,725	5,818	13,410
Lead do.	409,280	278,329	371,008
Zinc do.	57,044	45,458	49,340
Value:			
Silver thousands	$23,124	$11,406	$10,044
Copper do.	$13,033	$8,575	$19,797
Lead do.	$195,620	$156,766	$155,955
Zinc do.	$52,052	$48,707	$43,908
Total[1] do.	$283,830	$225,452	$229,705

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

Production began at Asarco's West Fork lead-zinc-silver mine in September. The mine was operating at about 40% of capacity by yearend and reported 65,300 metric tons of ore milled, and 2,000 ounces of silver in concentrate. West Fork reserves were 13.5 million metric tons, averaging 0.30 ounce of silver per ton, according to the firm's 1985 10K Annual Report.

Zinc.—The Buick Mine was the Nation's third largest and the State's foremost producer of zinc, followed in order of decreasing statewide output, by Magmont, Viburnum No. 29, Fletcher, Casteel, Viburnum No. 28, and West Fork Mines.

Asarco produced 91 metric tons of zinc in concentrates between early September, when the new West Fork Mine started up, and yearend. West Fork reserves were 13.5 million metric tons, grading 1.20% zinc, according to the firm's 1985 10K Annual Report.

St. Joe Minerals was the Nation's largest producer of zinc. The firm produced zinc concentrates from its four lead mines in Missouri for feed material to the electrolytic plant and refinery of its new sister company, National Zinc Div., Bartlesville, OK. The concentrates at St. Joe Minerals' Missouri lead mills produced 11,687, 12,243, and 19,786 metric tons of zinc in fiscal years 1985, 1984, and 1983, respectively. St. Joe Minerals' zinc was used primarily in galvanizing and in brass and bronze fabrication.[17]

INDUSTRIAL MINERALS

Abrasive Materials.—Finished tripoli was produced from raw out-of-State material by American Tripoli Co. at its Seneca plant in Newton County.

Barite.—Missouri was the Nation's third largest barite-producing State in 1985; barite output decreased from that of 1984. Active producers were General Barite Co. (Old Mines), NL Baroid (a subsidiary of NL Industries Inc., Cadet Mine), and DeSoto Mining Co. (Richwoods Mine), all in Washington County. The value of barite ore per ton increased from that of 1984.

Cement.—Five plants operated during 1985, producing nearly 3.7 million short tons of portland cement, down 2.4% from that of 1984. Utilized grinding capacity was 78.4%, down from 80.4% in 1984. Plants were operated at Cape Girardeau, Cape Girardeau County; Clarksville, Pike County; Festus, Jefferson County; Hannibal, Ralls County; and Sugar Creek, Jackson County. All but the Clarksville plant reported masonry cement production.

Clinker was produced at two wet-process and two dry-process plants, using 89.4% of capacity.

Raw materials consumed were 5.8 million tons of limestone, 0.8 million tons of

shale, 0.2 million tons of clay, and smaller amounts of clinker, fly ash, gypsum, iron ore, mill scale, sand, and various resins and chemicals.

Average value of portland cement shipped from mills fell $1.23 to $43.54 per ton in 1985; masonry cement fell $1.39 to $47.63 per ton.

Table 7.—Missouri: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1984	1985
Number of active plants	3	3
Production	142,664	139,387
Shipments from mills:		
Quantity	143,455	139,193
Value	$7,032,799	$6,629,930
Stocks at mills, Dec. 31	23,325	25,521

Table 8.—Missouri: Portland cement salient statistics

(Short tons unless otherwise specified)

	1984	1985
Number of active plants	5	5
Production	3,979,033	3,882,838
Shipments from mills:		
Quantity	3,980,706	3,668,945
Value	$178,225,067	$159,757,152
Stocks at mills, Dec. 31	384,212	605,439

In decreasing order of quantity, finished portland cement was sold to ready-mixed concrete companies (76.6% of shipments), concrete product manufacturers, highway contractors, building material dealers, miscellaneous customers, and contractors.

Lone Star Industries Inc.'s portland cement plant at Cape Girardeau was a dry-process plant with an annual rated capacity of 1.2 million tons. Net sales in 1985 were down 6%, primarily owing to the slowed regional economy.

In its 1985 annual report, Lone Star Industries stated that it was the Nation's largest importer of cement because imports were cheaper than cement that could be produced domestically.

At yearend, Pennsylvania-based H. K. Porter Co. sold Missouri Portland Cement Co. to MPC Holdings Inc., a Swiss-West German joint venture of Cementia Holding AG, Zurich, Switzerland, and Deutsche Afrika-Linien, Hamburg, Federal Republic of Germany. The sale included the Sugar Creek cement plant in Jackson County, near Kansas City. Approximately 125 persons worked at Sugar Creek.

Several Missouri cement firms, including Dundee Cement Co., Lone Star Industries, and Missouri Portland Cement, were among the founding members of a new cement trade group called the American Cement Trade Alliance Inc. The new group, representing 60% of U.S. clinker capacity, was formed to lobby Congress and the Administration on what it perceives to be unfairly priced, imported foreign government-subsidized cement.

Clays.—Missouri ranked 10th in the Nation in clay and shale production. Total output declined insignificantly from that of 1984, but average value per short ton declined 27.8%.

The State ranked first of 14 States that produced fire clay, accounting for 29% of the total national output. Missouri ranked fourth of 10 States that produced fuller's earth.

The State's 21 companies operated 44 pits in 17 of 114 counties: 23 pits produced fire clay; 13, common clay and shale; 6, kaolin; and 2, fuller's earth.

Common clay and shale production rose 11.7%, but value per ton declined $0.97 to $2.90 in 1985. Fire clay output and total value decreased nearly 34% and 41%, respectively, and fuller's earth output and value decreased about 10% and 8%, respectively, in 1985.

Four companies produced more than 100,000 tons of clay, accounting for 69% of the total output and 66% of the total value. The four top-ranking companies were Dundee Cement, Dillon Clay Mining Co., Southern Clay Inc., and Continental Cement Co. Continental, Dillon Clay, and Dundee Cement produced common clay and shale; Southern Clay produced fuller's earth.

A. P. Green Refractories Co., a subsidiary of the newly established holding company USG Corp., finished constructing a tar-impregnating plant at Fulton, Callaway County. The plant enables A. P. Green to meet customer requirements by economically impregnating its brick products with tar, an important value-added step in refractory brick production.

At the company's Mexico plant in Audrain County, a modern computer-operated raw material storage and handlings system provided more efficient and faster raw material handling. Also at Mexico, a newly installed hydraulic brick press provided better sizing control and a product that had superior physical properties.[18]

Kaiser Aluminum & Chemical Corp. sold most of its North American clay and nonclay refractory manufacturing facilities in four States, including Missouri, and a Canadian Province to the newly formed employee-owned National Refractories and Minerals Corp. National Refractories continued to produce refractory bricks used as linings in blast furnaces and ladles.

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
1981	669	13,397	974	2,797	104	2,220	1,747	18,414
1982[2]	448	8,833	851	2,605	84	1,971	1,383	13,409
1983[2]	311	5,480	1,004	3,716	103	2,652	1,418	11,848
1984[2]	428	8,540	1,079	4,179	68	1,947	1,575	14,666
1985[2]	284	5,073	1,205	3,497	57	1,701	1,545	10,271

[1]Data may not add to totals shown because of independent rounding.
[2]Excludes fuller's earth.

Lime.—Ash Grove Cement Co. (west of Springfield in Greene County), Resco Products of Missouri Inc. (at Bonne Terre, St. Francois County), and Mississippi Lime Co. (at Ste. Genevieve, Ste. Genevieve County) produced quicklime during 1985. Ash Grove and Mississippi Lime also reported hydrated lime output.

Total lime output fell slightly, but total value rose nearly 6% over that of 1984.

In February 1985, Ash Grove completed converting its Priest lime kilns to Parsons singleshaft, parallel flow calciners. Design capacity was 300 short tons per day, with a fuel efficiency of less than 4 million British thermal units per ton. The fuel used was natural gas, but the design can be adapted to almost any fuel, and the firm expected to burn coal in the future.[19]

Perlite (Expanded).—Brouk Co. and Georgia-Pacific Corp. expanded perlite from out-of-State sources. Brouk received its perlite ore from mines in northern New Mexico. The Brouk plant was in the southern part of St. Louis City, and the Georgia-Pacific plant was in Crawford County. Both firms reported selling all of their output; perlite has many construction-industry-related uses.

Salt.—Diamond Crystal Salt Co., St. Clair, MI, purchased the St. Louis warehouse facilities and properties of the Hardy Salt Co.'s Salt Div. for $9.5 million in early 1985.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Missouri construction sand and gravel production was estimated to have fallen nearly 6% from that of 1984. Value, however, increased an estimated 24 cents per short ton.

Virginia Mines Sand and Gravel (a subsidiary of Pruitt Construction Inc.) began operations in the St. Clair area, Franklin County, in September 1985. About 90% of the company's production was sold to concrete manufacturers; 10% was used as landscaping gravel.

Industrial.—Quantity and value of industrial sand fell 12.9% and 9.8%, respectively, from figures for 1984. Average price per short ton rose $0.46 to $13.71 per ton.

On September 13, United States Borax & Chemical Corp. acquired the Pennsylvania Glass Sand Corp. from ITT Corp. and made it a division of United States Borax & Chemical. Pennsylvania Glass Sand, headquartered in Berkeley Springs, WV, was a leading producer of silica sand and attapulgite clay—commodities used in the agricultural, chemical, glass, and oil and gas industries. Pennsylvania Glass Sand had a major industrial (silica) sand mine and processing plant in St. Louis County, just east of Pacific.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

In 1985, output and value of both crushed

and dimension stone increased over estimated figures for 1984.

Crushed.—Crushed stone production rose about 22%, and value, about 18%. Nearly 96% of the crushed stone produced from 238 quarries in Missouri during 1985 was limestone and dolomite. The State's output also included, in decreasing order, small amounts of crushed granite, sandstone, and marble.

Of the 238 quarries in Missouri, 10 produced more than 1 million short tons of stone each, accounting for 34.3% of the State's total output. Of the 10 largest quarries, 9 produced limestone; the largest of these was the Tower Rock Stone Co. quarry in Ste. Genevieve County. The largest producer of crushed granite was the Missouri Pacific Railroad Co. (quarry operator, Quality Aggregates) in Wayne County.

In decreasing order of tonnage produced, the top 5 of 139 companies were Tower Rock Stone Co., Fred Weber Inc., Moline Consumers Co., West Lake Quarry & Material Co., and Martin Marietta Aggregates, operating a total of 37 quarries in 22 counties. The top five companies accounted for 33% of the total quantity and 30% of the total value in 1985.

Crushed stone was transported by truck (78.9% of quantity shipped), waterway (11.7%), unspecified methods (5.5%), and railroad (3.9%).

The Missouri Limestone Producers Association calculated that a State highway in Missouri cost 7.4% more to build in 1985 than it did in 1984. The cost increase was largely attributed to higher bid prices on construction materials such as asphalt, concrete, and steel, and partly on activities such as earthmoving.[20]

Missouri Portable Stone Co., Warrenton, added a secondary impact crusher in March 1985 to one of its portable plants, increasing production from 150 to 336 tons per hour. The new unit handled feed as large as 20 inches in diameter, up from 5- and 6-inch diameters in the old crusher. The company planned also to install a new screening system to increase production capacity of finished materials.[21]

Table 10.—Missouri: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	1,522	3,147
Riprap and jetty stone	5,224	14,101
Filter stone	279	969
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,845	14,889
Bituminous aggregate, coarse	2,630	9,209
Bituminous surface-treatment aggregate	913	3,458
Railroad ballast	1,491	3,193
Fine aggregate (-3/8 inch):		
Stone sand, concrete	227	960
Stone sand, bituminous mix or seal	70	266
Screening, undesignated	995	3,962
Combined coarse and fine aggregates:		
Graded road base or subbase	5,653	18,735
Unpaved road surfacing	2,844	10,048
Crusher run or fill or waste	5,962	20,327
Other construction[2]	985	2,961
Agricultural:		
Agricultural limestone	1,708	5,532
Poultry grit and mineral food	360	2,397
Chemical and metallurgical:		
Cement manufacture	6,293	15,132
Lime manufacture	205	892
Special:		
Other fillers or extenders	41	157
Roofing granules	242	879
Other miscellaneous[3]	369	2,342
Other unspecified[4]	8,789	28,538
Total[5]	50,646	162,097

[1]Includes dolomite, granite, limestone, marble, and sandstone.
[2]Includes stone used in building products, coarse aggregate (large), and stone used for other construction and maintenance purposes.
[3]Includes stone used in chemical stone, asphalt fillers or extenders, glass manufacture, and other uses not specified.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

In January 1985, Tower Rock Stone Co. completed the third and last phase of an expansion program that began in 1979 at its Ste. Genevieve facility. Phase 1 provided greater capacity for larger sized materials production. Phase 2, completed in 1980, added capacity for aggregates and agricultural limestone production. Phase 3, the primary plant, produced riprap and other large products, some aggregates, and surge pile feed. The annual capacity was increased to 3 million tons of processed material.[22]

Missouri Department of Natural Resources, Division of Geology and Land Survey, scientists completed six regional studies to determine the chemical and physical properties of selected stone resources in Missouri. The reports are numbered OFR-85-33-MR through OFR-85-38-MR.

Selected stone resources also were studied for use as railroad ballast.[23]

Dimension.—Dimension stone output increased about 80% over that of 1984; total value increased 49%. Average value per ton, however, fell from $141.87 in 1984 to $117.23 in 1985. Beavers Natural Stone Co. in Camden County and Keystone (Granite) Memorial Inc. in Iron County were the two reporting dimension stone producers. Beavers cut sandstone; Keystone cut granite.

Sulfuric Acid.—Sulfuric acid production rose 44% from that of 1984; value per short ton, however, increased 8%, or $2.35. St. Joe Lead produced sulfuric acid during lead refining at its Herculaneum plant.

Vermiculite (Exfoliated).—The quantity and value of exfoliated vermiculite decreased 7% and 12%, respectively, from those of 1984.

Brouk and W. R. Grace & Co., Construction Products Div., processed vermiculite received from out-of-State or foreign sources. Both plants were in the independent city of St. Louis. Brouk received its ore from Africa and South Carolina and Virginia. The African ore was shipped up the Mississippi River by barge from gulf coast seaports.

Both firms sold vermiculite as block insulation, concrete aggregate, horticultural mix, loose-fill insulation, and soil conditioning mix. One or the other firm also sold the product for use as fire proofing, packing insulation, plaster aggregate, and miscellaneous uses.

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[12]AMAX 1985 10K Annual Report. P. 20.

[13]Engineering and Mining Journal. This Month in Mining. Oct. 1985, p. 59.

[14]———. Apr. 1980, p. 41, and Jan. 1986, p. 29.

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[16]Work cited in footnote 9.

[17]Work cited in footnote 9.

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Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
NL Industries Inc. Baroid Div	Box 2808 St. Louis, MO 63111	Mines and plant	Washington.
Cement:			
Continental Cement Co.[1]	Box 71 Hannibal, MO 63401	Quarry and plant	Ralls.
Dundee Cement Co.[2 3]	Box 67 Clarksville, MO 63336	____do	Pike.
Lone Star Industries Inc.[4]	Box 12449 Dallas, TX 75225	Quarries and plants	Cape Girardeau.
River Cement Co., a subsidiary of IFI International of Italy (Instituto Finanziario Industriale S.p.A.).[5]	Box 14545 St. Louis, MO 63178	Quarry and plant	Jefferson.
Clays:			
Carter Waters Corp	Box 19676 Kansas City, MO 64141	Pits and plants	Platte.
Dillon Clay Mining Co	Box 115 St. James, MO 65559	Pits	Crawford.
A. P. Green Refractories Co., a subsidiary of USG Corp.	1018 East Breckenridge St. Mexico, MO 65265	Mines	Audrain, Franklin, Gasconade, Maries, Osage.
Southern Clay Inc. (Lowe's Inc.)	Box 1086 Cape Girardeau, MO, 63701	Pits and plants	Stoddard.
Iron:			
Pea Ridge Iron Ore Co., a subsidiary of St. Joe Minerals Corp.	Route 4 Sullivan, MO 63080	Underground mine and plant.	Washington.
Lead:			
AMAX Lead Co. of Missouri and Homestake Mining Co.[6]	Boss, MO 65440	____do	Iron.
ASARCO Incorporated[6]	Box 116 Bunker, MO 63629	Mine and plant	Iron and Reynolds.
Cominco American Incorporated[6]	Bixby, MO 65439	Underground mine and plant.	Iron.
St. Joe Lead Co., a division of St. Joe Minerals Corp., a subsidiary of Fluor Corp.[6 7]	Box 500 Viburnum, MO 65566	Underground mines and plants.	Iron, Reynolds, Washington.
Lime:			
Ash Grove Cement Co.[8]	8900 Indian Creek Parkway Suite 600 Overland Park, KS 66225	Plant	Greene.
Mississippi Lime Co	7 Alby St. Alton, IL 62002	Quarry and plant	Ste. Genevieve.
Resco Products of Missouri Inc., Bonne Terre Limekiln.	Box 1110 Bonne Terre, MO 63628	Plant	St. Francois.
Perlite (expanded):			
Brouk Co.[9]	1367 South Kingshighway Blvd. St. Louis, MO 63110	____do	St. Louis City.
Georgia-Pacific Corp	900 SW. 5th St. Portland, OR 97217	____do	Crawford.
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. Louis and St. Louis City.
Missouri Gravel Co., a subsidiary of Moline Consumers Co.	313 16th St. Moline, IL 61265	Pits and plants	Lewis and St. Louis.
Winters Bros. Material Co	13098 Gravois Rd. St. Louis, MO 63127	Dredge and plant	St. Louis.
Industrial:			
Master Bros. Silica Sand Co., a subsidiary of Bussen Quarries Inc.	Route 1, Box 204 Pevely, MO 63070	____do	Jefferson.
Pennsylvania Glass Sand Corp., a subsidiary of United States Borax & Chemical Corp.	Box 187 Berkeley Springs, WV 25411	____do	St. Charles and St. Louis.
Unimin Corp	258 Elm St. New Canaan, CT 06840	Mine and plant	Jefferson.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Martin Marietta Aggregates	Box 30013 Raleigh, NC 27622	Quarries	Andrew, Daviess, Gentry, Harrison, Holt, Jackson, Mercer, Nodaway, Worth.
Moline Consumers Co	313 16th St. Moline, IL 61265	do	Jefferson, Knox, Lewis, Marion, Monroe, Pike, Ralls, St. Louis, Shelby.
Tower Rock Stone Co	Box 69 Columbia, IL 62236	Quarry	Ste. Genevieve.
Fred Weber Inc	7929 Alabama Ave. St. Louis, MO 63111	Quarries	Jefferson, St. Charles, St. Louis.
West Lake Quarry & Material Co	13570 St. Charles Rock Rd. Bridgeton, MO 63044	do	Cape Girardeau, Jefferson, St. Louis, Scott.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	St. Louis City.

[1]Also clays in Ralls County.
[2]Also clays in Pike County.
[3]Also stone in Pike County.
[4]Also stone in Cape Girardeau County.
[5]Also stone in Jefferson County.
[6]Also silver, copper, and zinc.
[7]Also stone in St. Francois County.
[8]Also stone in Bates, Dallas, Greene, Hickory, Polk, and Vernon Counties.
[9]Also vermiculite in St. Louis City.

The Mineral Industry of Montana

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

By W. L. Rice,[1] D. C. Lawson,[2] and Richard B. Berg[3]

Montana's nonfuel mineral production value dropped to $200 million in 1985, a 17% decrease from the $240 million recorded in 1984. A substantial decline in gold and silver production, a yearlong deterioration in silver prices, and a reduction in both the quantity and value of copper production were significant factors contributing to a 32% drop in the State's metallic mineral production value from the 1984 level. The largest production value gains recorded in 1985 were for construction sand and gravel, talc, and phosphate rock.

Gold was the leading commodity in terms of value, followed by construction sand and gravel, silver, and copper. The metals—copper, gold, iron ore, lead, and silver—accounted for 49% of the State's total nonfuel mineral value for the year, compared with 58% of the total value in 1984, and 65% in 1983. Montana ranked 34th in the Nation in value of nonfuel minerals produced in 1985, down from the 30th ranking gained in 1984. The State ranked 39th in the value of industrial mineral production in 1985.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	r229	r$5,642	279	$8,296
Copper (recoverable content of ores, etc.) metric tons	W	W	15,092	22,281
Gem stones	NA	450	NA	400
Gold (recoverable content of ores, etc.) troy ounces	181,190	65,348	160,262	50,909
Lead (recoverable content of ores, etc.) metric tons	W	W	846	356
Lime thousand short tons	89	5,097	W	W
Sand and gravel (construction) do	7,776	21,269	e9,000	e26,000
Silver (recoverable content of ores, etc.) thousand troy ounces	5,653	46,018	4,010	24,630
Stone (crushed) thousand short tons	e950	e2,400	21,730	25,044
Combined value of barite, cement, graphite (1984), gypsum, iron ore, peat, phosphate rock, sand and gravel (industrial), stone (crushed traprock, 1985), stone (dimension), talc, vermiculite, and values indicated by symbol W	XX	r93,811	XX	62,356
Total	XX	r240,035	XX	200,272

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

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

[2]Excludes traprock; data included with "Combined value" figure.

Trends and Developments.—The Anaconda Minerals Co. and parent company Atlantic Richfield Co. (ARCO) sold the bulk of the Anaconda-ARCO mineral holdings in Montana during 1985. Washington Corps., a Missoula-based mining and heavy construction company, acquired the mining assets in Butte for a sum reportedly under $10 million. Washington Corps. established a new mining subsidiary, Montana Resources Inc., and announced plans to reopen the Butte copper-molybdenum operations in 1986.

Western Energy Co., a wholly owned coal and metals mining subsidiary of Montana Power Co., signed a purchase agreement in November for 800,000 acres of ARCO mineral ownership in 19 western Montana counties. The properties include holdings in 21 established mining districts with recorded production in lead, zinc, copper, silver, or gold. Western Energy immediately launched a geologic and economic evaluation program covering the purchased property.

Lac Minerals Ltd. of Toronto, Ontario, Canada, bought out Anaconda Minerals' one-third interest in Stillwater Mining Co., a joint venture of Anaconda Minerals, Chevron Resources Co., and Manville Corp. The joint venture company is currently developing a platinum-group metals mine near Nye, in Stillwater County.

Syracuse Minerals Inc. negotiated the purchase from ARCO of 35,000 acres of property west of the town of Anaconda in Deer Lodge and Granite Counties.

Employment.—Overall mining employment for 1985, including petroleum and coal industry workers, declined to 6,800 from the 7,700 employees reported in 1984. Average weekly earnings for Montana's mineral industry production workers rose slightly to $517.24, up from the $504.71 recorded in 1984. Mineral industry workers were the highest paid group in the private nonfarm industries wage sector during 1985.

Table 2.—Nonfuel minerals produced in Montana in 1984, by county[1]

County	Minerals produced in order of value
Beaverhead	Sand and gravel, peat, gold, silver.
Big Horn	Sand and gravel.
Broadwater	Lime, gold, graphite, silver.
Carbon	Clays, sand and gravel.
Carter	Clays.
Cascade	Sand and gravel.
Custer	Do.
Dawson	Do.
Deer Lodge	Do.
Fergus	Sand and gravel, gypsum.
Flathead	Sand and gravel, peat.
Gallatin	Cement, sand and gravel, clays.
Garfield	Sand and gravel.
Granite	Silver, copper, lead, gold.
Hill	Sand and gravel.
Jefferson	Gold, cement, silver, clays, lead, copper.
Judith Basin	Gypsum.
Lake	Sand and gravel.
Lewis and Clark	Do.
Liberty	Do.
Lincoln	Silver, copper, vermiculite, sand and gravel.
Madison	Talc, gold, silver, lead.
Meagher	Iron ore, gold.
Mineral	Sand and gravel, gold.
Missoula	Sand and gravel, barite.
Musselshell	Sand and gravel.
Park	Do.
Petroleum	Do.
Phillips	Gold, silver, sand and gravel.
Pondera	Sand and gravel.
Powell	Phosphate rock, sand and gravel.
Ravalli	Sand and gravel.
Richland	Lime, sand and gravel.
Roosevelt	Sand and gravel.
Rosebud	Do.
Sanders	Do.
Sheridan	Do.
Silver Bow	Copper, sand and gravel, gold, silver, lead.
Teton	Sand and gravel.
Toole	Do.
Valley	Clays, sand and gravel.
Wibaux	Sand and gravel.
Yellowstone	Lime, sand and gravel.
Undistributed[2]	Stone (crushed), gem stones, stone (dimension).

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Montana business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	816	823	826
Total civilian labor force	do	396	404	405
Unemployment	percent	8.8	7.4	7.7
Employment (nonagricultural):				
Mining total[1]	thousands	7.4	7.7	6.8
Metal mining[2]	do	1.4	1.1	.9
Nonmetallic minerals except fuels[2]	do	.9	1.0	1.0
Coal mining[2]	do	1.3	1.3	1.4
Oil and gas extraction[2]	do	3.7	4.3	3.4
Manufacturing total	do	22.1	22.5	21.7
Primary metal industries[2]	do	1.2	1.5	1.4
Stone, clay, and glass products[2]	do	1.1	1.2	1.1
Chemicals and allied products[2]	do	.5	.6	.6
Petroleum and coal products[2]	do	1.0	.9	.9
Construction	do	13.3	12.6	11.3
Transportation and public utilities	do	20.4	20.8	20.6
Wholesale and retail trade	do	73.6	75.9	75.6
Finance, insurance, real estate	do	13.0	13.3	13.3
Services	do	57.8	59.6	60.1
Government and government enterprises	do	68.4	68.7	69.0
Total	do	276.0	281.1	278.4
Personal income:				
Total	millions	$8,488	$8,921	$9,067
Per capita		$10,402	$10,838	$10,974
Hours and earnings:				
Total average weekly hours, production workers		39.7	39.2	39.0
Mining		41.3	39.4	38.6
Total average hourly earnings, production workers		$10.4	$10.8	$11.0
Mining		$12.9	$12.8	$13.4
Earnings by industry:				
Farm income	millions	$139	$779	-$35
Nonfarm	do	$5,569	$5,868	$5,991
Mining total	do	$242	$249	$229
Metal mining	do	$54	$38	$31
Nonmetallic minerals except fuels	do	$23	$27	$31
Coal mining	do	$55	$59	$64
Oil and gas extraction	do	$110	$124	$103
Manufacturing total	do	$525	$560	$552
Primary metal industries	do	$39	$54	$51
Stone, clay, and glass products	do	$26	$29	$26
Chemicals and allied products	do	$14	$17	$18
Construction	do	$462	$452	$435
Transportation and public utilities	do	$649	$705	$719
Wholesale and retail trade	do	$1,078	$1,122	$1,114
Finance, insurance, real estate	do	$257	$265	$289
Services	do	$1,100	$1,204	$1,276
Government and government enterprises	do	$1,201	$1,260	$1,328
Construction activity:				
Number of private and public residential units authorized[3]		3,057	2,837	2,034
Value of nonresidential construction[3]	millions	$130.0	$133.8	$125.9
Value of State road contract awards	do	$144.5	$143.9	$201.3
Shipments of portland and masonry cement to and within the State	thousand short tons	266	254	191
Nonfuel mineral production value:				
Total crude mineral value	millions	$292.0	$240.0	$200.3
Value per capita		$358	$292	$242

[p]Preliminary. [r]Revised.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

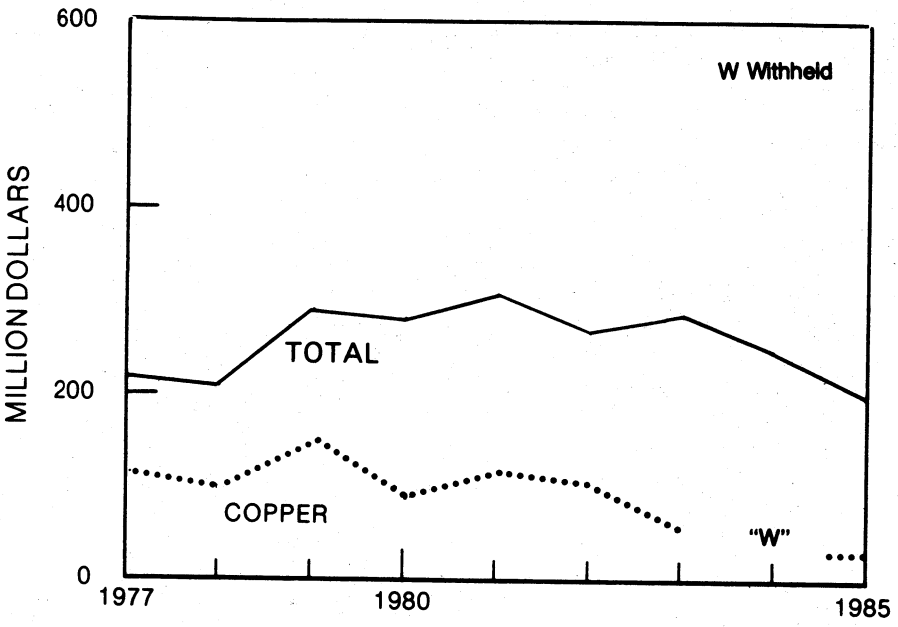

Figure 1.—Value of copper and total value of nonfuel mineral production in Montana.

Exploration Activities.—The 1985 level of exploration activity in Montana, largely for precious metals and industrial minerals, was up from that achieved in 1984. In 1985, 110 companies held operating and exploration permits for about 250 metallic and industrial mineral projects; a total of 29 new exploration licenses were issued during the year. In 1984, 91 companies held permits covering 215 projects. The number of new mining claims filed in 1985 was down about 35% from that of 1984; by yearend, the cumulative total of Small Miner's Exclusion Statements granted exceeded 1,000, 65 of which were issued in 1985.

United States Borax & Chemical Corp. and ASARCO Incorporated continued exploration programs for stratabound silver-copper deposits in and adjoining the Cabinet Mountains Wilderness in Lincoln County. U.S. Borax resumed drilling on its claims north of Rock Lake; the company was exploring for extensions of mineralization exposed in outcrop on a validated claim near the lake.

AMAX Exploration Inc. continued drifting and drilling at the Cruse-Belmont gold project near Marysville, Lewis and Clark County. The project is a joint venture between AMAX and Gulf Titanium Ltd. Five potentially productive gold- and silver-bearing veins are now known on the property; AMAX began an environmental impact study and started design work on a mill. Gulf Titanium was conducting an exploration program on a 137-claim block it holds in the immediate vicinity of the Cruse-Belmont. The company hopes to establish a large, low-grade gold deposit on the property.

Queenstake Resources Inc. drilled nine holes at its Quartz Hill silver property 23 miles southeast of Butte. The 1985 drilling program, planned to test five parallel veins in the patented claims block, more than doubled the company's indicated ore reserve.

Aries Resources (U.S.) Inc. continued exploration for silver on a 1,705-acre tract of land just west of Butte in Silver Bow County. The area, owned by Anaconda Minerals, contains up to 30 mineralized veins having values in gold, silver, lead, zinc, and manganese. In 1985, Aries conducted trenching, shallow drilling, and sampling on four vein systems in the west Butte tract. Aries also worked on a cooperative project with Blue Range Engineering, Montana College of Mineral Science and Technology, and the Montana Department of Commerce to conduct feasibility testing of a portable flotation mill.

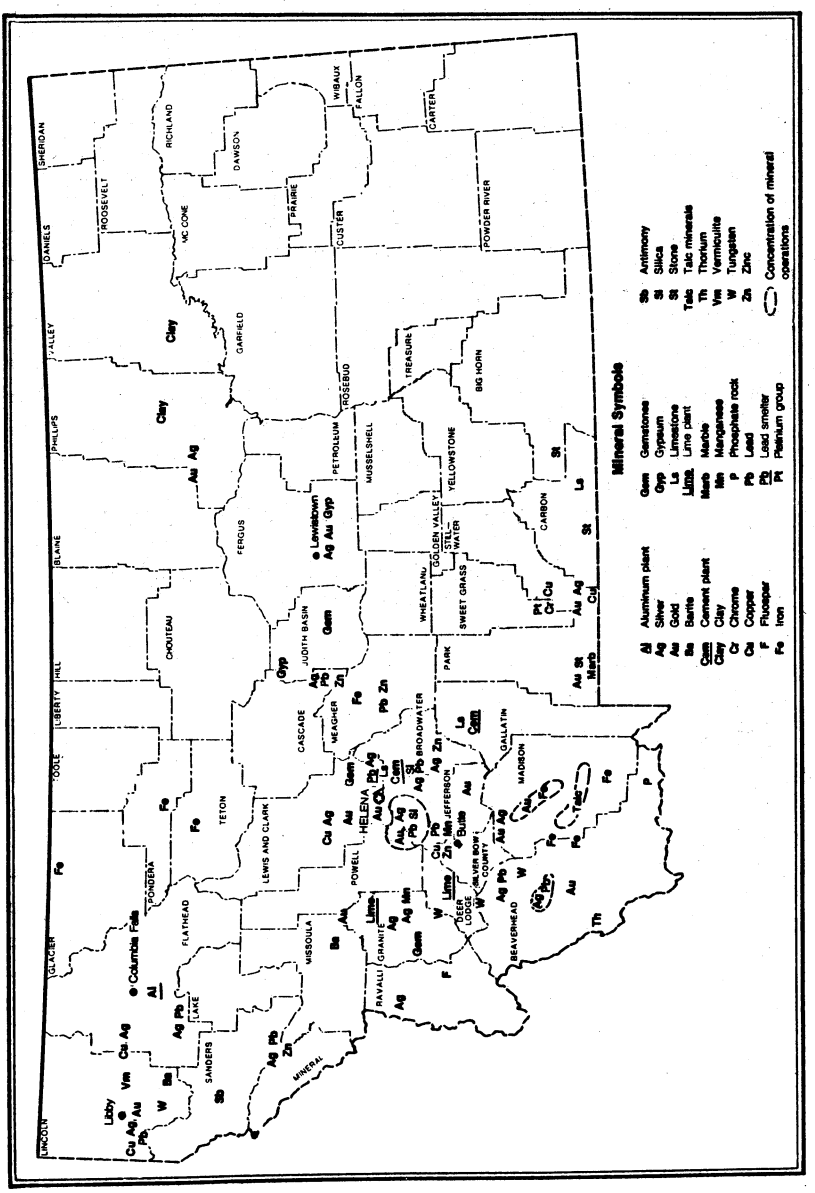

Figure 2.—Principal mineral producing localities in Montana.

Continued drilling in 1985 by Mountain-West Resources Inc. on its Elkhorn gold property, Jefferson County, partially defined the limits of a gold-bearing, pipelike replacement body.

Mines Management Inc. drilled the down-dip projections of four zones bearing disseminated copper-silver mineralization as identified in 1984 on its Janstan property north of Thompson Pass in Sanders County.

Sunshine Mining Co. continued sampling, trenching, and drilling at the old Blackfoot gold mine near Lincoln, Lewis and Clark County. Preliminary results indicated a mass-minable ore body.

Guardian Resource Corp. carried out an 11-hole diamond drilling program on the old Miller gold mine in Broadwater County. The drilling investigated lode gold-silver mineralization in the Miller Mountain stock.

Winchester Gold Corp. explored underground at the B & H Pete and Joe gold mine in Madison County, and Gold Coin Mining Inc. completed more than 1,000 feet of drilling at its Gold Coin property near Georgetown Lake in Deer Lodge County.

Legislation and Government Programs.—The 1985 Montana State Legislature considered several measures that would have strengthened environmental and social safeguards and increased taxes on the mining industry. Proposed legislation that would have been disadvantageous to mining, however, did not pass into law. A bill was passed to clarify the 1981 Hardrock Impact Act dealing with socioeconomic impacts caused by mining; the Hardrock Reclamation Act was amended to include some existing regulations and to cover custom mills and the processing of mill tailings.

Interagency plans for a large-scale land exchange between the U.S. Bureau of Land Management (BLM) and the U.S. Forest Service were released during the year. Under the exchange plan, the BLM would manage 7.4 million acres of Federal land in eastern Montana, down from the 8.1 million acres currently under its jurisdiction. The Forest Service, however, would manage 17.4 million acres of high mineral potential land in western Montana, compared with its current domain of 16.7 million acres. The proposed exchange of management responsibility, advanced as a means to improve efficiency and cut costs, awaited enabling legislation at yearend.

A proposal was made in 1985, by the Greater Yellowstone Coalition of environmentalist groups, to establish a 4-million-acre Greater Yellowstone Ecosystem buffer zone surrounding Yellowstone National Park. All activities of man, including mining, would be either severely restricted or eliminated within the federally managed ecosystem zone. The Montana portion of the ecosystem was drawn to cover large parts of the Beaverhead, Gallatin, and Custer National Forests; most of Montana's talc operations and resources, the Stillwater Complex, the Jardine and Cooke City Districts, and other areas with high mineral potential would be included. The coalition was pushing for congressional action on the proposal.

The Montana congressional delegation was unable to complete a jointly sponsored wilderness bill in 1985. The inclusion of a number of areas—the Middle Fork of the Judith and Big Snowy Mountains Wilderness study areas, lands along the east slope of the Rocky Mountains, some small areas in the West Pioneer Mountains, and lands in the Gallatin National Forest—had not been resolved by yearend.

Montana received $32.5 million in 1985 from the BLM as receipts from the Mineral Leasing Act.

Mineral taxes collected by the State on nonfuel minerals, coal, oil, and natural gas amounted to $145.7 million in 1985; mineral taxes represented 25.2% of the total Montana Department of Revenue collections for the year.

The Montana Bureau of Mines and Geology (MBMG) made significant progress on its Montana Atlas Project during the year. When completed, the project will provide full color, detailed geologic maps at a scale of 1:250,000 for 26 quadrangles covering the entire State. Each 2° sheet will be the base for a folio of projected maps, including mineral resources, hydrology, and other subjects where applicable (i.e., environmental-engineering geology, geologic hazards, land use, soil and vegetation, etc.). Although compilation of geology for the Kalispell Quadrangle was completed, the map was placed on open file pending completion of new mapping by the U.S. Geological Survey (USGS). Compilation of geology was in progress for the Bozeman, Butte, Dillon, Forsythe, Jordan, Miles City, and Wolf Point Quadrangles. The Series 4 Wallace Quadrangle, prepared cooperatively under the USGS Conterminous United States Mineral Appraisal Program (CUSMAP), was in press at yearend.

Major current MBMG projects included a

talc assessment project in the Ruby Mountains, funded by the USGS; a compilation and review of Montana's barite deposits; an appraisal of mineral resources in ten 7.5-minute quadrangles; and a geochemical assessment and geologic mapping of the Elkhorn Mountains Volcanics near Deer Lodge, and the Lowland Creek Volcanics near Butte. The MBMG released 14 formal publications and placed 13 titles on open file in fiscal year 1985, and the ongoing MBMG-USGS hydrologic program worked on 6 projects during the year.

The Mining and Mineral Resources Research Institute of the Montana College of Mineral Science and Technology at Butte received an allotment of $142,000 from the U.S. Bureau of Mines in 1985. The MBMG received a 1-year grant of $82,000 from the U.S. Mine Safety and Health Administration, which aided the State-funded Small Mine Operator Assistance Program in providing educational information on health and safety.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Aluminum.—Primary aluminum production in Montana increased more than 11% in both quantity and value over that reported in 1984. Despite a continuing worldwide oversupply of aluminum and consequent low prices, the Columbia Falls Aluminum Co.'s reduction plant, Flathead County, operated at its normal annual rated capacity of 180,000 short tons of metal in 1985. In September, ARCO Aluminum Co. sold the plant to Montana Investors Aluminum Co.; a new company, Columbia Falls Aluminum Co., was formed to operate the five-potline smelter. Starting in April 1986, plans call for the plant to be operated as a tolling facility. A phased shutdown of the operation was averted in November, when union employees ratified a labor contract calling for a 15% pay cut, a 16% reduction in benefits, and the elimination of 100 hourly jobs. At yearend, the company was negotiating with the Bonneville Power Administration for a reduction in electric power rates.

Copper.—Copper production was reported from five mines in four counties in 1985, compared with output from six mines and one leaching operation in five counties in 1984. Montana's copper production, which has declined significantly since the closure of Anaconda Minerals' Butte operations in mid-1983, dropped again in 1985, but continued its fourth ranking nationally.

The State's top-ranked producers were Asarco's Troy silver-copper mine in Lincoln County, and Black Pine Mining Co.'s Black Pine Mine near Philipsburg, in Granite County.

Gold.—Montana's gold production declined nearly 12% in quantity and 22% in value from that of 1984. The State ranked fourth in the Nation, accounting for almost 7% of the national total in 1985. Production was reported from 7 lode mines and 1 gold tailings operation in 5 counties in 1985, compared with production from 14 mines in 7 counties in 1984. Placer gold production was reported from six operations in four counties in 1985.

Production from Placer U.S. Inc.'s Golden Sunlight Mine near Whitehall, Jefferson County, decreased slightly to about 96,500 troy ounces from the 97,000 ounces reported in 1984. The mill throughput was moderately increased from about 2 million tons in 1984 to nearly 2.2 million tons in 1985 to offset a slightly lower average ore grade. Ore reserves at yearend were 19.8 million tons, grading 0.048 ounce of gold per ton. Overburden removal was carried out for the Stage II pit, in preparation for ore production in 1986, and an underground drilling program to further delineate deep-seated West Mineral Hill ore reserves was rescheduled for 1986. Metallurgical research and a feasibility study to improve overall gold recovery were under way in 1985. The Golden Sunlight Mine was Montana's first-ranked gold producer in 1985, accounting for nearly 61% of the State's production.

Production at Pegasus Gold Inc.'s Zortman-Landusky seasonal open pit heap leach operation in Phillips County amounted to about 60,400 ounces of gold and 157,500 ounces of silver in 1985, down from the 70,000 ounces of gold and up from the 152,000 ounces of silver recorded in 1984. A combination of an early onset of cold weather and a midyear shifting of 3 million tons of ore on the Zortman leach pad caused production to fall short of the company's 1985 targets of 86,000 ounces of gold and 170,000 ounces of silver. During the 1985 season, 5.3 million tons of ore was added to the leach pads, bringing the total amount of ore placed on the pads since startup in 1979 to 23 million tons.

Late in the year, Pegasus purchased the remainder of Wharf Resources Ltd.'s interest in the Landusky property, giving Pegasus a 100% ownership of the Zortman-Landusky Mines. The use of microcomputers at the minesite to estimate ore grade resulted in a lower waste-to-ore ratio and lower mining costs; computer technology was also used to facilitate pit design and to enhance efficiency in engineering, geology, exploration, accounting, and laboratory functions at the mine. New methods of scheduled spraying of leach solutions started during the year resulted in a decrease in leach costs without affecting gold recovery. Ore reserves at the property were 40 million tons after reductions for 1985 mining; over 2 million tons was added to the reserves by exploration drilling during the year.

The Homestake Mining Co.-American Copper & Nickel Co. Inc. joint venture continued development work and permitting at its Jardine gold mine north of Gardiner, Park County. Underground drilling and bulk sampling were done in 1985, and production was scheduled for mid-1987.

Mount Hagen Development Inc. got into production at its gold heap leach operation in the Elkhorn District, Jefferson County, and further development drilling was started on the deposit.

Golden Maple Mining and Leaching Co. was active at the old Gilt Edge Mine near Lewistown, Fergus County; Triad Investments Inc. continued development and leaching at the Kendall property; and Canadian Minerals Inc. produced gold and silver at the Spotted Horse Mine in Fergus County.

Western Energy Co. entered into a third phase of drilling at its Char-Tam gold project south of Winston, Broadwater County. The company plans to spend between $20 and $25 million to bring the open pit mine into production; mine life was projected at 10 years with an annual production of 40,000 ounces of gold.

The Centennial Minerals Ltd.-U.S. Minerals Exploration Co. (USMX) joint venture continued development at its Montana Tunnels project near Wickes, in Jefferson County. Late in the year, Pegasus acquired control of Centennial and executed an agreement with USMX that allowed Pegasus to assume operational control of the project. Permitting for the 12,500-ton-per-day open pit, flotation milling operation was secured, a feasibility study performed, and engineering and construction contracts were let during the year. Production is scheduled to commence in May 1987 at a planned rate of 4.3 million tons of ore per year, yielding an average of 106,000 ounces of gold, 1.7 million ounces of silver, 26,000 tons of lead, and 5,700 tons of zinc. Minable ore reserves are reported to total 41.2 million tons grading 0.033 ounce of gold, 0.373 ounce of silver, 0.289% lead, and 0.713% zinc.

Placer gold production employed small-scale mechanical and hand methods at four operations, and two placers were worked by dragline dredging.

Iron Ore.—Hallett Minerals Co. produced iron ore from the Black Butte Mine near White Sulphur Springs in Meagher County. The iron ore was used instate in cement manufacture.

Lead.—Lead was recovered as a byproduct from five base and precious metals mines in four counties. Montana ranked fifth in the Nation for lead production in 1985.

Asarco's 75,000-ton-per-year-capacity lead bullion smelter at East Helena cut operations to a 5-day workweek in midyear, reducing output by 20% and laying off 20 employees. The zinc fuming plant placed on standby in 1982 did not operate in 1985.

Platinum-Palladium.—The Stillwater Mining Co. (SMC), a joint venture between Lac Minerals, Chevron, and Manville, continued work on its platinum-palladium mine in the Stillwater Complex near Nye, Stillwater County. In September, SMC contracted with American Mine Services to conduct a 12-month underground mining test program. Near yearend, the company's operating permit was approved by the U.S. Forest Service, and an Environmental Impact Statement was issued by the State of Montana. If ore grades prove favorable, the company intends to start construction in 1986 and proceed to production in 1987. The planned initial 500-ton-per-day production rate would eventually be doubled.

Silver.—Reflecting depressed silver prices prevalent in 1985, Montana's silver production decreased 29% in quantity and 46% in value from that recorded in 1984. The State produced 10% of the Nation's silver in 1985 and dropped to fourth ranking in total silver production. In 1985, silver production was reported from 7 mines in 5 counties, compared with production from 14 mines in 8 counties in 1984.

Asarco's Troy silver-copper mine in Lincoln County was again Montana's top silver producer, accounting for nearly 89%

of the State total; the Troy Mine was the fourth-ranked producer in the Nation for 1985. Asarco reported that 3.6 million troy ounces of silver in concentrate was produced at the Troy Mine compared with 4.3 million ounces in 1984.

Black Pine Mining's Black Pine silver-copper mine in Granite County suspended operations in late January because of low silver prices. Drilling and development work continued, and mining was resumed on a limited scale later in the year. Despite a reduction in its 1985 silver production to 20% of that reported in 1984, the Black Pine Mine remained Montana's second largest silver producer. Ore from the mine was trucked 14 miles to Philipsburg and beneficiated by Contact Mining Co. at its 1,200-ton-per-day custom mill.

The U.S. Forest Service recognized that Asarco had established valid existing rights on 101 of its 133 mining claims covering the Rock Creek stratabound silver-copper deposit in the Cabinet Mountains Wilderness, Lincoln County. The Rock Creek deposit reportedly has a 145-million-ton silver-copper ore reserve with a gross value of more than $3.5 billion. Environmental studies at the Rock Creek deposit, necessary for preparation of an Environmental Impact Statement and subsequent operating permit applications, continued during the year.

The U.S. Forest Service received a conceptual mining plan from U.S. Borax for a major silver-copper mine near the south end of the Cabinet Mountains Wilderness. Pacific Coast Mines, a division of U.S. Borax, has four validated claims near Rock Lake; drilling was done in 1985 to test extensions of known mineralization.

Table 4.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1985, 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]	4	W	W	W	--	--	--
Gold-silver	1	W	W	W	W	W	--
Silver	1	37,042	158	231,894	153	W	--
Total	6	W	W	W	W	W	--
Copper-silver	1	W	W	3,565,927	14,936	W	--
Other lode material:							
Gold cleanup	--	W	W	W	W	W	--
Gold tailings	1	W	W	W	W	W	--
Total lode	8	[4]9,445,713	[4]159,139	W	[4]15,092	[4]846	--
Placer	6	--	1,123	W	--	--	--
Grand total	13	[4]9,445,713	[4]160,262	[4]4,009,979	[4]15,092	[4]846	--

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 metals were recovered only from cleanup 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 5.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1983, total	25	2	14,769,569	161,436	$68,448,864	5,707,963	$65,299,096
1984, total	16	2	10,034,174	181,190	65,347,626	5,652,847	46,017,907
1985:							
Broadwater	--	2	--	W	W	--	--
Fergus	1	--	272	650	206,478	650	3,992
Granite	1	--	37,042	158	50,190	231,894	1,424,339
Jefferson	3	1	W	W	W	W	W
Lewis and Clark	--	1	--	W	W	--	--
Lincoln	1	--	2,579,101	W	W	3,565,927	21,902,637
Phillips	1	--	W	W	W	W	W
Powell	--	2	--	W	W	--	--
Total	7	6	[3]9,445,713	[3]160,262	[3]50,908,666	[3]4,009,979	[3]24,630,092

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1983, total	33,337	$56,245,432	1,163	$556,076	--	--	$190,549,468
1984, total	W	W	W	W	--	--	W
1985:							
Broadwater	--	--	--	--	--	--	W
Fergus	--	--	--	--	--	--	210,470
Granite	153	225,410	W	W	--	--	W
Jefferson	W	W	W	W	--	--	W
Lewis and Clark	--	--	--	--	--	--	W
Lincoln	14,936	22,051,310	W	W	--	--	W
Phillips	W	W	W	W	--	--	W
Powell	--	--	--	--	--	--	W
Total	[3]15,092	[3]22,280,514	[3]846	[3]355,668	--	--	[3]98,174,940

W Withheld to avoid disclosing company proprietary data.
[1]Operations from which gold and silver are recovered as byproducts from sand and gravel operations are not counted as producing mines.
[2]Excludes gravel washed.
[3]Includes items indicated by symbol W.

Table 6.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1985, 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 from ore	W	3,797,821	15,089	W	--
Direct smelting of:					
Ore	W	W	W	W	--
Tailings	W	W	W	W	--
Cleanup	W	W	W	W	--
Total lode material	W	W	[1]15,092	[1]846	--
Placer	W	W	--	--	--
Grand total	[1]160,262	[1]4,009,979	[1]15,092	[1]846	--

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

Table 7.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in Silver Bow County

Year	Mines producing	Material sold or treated (thousand metric tons)	Gold (troy ounces)	Silver (thousand troy ounces)
1981	1	13,729	14,394	2,028
1982	1	12,847	3,361	739
1983	1	6,287	1,383	313
1984	3	W	W	W
1985	--	--	--	--
1882-1985	--	W	W	W

Year	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)	Total value[1] (thousands)
1981	59,477	--	--	$139,555
1982	48,144	--	--	84,410
1983	18,694	111	--	35,761
1984	W	--	--	W
1985	--	--	--	--
1882-1985	W	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1]Derived from average values of the metals; includes average value of copper produced in wire bars prior to 1982 and average value of copper produced in cathodes for 1982 and 1983.

INDUSTRIAL MINERALS

Barite.—The amount of barite produced in Montana in 1985 decreased from that reported in 1984, although the value increased. Montana Barite Co. Inc., a subsidiary of NICOR Mineral Ventures, mined barite at Elk Creek in the Garnet Range and operated its mill in Missoula.

Cement.—Montana's cement production in 1985 was down by 23% in quantity and 26% in value from the levels achieved in 1984. Portland and masonry cements were produced by Ideal Basic Industries Inc. at Trident, Gallatin County, and by Kaiser Cement Corp. at Montana City in Jefferson County. Portland cement produced in the State was used by general contractors (43%); ready-mixed concrete companies (35%); concrete products manufacturers (14%); government agencies, highway contractors, and miscellaneous customers (5%); and building material dealers (3%). Raw materials consumed in cement manufacture were locally mined limestone, clays, sandstone, sand, iron ore, gypsum, slag, and other additives. Both of the one-kiln cement plants used natural gas and coal for fuel and purchased electricity for energy. Shipments to consumers were by rail, truck, and barge.

Clays.—Montana again ranked second in the Nation in bentonite production. The 1985 output increased 20% in quantity and 47% in value from the 1984 totals. The increase in swelling bentonite production was largely due to increased oil and gas drilling activity and established oilfields in the eastern part of the State. Bentonite production was reported by 4 companies from 12 deposits in Carbon, Carter, and Valley Counties.

American Colloid Co. mined bentonite in Carbon County and operated its mill near Malta, Phillips County, at a reduced rate. International Minerals & Chemical Corp. operated its Belle Mine near Alzada in Carter County; NL Industries Inc. also reported production from Carter County. Federal Ore and Chemicals Inc. mined bentonite from its Glasgow deposit in Valley County; the material was shipped to a company plant at Burnett, MN, for processing and sale to the taconite industry.

Fire clay was produced from one operation in Deer Lodge County. Common clay, mined at three operations in Gallatin and Jefferson Counties, was used in cement and pottery. Kanta Products mined shale from two pits in Gallatin County and operated its expanded shale and construction materials plant at Three Forks.

Gem Stones.—Montana tied for fourth ranking in the Nation in gem stone production for 1985. Sapphires were produced from the Rock Creek District, Granite County; from Intergem Inc.'s Yogo Sapphire Mine in Judith Basin County; and from placer operations on the Missouri River in Lewis and

Clark County. Smoky quartz was produced from claims in Missoula County. Amethyst was produced in Beaverhead and Jefferson Counties.

Gypsum.—Gypsum production in Montana increased nearly 12% in quantity and 13% in value over that reported for 1984. The limited recovery in building construction that commenced in 1984 carried on through 1985; a resulting improvement in the wallboard industry accounted for the increase.

USG Corp. mined gypsum from its underground Shoemaker Mine at Heath in Fergus County; the gypsum was calcined at Heath and used in the company's wallboard plant. Maronick Construction Co. Inc. mined gypsum at its open pit at Raynesford in Judith Basin County; the product was shipped to the Kaiser Cement plant at Jefferson City and the Ideal Basic Industries cement plant at Trident.

Lime.—Lime production in the State in 1985 was down substantially from that reported in 1984. Continental Lime Inc. and Holly Sugar Corp. produced quicklime in Broadwater and Richland Counties.

Peat.—Montana's 1985 peat production decreased 25% in quantity and sales decreased 20% in value from that of 1984. Peat was marketed in packaged form by Farmer's Aid Corp. at Hamilton, Ravalli County, and by Martins Peat Inc. at Swan Lake in Flathead County.

Phosphate Rock.—Phosphate rock production in Montana increased by 12% in quantity and 16% in value over the 1984 figures. The State's sole producer, Cominco American Incorporated, continued to mine phosphate rock at its underground Warm Springs Mine near Garrison in Powell County. After primary crushing, the phosphate was rail-shipped to Cominco's fertilizer plant at Kimberley, British Columbia, Canada.

Stauffer Chemical Co. shut down the second electric furnace and laid off 40 employees at its Silver Bow elemental phosphorus plant during the first quarter of 1985. Reasons cited were climbing production costs and a shrinking market for phosphorus products. In early November, Montana Power Co. granted Stauffer a reduction in electric power rates. The decreased power rate, combined with more favorable rail rates and raw materials contracts, enabled Stauffer to restart the second furnace and rehire 13 workers before yearend.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on estimates made before yearend.

Estimated 1985 construction sand and gravel production increased 16% in quantity and 22% in value from those of 1984, largely owing to a partial recovery in the construction industry.

Industrial.—The quantity of industrial sand and gravel produced in Montana in 1985 was five times that reported in 1984, while the value was more than twice that recorded for 1984.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

The State's 1985 output of crushed stone increased 82% in quantity and more than twice in value from that estimated for 1984. Increased activity in highway and secondary road construction and road maintenance and in heavy construction, in general contributed to the increase. Five counties—Carbon, Gallatin, Jefferson, Park, and Silver Bow—accounted for 98% of the State's crushed stone production; Ideal Basic Industries, Kaiser Cement, Jim Gilman Excavating Inc., and the Park County Highway Department were the leading producers. Travertine building stone was produced by the Livingston Marble & Granite Works from its quarry north of Gardiner in Park County.

Table 8.—Montana: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate, graded: Bituminous aggregate, coarse	139	696
Combined coarse and fine aggregates:		
Graded road base or subbase	303	910
Other construction[2]	258	1,046
Chemical and metallurgical:		
Cement manufacture	960	2,195
Flux stone	W	W
Special: Other unspecified[3]	W	W
Total	1,730	5,044

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1]Includes limestone, sandstone, and quartzite, and excludes a minor amount of traprock withheld to avoid disclosing company proprietary data.

[2]Includes riprap and jetty stone, bituminous surface-treatment aggregate, and stone used for unpaved road surfacing.

[3]Includes production reported without a breakdown by end use and estimates for nonrespondents.

Sulfur (Recovered).—Montana Sulphur & Chemical Co. and Farmers Union Central Exchange recovered sulfur as a byproduct from petroleum refining in Yellowstone County. The State's 1985 sulfur production declined nearly 14% in quantity but increased 15% in value from that reported in 1984.

Talc.—Montana ranked first in the Nation for the quantity and value of its talc production. The 1985 production increased nearly 33% in quantity and slightly more than 48% in value over that reported in 1984. All of the State's talc production came from open pit mines in the Ruby and Gravelly Ranges in Madison County. Cyprus Industrial Minerals Co. increased production at its Beaverhead and Yellowstone Mines; the ore was processed at its Three Forks mill in Gallatin County. Pfizer Inc. operated its Treasure Chest Mine at an increased rate and milled the talc at its Barretts mill south of Dillon, Beaverhead County. Talc milled in Montana in 1985 was used in paper (39%), paint (23%), ceramics (13%), cosmetics (6%), plastics (5%), and other uses including rubber, refractories, roofing, and miscellaneous (14%).

Montana Talc Co., a joint venture between NICOR Mineral Ventures and Meridian Minerals Co., continued development of its Johnny Gulch open pit talc mine south of Ennis in Madison County; the deposit has an identified reserve of 1.5 million short tons grading over 90% talc. Production, slated for mid-1986, will be at a rate of 100,000 tons per year. Mined talc will be trucked 53 miles to a mill on the railroad at Sappington; mill construction was under way by yearend, with completion planned for April 1986. Total capital investment will be about $12 million; at full capacity the mine and plant will employ 93 people with an annual payroll of about $3 million.

Willow Creek Talc Co. did exploratory drilling in 1985 at its Willow Creek Mine in the Greenhorn Range, Madison County. The company initiated the operating permit process and expects to begin open pit mining at a rate of 20,000 tons of talc per year in mid-1986.

Exploration activity for talc in 1985, by the producing companies and others, continued in the Precambrian areas of southwestern Montana.

Vermiculite.—Montana again led the Nation in the production of vermiculite. Production in 1985 was 95% of the yearly average for the 5-year period (1981-85); the value of production was about 99% of the yearly average for the 5-year period. W. R. Grace & Co. continued to mine and mill vermiculite at its Rainy Creek operation north of Libby in Lincoln County. Robinson Insulation Co. at Great Falls, Cascade County, produced exfoliated vermiculite, which was sold for block insulation, loose fill insulation, fireproofing material, agricultural soil conditioner, concrete aggregate, and horticultural applications.

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[3]Acting chief, Geology and Mineral Resources Div., Montana Bureau of Mines and Geology, Butte, MT.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Columbia Falls Aluminum Co	Columbia Falls, MT 59912	Reduction plant	Flathead.
Barite:			
Montana Barite Co. Inc., a subsidiary of NICOR Mineral Ventures.	6700 Desmet Rd. Box 3296 Missoula, MT 59806	Mine and plant	Lincoln and Missoula.
Cement:			
Ideal Basic Industries Inc., Cement Div.[1]	Box 8789 Denver, CO 80201	Plant	Gallatin.
Kaiser Cement Corp.[1]	Montana City, MT 59602	do	Jefferson.
Clays:			
American Colloid Co	5100 Suffield Ct. Skokie, IL 60078	Pits and plant	Carbon and Phillips.
Federal Ore and Chemicals Inc	117 Fifth Ave. Belle Fourche, SD 57717	Pit and plant	Valley.
International Minerals & Chemical Corp., Industrial Minerals Div.	Box 460 Belle Fourche, SD 57717	Pits	Carter.
NL Industries Inc., Baroid Div	Box 1675 Houston, TX 77251	Pit and plant	Do.
Copper:			
ASARCO Incorporated	Box 868 Troy, MT 59935	Underground mine and plant.	Lincoln.
Gem Stones:			
Intergem Inc	3025 South Parker Rd. No. 209 Aurora, CO 80014	Open pit mine and plant.	Judith Basin.
Gold:			
Golden Sunlight Mines Inc., a subsidiary of Placer U.S. Inc.[2]	Box 678 Whitehall, MT 59759	do	Jefferson.
Pegasus Gold Inc.[2]	Zortman, MT 59546	Open pit mines and leach plant.	Phillips.
Gypsum:			
Maronick Construction Co. Inc.[3]	East Helena, MT 59635	Open pit mine	Judith Basin.
USG Corp	Heath, MT 59457	Underground mine and plant.	Fergus.
Lime:			
Continental Lime Inc	268 West 400 South Suite 201 Salt Lake City, UT 84101	Open pit mine	Broadwater.
Holly Sugar Corp	Box 1052 Colorado Springs, CO 80901	Surface mine and plant.	Richland.
Phosphate rock:			
Cominco American Incorporated	Box 638 Garrison, MT 59731	Underground mine	Powell.
Silver:			
ASARCO Incorporated[4]	Box 868 Troy, MT 59935	Underground mine and plant.	Lincoln.
Black Pine Mining Co.[4]	Box 610 Philipsburg, MT 59858	Underground mine	Granite.
Stone:			
Crushed and broken:			
Big Horn Calcium Co	Box 22007 Billings, MT 59104	Quarry	Carbon.
Jim Gilman Excavating Inc	3015 Kossuth Butte, MT 59701	Quarries	Silver Bow.
Ideal Basic Industries Inc., Cement Div.	Box 8789 Denver, CO 80201	do	Gallatin.
Kaiser Cement Corp	Montana City, MT 59602	do	Jefferson.
Park County Highway Department.	Livingston, MT 59047	Quarry	Park.
Dimension:			
Livingston Marble & Granite Works.	Box 851 Livingston, MT 59047	do	Do.
Sulfur (recovered):			
Montana Sulphur & Chemical Co	Box 31118 Billings, MT 59107	Plant	Yellowstone.
Talc:			
Cyprus Industrial Minerals Co	Box 3299 7000 South Yosemite Englewood, CO 80155	Plant and open pit mines	Gallatin and Madison.
Pfizer Inc	Box 1147 Dillon, MT 59725	Plant and open pit mine	Beaverhead and Madison.
Vermiculite:			
W. R. Grace & Co., Zonolite Div	1114 Avenue of the Americas New York, NY 10036	do	Lincoln.

[1]Also clays and stone.
[2]Also silver.
[3]Also stone.
[4]Also copper, gold, and lead.

The Mineral Industry of Nebraska

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

By Karl E. Starch[1] and Raymond R. Burchett[2]

The value of nonfuel minerals produced in Nebraska in 1985 was about $100 million, virtually unchanged from 1984's record-high level. Six industrial minerals were reported produced in the State: cement, clays, gem stones, lime, sand and gravel, and stone. Several metals were processed at a refinery in the State, but none were mined. Nebraska ranked 41st among the States in value of nonfuel mineral production.

The most important minerals produced were, in decreasing order of value, portland cement, construction sand and gravel, and crushed stone. Cement production was moderately higher than in 1984, while output of construction sand and gravel and crushed stone was moderately lower. Clay production increased significantly, along with output of industrial sand. Average values per short ton increased for construction sand and gravel but decreased for clays, crushed stone, and industrial sand.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	180	$556	244	$718
Gem stones	NA	W	NA	10
Sand and gravel (construction) thousand short tons	11,839	27,791	e11,600	e28,800
Stone (crushed) do	e4,500	e23,400	4,175	19,134
Combined value of cement, lime, sand and gravel (industrial), and value indicated by symbol W	XX	48,621	XX	51,308
Total	XX	100,368	XX	99,970

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

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

Table 2.—Nonfuel minerals produced in Nebraska in 1984, by county[1]

County	Minerals produced in order of value
Adams	Sand and gravel.
Antelope	Do.
Brown	Do.
Buffalo	Do.
Burt	Do.
Butler	Do.
Cass	Cement, sand and gravel, clays.
Cedar	Sand and gravel.
Chase	Do.
Cheyenne	Do.
Clay	Do.
Colfax	Do.
Cuming	Do.
Custer	Do.
Dawson	Do.
Deuel	Do.
Dixon	Do.
Dodge	Do.
Douglas	Sand and gravel, clays.
Dundy	Sand and gravel.
Franklin	Do.
Frontier	Do.
Furnas	Do.
Gage	Do.
Garden	Do.
Garfield	Do.
Hall	Do.
Hamilton	Do.
Harlan	Do.
Hayes	Do.
Hitchcock	Do.
Holt	Do.
Howard	Do.
Jefferson	Sand and gravel, clays.
Keith	Sand and gravel.
Kimball	Do.
Knox	Do.
Lancaster	Clays, sand and gravel.
Lincoln	Sand and gravel.
Loup	Do.
Madison	Do.
Merrick	Do.
Morrill	Lime, sand and gravel.
Nance	Sand and gravel.
Nemaha	Do.
Nuckolls	Cement, sand and gravel.
Perkins	Sand and gravel.
Phelps	Do.
Pierce	Do.
Platte	Do.
Polk	Do.
Red Willow	Do.
Saline	Do.
Sarpy	Sand and gravel, clays.
Saunders	Sand and gravel.
Scotts Bluff	Lime, sand and gravel.
Stanton	Sand and gravel.
Thayer	Do.
Thomas	Do.
Valley	Do.
Webster	Do.
York	Do.
Undistributed[2]	Stone (crushed), gem stones.

[1]No production of nonfuel commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Nebraska business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	1,596	1,605	1,606
Total civilian labor force	do	792	796	813
Unemployment	percent	5.7	4.4	5.5
Employment (nonagricultural):				
Mining total[1]	thousands	1.9	1.9	1.8
Nonmetallic minerals except fuels[2]	do	.9	1.0	1.0
Oil and gas extraction[2]	do	.9	1.0	.9
Manufacturing total	do	84.7	90.5	88.9
Primary metal industries[2]	do	1.3	W	W
Stone, clay, and glass products[2]	do	2.6	2.5	2.6
Chemicals and allied products	do	2.5	2.6	2.6
Petroleum and coal products[2]	do	.2	.2	.2
Construction	do	23.5	25.8	26.5
Transportation and public utilities	do	43.1	43.3	43.7
Wholesale and retail trade	do	157.8	163.6	166.7
Finance, insurance, real estate	do	41.9	43.4	45.2
Services	do	127.5	135.9	142.4
Government and government enterprises	do	130.2	131.3	135.2
Total[3]	do	610.8	635.4	650.3
Personal income:				
Total	millions	$17,992	$19,916	$21,323
Per capita		$11,272	$12,412	$13,281
Hours and earnings:				
Total average weekly hours, production workers		40.3	40.5	40.3
Total average hourly earnings, production workers		$8.8	$8.9	$9.0
Earnings by industry:				
Farm income	millions	$686	$1,434	$1,865
Nonfarm	do	$12,042	$13,069	$13,794
Mining total	do	$61	$72	$71
Nonmetallic minerals except fuels	do	$17	$22	$23
Oil and gas extraction	do	$42	$47	$43
Manufacturing total	do	$1,841	$2,044	$2,089
Primary metal industries	do	$40	$50	$52
Stone, clay, and glass products	do	$53	$56	$57
Chemicals and allied products	do	$68	$73	$75
Petroleum and coal products	do	$6	$10	$7
Construction	do	$731	$864	$909
Transportation and public utilities	do	$1,425	$1,555	$1,605
Wholesale and retail trade	do	$2,315	$2,415	$2,515
Finance, insurance, real estate	do	$871	$931	$1,046
Services	do	$2,323	$2,566	$2,769
Government and government enterprises	do	$2,370	$2,524	$2,688
Construction activity:				
Number of private and public residential units authorized[4]		5,526	5,786	5,001
Value of nonresidential construction[4]	millions	$192.5	$280.1	$286.4
Value of State road contract awards	do	$191.1	$154.3	$169.7
Shipments of portland and masonry cement to and within the State	thousand short tons	726	835	794
Nonfuel mineral production value:				
Total crude mineral value	millions	$87.4	$100.4	$100.0
Value per capita		$55	$63	$62

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

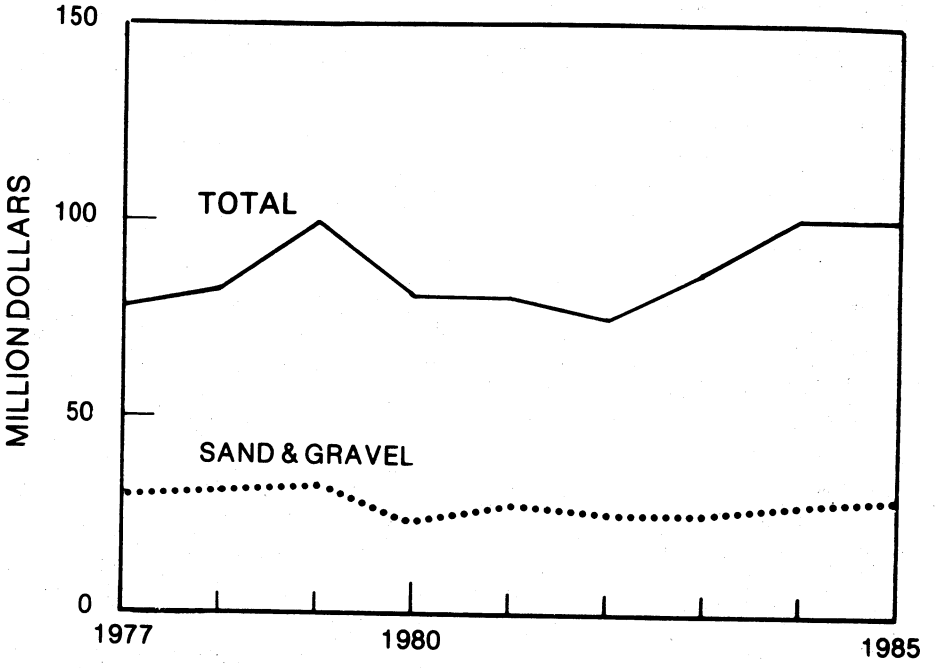

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Nebraska.

Trends and Developments.—"The Nebraska Mineral Operations Review, 1985," published by the Nebraska Geological Survey, reported 621 sand, gravel, and silt or siltstone pits; 28 limestone quarries; 17 sandstone pits; and 7 clay or shale pits active in Nebraska in 1985. These 673 active mining operations disturbed 819 acres of land, but restored 397 acres during the year. A total of 3,379 quarries, pits, and mines have been active in Nebraska at one time or another during the past 85 years; nearly 50% of the 40,000 acres affected has been reclaimed.

About 1,800 people were employed in mining in Nebraska in 1985, including oil and gas workers, slightly less than in 1984. This represented a fraction of 1% of the total nonagricultural work force of 650,300 people.

Exploration Activities.—Molycorp Inc. continued its exploration of the Elk Creek carbonatite of southeastern Nebraska, thought to have a potential for rare-earth production.

Legislation and Government Programs.—Public Law 99-504 established the Pine Ridge Wilderness and the Soldier Creek Wilderness in the Nebraska National Forest. The two areas in northwestern Nebraska total about 14,700 acres.

The Conservation and Survey Division, University of Nebraska (Nebraska Geological Survey), published a 1:1,000,000-scale "Aeromagnetic Map of Nebraska" and the "Nebraska Mineral Operations Review, 1984." A revised State geologic map at a scale of 1:1,000,000 was readied for publication.

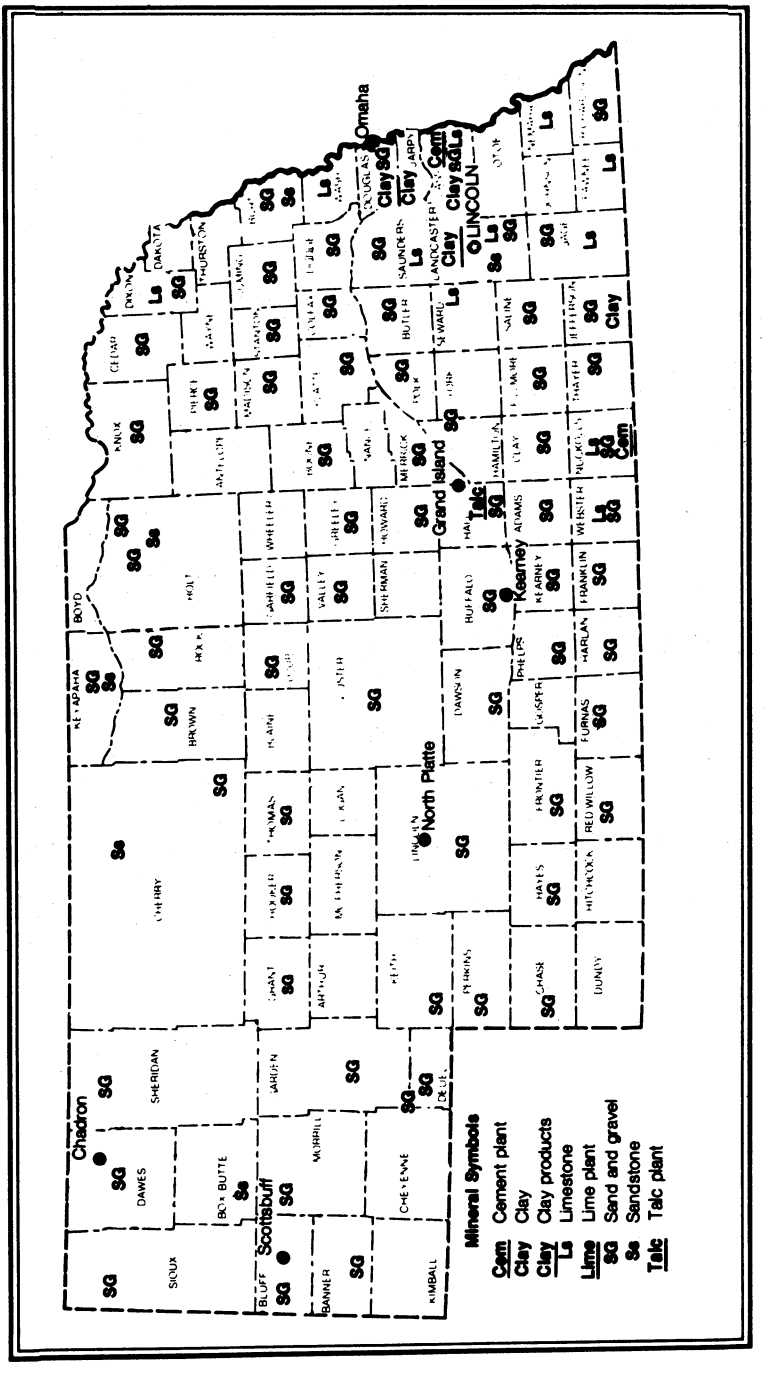

Figure 2.—Principal mineral producing localities in Nebraska.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Ammonium Nitrate.—The Homestead ammonium nitrate plant of Cominco American Incorporated at Beatrice in Gage County expanded its production capabilities with the startup of a $600,000, 1,550-short-ton-per-day urea-ammonium nitrate solution plant in early 1985. The Cominco Ltd. 1985 annual report further stated that production of granular nitrate in 1985 was reduced to 118,900 short tons per year, from 154,800 tons, by a 6-week shutdown to make major repairs to the nitric acid air compressor and to control inventories. Output of urea-ammonium nitrate solution was 72,000 tons. Employment at yearend was 59 people. Also producing ammonia, urea, or ammonium nitrate were Allied Chemical Corp. at La-Platte, Sarpy County; C.F. Industries Inc. at Fremont, Dodge County; Phillips Chemical Co. at Beatrice; and Farmland Industries Inc. at Hastings, Adams County.

Cement.—Portland cement was Nebraska's most important nonfuel mineral product. Output in 1985 was almost 9% more than 1984 output. Cement was produced by two companies, Ash Grove Cement Co. near Louisville in Cass County, and Ideal Basic Industries Inc. near Superior in Nuckolls County. These companies operated two kilns each. Ash Grove utilized the dry process; Ideal, the wet process. Most cement produced was general use, moderate heat Types I and II gray portland. A moderate amount of high-early-strength Type III was manufactured by Ash Grove.

Ash Grove was much the larger of the two producers. Both producers had higher stocks on hand at the end of the year than at the beginning. Two-thirds of the total output went to ready-mixed concrete companies, about one-quarter to highway contractors, and the balance to concrete product manufacturers, other contractors, and building material dealers, in that order. Shale, limestone, clays, and gypsum were the main raw materials used.

Clays.—Output of clays in Nebraska increased more than 35% in 1985 over 1984 levels. Only common clay was produced, with output by four companies from five mines in five counties. Endicott Clay Products Co., Jefferson County, and Ash Grove, Cass County, were the largest producers, followed, in order of output, by Yankee Hill Brick Manufacturing Co. in Lancaster County and Omaha Brick Works in Douglas and Sarpy Counties. All production was in the more populated southeastern area of Nebraska, near the metropolitan areas of Lincoln and Omaha. All the clay output was used in the manufacture of face brick, except Ash Grove's output, which went into cement manufacture. Unit prices ranged from $2.11 per short ton to $8.40 per ton.

Endicott began work on a $6.5 million plant capable of producing 25 to 30 million brick per year. When completed in 1986, the plant will increase Endicott's brick capacity by about 50%.

Gem Stones.—Numerous small firms around the State cut and polished gems and ornamental stones such as agate, chalcedony, chert, jasper, petrified wood, and quartz.

Lime.—A small amount of quicklime was reported produced in Nebraska in 1985, but reduction in operations by The Great Western Sugar Co. led to a decline in output of nearly 80%. Quicklime had been produced from limestone quarried in Wyoming and used by Great Western in the processing of sugar beets. Great Western filed for chapter 11 bankruptcy in March and closed its sugar beet plants.

Perlite (Expanded).—The Zonolite Div. of W. R. Grace & Co. expanded perlite brought in from other States at its plant near Omaha in Douglas County and sold it as filler material, aggregate for plaster and concrete, and as a horticultural product.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel was the most widely produced mineral in Nebraska, with output in all but 9 of the State's 93 counties; it was second only to cement in value of output. Among the largest producers were Central Paving Sand & Gravel Co. Inc. in Butler, Madison, Pierce, and Platte Counties; Hartford Sand & Gravel Co. in Cass, Dodge, Douglas, Morrill, Platte, Sarpy, and Saunders Counties; and Western Sand & Gravel Co. in Cass, Dodge, and Saunders Counties.

Industrial.—Western Sand & Gravel produced a moderate amount of industrial sand at its dredging operations along the Platte

River in Saunders County. The major use of its product was for locomotive traction sand by the Union Pacific Railroad. Through use of a drying kiln, Western Sand & Gravel could ship traction sand year-round.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone production was reported by 12 companies from 18 quarries in 9 counties. Output was down 7% from 1984's record-high level; value was down 18%.

Only limestone was quarried in Nebraska and all was marketed as crushed stone. Although 13 firms cut stone brought in from other States, no dimension stone was quarried in Nebraska. More than three-fourths of all stone quarried came from Cass County. Other counties in which stone was produced were Dixon, Gage, Lancaster, Nuckolls, Pawnee, Saunders, Seward, and Washington. Nearly all these counties are in the southeastern part of the State, near the major urban centers in Lincoln and Omaha.

Major producing companies were Kerford Limestone Co., Ash Grove, Martin Marietta Aggregates, and Fort Calhoun Stone Co. These four companies accounted for nearly 95% of total production. Cement manufacture was the major use of crushed stone in Nebraska, followed in decreasing order by concrete aggregate, unpaved road surfacing, and dense road base. These four uses absorbed 65% of all output. Other important uses included fill, riprap and jetty stone, poultry grit and mineral food, and agricultural limestone. Prices ranged from $2.09 to $9.77 per short ton.

Kerford Limestone, American Cyanamid Co., and Texasgulf Inc. produced finely ground limestone (calcium carbonate) for feed supplements and use in cement, paint, and rubber. Three companies produced agricultural lime exclusively, while most of the limestone plants in eastern Nebraska produced some agricultural lime.

Essential Minerals of Ashland exported its first shipment of high-quality, pelletized, fine-grained limestone "Neutra Nuggets" for lawn and garden use to a fertilizer firm in San Juan, Puerto Rico. The $2,000 sale was seen as an initial step in developing an export market for the company's products.

Plains Pozzolanic of Lincoln utilized ash from the coal-fired electric powerplant, Gerald Gentleman, near Sutherland, as road base stabilization material and concrete mix for road paving. About 140,000 tons of ash annually was used by Plains Pozzolanic in concrete and asphalt products or sold to other firms, including a Colorado firm, for use in concrete blocks and ready-mixed cement.

Table 4.—Nebraska: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	38	186
Riprap and jetty stone	264	1,604
Filter stone	9	43
Coarse aggregate, graded:		
Concrete aggregate, coarse	654	3,583
Railroad ballast	3	17
Fine aggregate (-3/8 inch): Stone sand, concrete	138	683
Combined coarse and fine aggregates:		
Terrazzo and exposed aggregate	555	3,160
Crusher run, fill, or waste	13	62
Other coarse and fine aggregates	314	1,767
Other construction[2]	770	3,357
Agricultural:		
Agricultural limestone	77	346
Poultry grit and mineral food	153	1,493
Chemical and metallurgical: Flux stone	4	19
Special:		
Asphalt filler or extenders	50	249
Other fillers or extenders	25	124
Roofing granules	13	62
Other miscellaneous[3]	1,098	2,379
Other unspecified[4]	W	W
Total	[5]4,175	19,134

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

[1]Includes limestone.

[2]Includes stone used in bituminous aggregate (coarse), bituminous surface-treatment aggregate, graded road base or subbase, and stone used for other construction and maintenance purposes.

[3]Includes stone used in cement manufacture and data indicated by symbol W.

[4]Includes production reported without a breakdown by end use.

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

Talc.—Cyprus Minerals Co., United Sierra Div., ground talc obtained from outside the State at its Grand Island mill in Hall County. The ground talc was marketed for use in ceramics, cosmetics, insecticides, paint, paper, plaster, textiles, and toilet articles.

Vermiculite (Exfoliated).—W. R. Grace produced exfoliated vermiculite at its plant near Omaha in Douglas County. Crude vermiculite was brought in from W. R. Grace's mining and beneficiating operations at Libby, MT. The exfoliated product typically was marketed to the construction industry for use as fireproofing, block insulation, and loose-fill insulation, but also as concrete aggregate and as horticultural soil conditioner.

METALS

Lead bullion from smelters outside the State was processed at the Omaha refinery of ASARCO Incorporated to produce refined and antimonial lead and refined bismuth. The refinery also recovered antimony, antimony oxide, copper, zinc, and doré containing silver and gold. Total rated annual capacity of the refinery was 180,000 short tons of metal.

Wyoming Fuels Co., a subsidiary of KN Energy Inc., received a permit from the Nebraska Department of Environmental Control for a pilot solution uranium mining operation 22 miles south of Chadron. The pilot plant of less than 100 gallons per minute capacity was designed to test the feasibility of commercial development of an ore body estimated by Wyoming Fuels to contain more than 30 million pounds of uranium oxide (U_3O_8). A sodium carbonate-bicarbonate solution will be injected into the uranium-bearing formation to extract a uranium leachate.

[1]State Mineral Officer, Bureau of Mines, Denver, CO.
[2]Research geologist, Conservation and Survey Division of the University of Nebraska (Nebraska Geological Survey), Lincoln, NE.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co.[1]	Box 25900 Overland Park, KS 66225	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 Paving Sand & Gravel Co. Inc	Box 626 Columbus, NE 68601	Pits and plants	Butler, Platte, York.
Hartford Sand & Gravel Co	Box Z Valley, NE 68064	Dredges and pits	Dodge, Douglas, Hall.
Western Sand & Gravel Co.[2]	Box 28 Ashland, NE 68003	do	Cass, Dodge, Saunders.
Stone:			
Fort Calhoun Stone Co	1255 South St. Blair, NE 68008	Quarries and plants.	Washington.
Kerford Limestone Co	Box 449 Weeping Water, NE 68463	Quarry and plant	Cass.
Martin Marietta Aggregates, Central Div.	Box 30013 Raleigh, NC 27622	Quarries and plants.	Cass, Nemaha, Nuckolls, Pawnee, Saunders.

[1]Also clays and limestone in Cass County.
[2]Also industrial sand in Saunders County.

The Mineral Industry of Nevada

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

By Fred V. Carrillo[1] and John H. Schilling[2]

The value of Nevada's nonfuel mineral production in 1985 was $631 million, an increase of almost $7 million over that reported in 1984. The State ranked 12th nationally in the value of its nonfuel mineral production, led the Nation in the production of barite and gold, and was the sole producer of mined magnesite and mercury. Gold, the leading commodity produced in terms of value, accounted for $405 million or 64% of the total nonfuel mineral value produced in the State.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite thousand short tons	615	$14,924	590	$10,904
Clays[2] do.	20	1,191	80	3,776
Gem stones	NA	1,300	NA	1,300
Gold (recoverable content of ores, etc.) troy ounces	r1,020,546	r368,068	1,276,114	405,369
Gypsum thousand short tons	1,192	8,860	1,207	8,942
Lead (recoverable content of ores, etc.) metric tons	W	W	(3)	(3)
Mercury 76-pound flasks	19,048	W	16,530	W
Sand and gravel:				
Construction thousand short tons	8,202	20,505	e9,500	e24,800
Industrial do.	489	W	479	W
Silver (recoverable content of ores, etc.) thousand troy ounces	6,477	52,727	4,947	30,383
Stone (crushed) thousand short tons	e1,100	e4,700	1,334	6,218
Combined value of cement (portland), clays (fuller's earth and kaolin), copper, diatomite, fluorspar, iron ore, lime, lithium compounds, magnesite, molybdenum, perlite, salt, tungsten ore and concentrate (1984), and values indicated by symbol W	XX	151,787	XX	139,191
Total	XX	r624,062	XX	630,883

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

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

[2]Excludes fuller's earth and kaolin; value included with "Combined value" figure.

[3]Less than 1/2 unit.

Table 2.—Nonfuel minerals produced in Nevada in 1984, by county

County	Minerals produced in order of value
Carson City	Sand and gravel.
Churchill	Diatomite, sand and gravel, salt, iron ore, silver, gold, lead, copper.
Clark	Lime, gypsum, gold, silver, sand and gravel.
Douglas	Sand and gravel.
Elko	Gold, barite, silver, lead, copper.
Esmeralda	Lithium, silver, gold, diatomite, clays.
Eureka	Gold, iron ore, sand and gravel, silver, mercury.
Humboldt	Gold, mercury, sand and gravel, clays.
Lander	Gold, barite, copper, silver, sand and gravel.
Lincoln	Gold, silver, perlite, sand and gravel.
Lyon	Cement (portland), gypsum, sand and gravel, diatomite.
Mineral	Gold, silver, sand and gravel, lead.
Nye	Gold, molybdenum, copper, clays, silver, magnesite, barite, fluorspar, sand and gravel, lead.
Pershing	Diatomite, gypsum, perlite, silver, iron ore, gold, sand and gravel.
Storey	Silver, diatomite, gold.
Washoe	Sand and gravel, clays.
White Pine	Gold, silver, sand and gravel.
Undistributed[1]	Stone (crushed), gem stones.

[1]Data not available by county for minerals listed.

Table 3.—Indicators of Nevada business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	897	917	936
Total civilian labor force	do	486	500	509
Unemployment	percent	9.8	7.8	8.0
Employment (nonagricultural):				
Mining total[1]	thousands	5.8	6.6	6.1
Metal mining	do	4.1	4.8	4.4
Manufacturing total	do	19.1	21.0	21.9
Primary metal industries	do	1.1	1.1	1.1
Stone, clay, and glass products	do	1.2	1.4	1.5
Chemicals and allied products	do	.7	.7	.7
Construction	do	19.4	21.8	23.5
Transportation and public utilities	do	24.5	24.9	25.2
Wholesale and retail trade	do	80.3	85.9	91.0
Finance, insurance, real estate	do	18.5	20.0	21.5
Services	do	177.2	186.9	196.2
Government and government enterprises	do	58.0	58.9	60.4
Total	do	402.8	426.0	445.8
Personal income:				
Total	millions	$11,530	$12,597	$13,560
Per capita		$12,857	$13,740	$14,488
Hours and earnings:				
Total average weekly hours, production workers		38.8	39.8	40.4
Mining		43.0	42.8	42.9
Total average hourly earnings, production workers		$9.0	$9.1	$9.1
Mining		$12.3	$13.3	$13.2
Earnings by industry:				
Farm income	millions	$32	$44	$23
Nonfarm	do	$8,809	$9,563	$10,349
Mining total	do	$199	$231	$229
Metal mining	do	$131	$155	$153
Nonmetallic minerals except fuels	do	$45	$47	$48
Oil and gas extraction	do	$23	W	W
Manufacturing total	do	$436	$497	$531
Primary metal industries	do	$36	$39	$40

See footnotes at end of table.

Table 3.—Indicators of Nevada business activity —Continued

		1983[r]	1984	1985[p]
Earnings by industry—Continued				
Stone, clay, and glass products	millions	$35	$41	$42
Chemicals and allied products	do	$22	$22	$22
Petroleum and coal products	do	$2	$2	$3
Construction	do	$698	$756	$817
Transportation and public utilities	do	$714	$739	$765
Wholesale and retail trade	do	$1,252	$1,371	$1,499
Finance, insurance, real estate	do	$387	$424	$491
Services	do	$3,629	$4,000	$4,369
Government and government enterprises	do	$1,453	$1,503	$1,607
Construction activity:				
Number of private and public residential units authorized[2]		16,170	13,868	14,004
Value of nonresidential construction[2]	millions	$456.9	$442.0	$496.4
Value of State road contract awards	do	$64.0	$168.0	$114.0
Shipments of portland and masonry cement to and within the State	thousand short tons	459	503	637
Nonfuel mineral production value:				
Total crude mineral value	millions	$632.5	$624.1	$630.9
Value per capita		$705	$681	$674

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

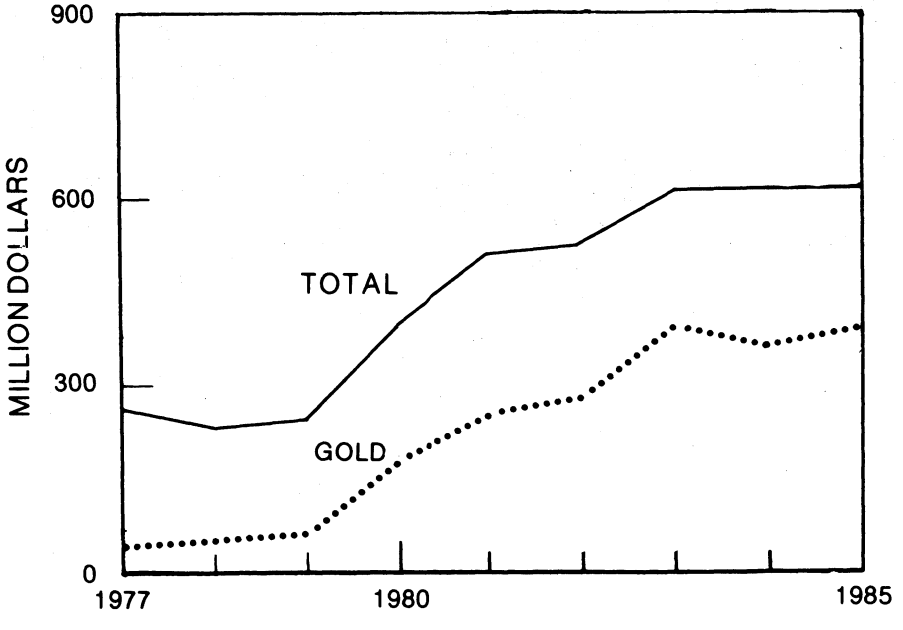

Figure 1.—Value of gold and total value of nonfuel mineral production in Nevada.

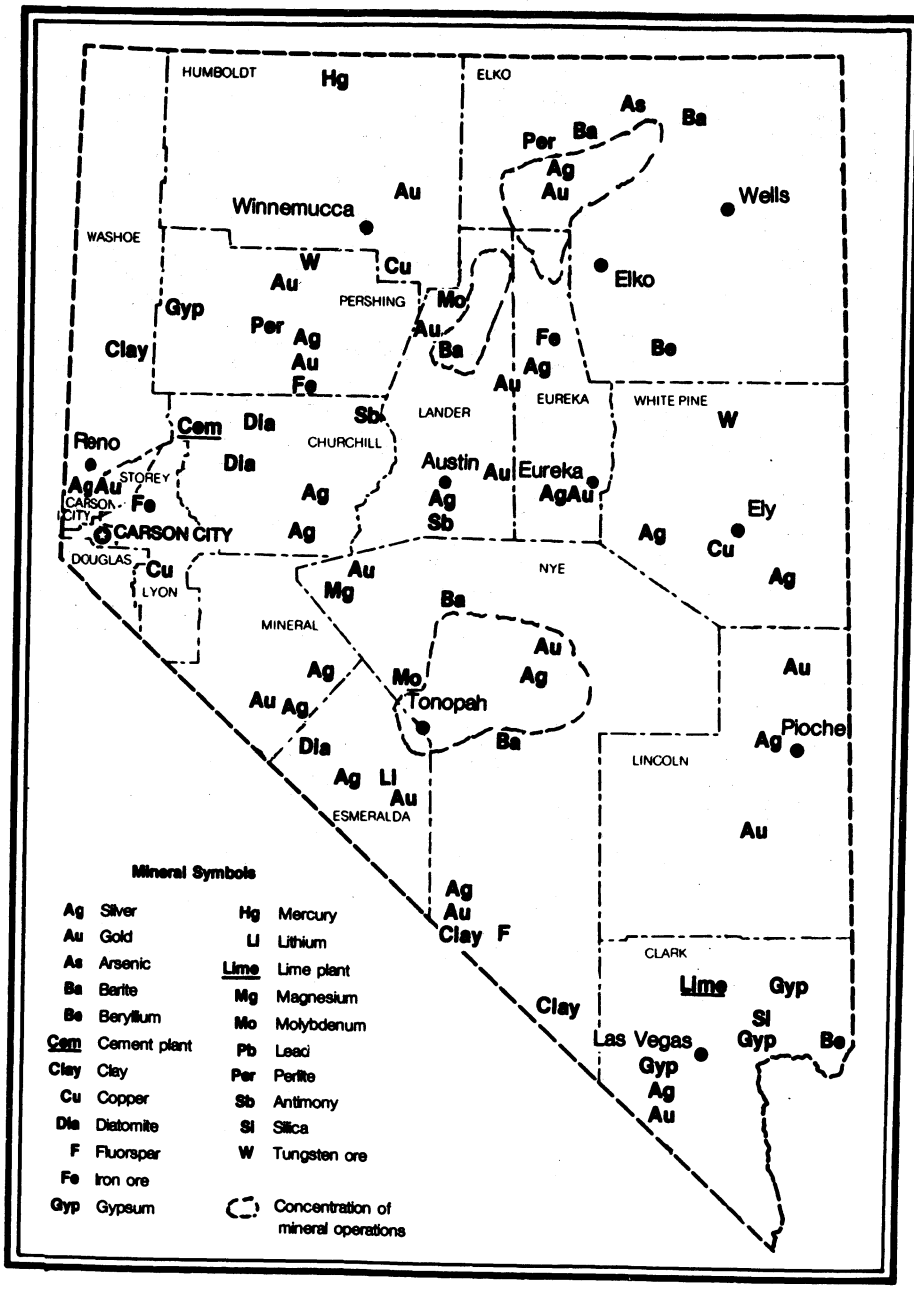

Figure 2.—Principal mineral producing localities in Nevada.

Trends and Developments.—Nearly a dozen new gold mines came on-line or were being developed and expanded from existing mines in Nevada during the year. Gold occurrences, from isolated pockets through large disseminated deposits, were reportedly under examination or development in every county of the State in 1985.

Battle Mountain Gold Co. was established in August following a release to shareholders from Duval Corp.'s former parent, Pennzoil Corp. Mineral prices were generally depressed and several mines in Nevada suspended operation during the year. Barite mining continued at a reduced level throughout the year owing to foreign competition and a reduced demand by the oil industry. Copper and molybdenum mining in the State practically ceased, and several silver mines reported closed in 1984 remained closed in 1985.

Employment.—According to the Nevada Employment Security Department, approximately 6,100 workers were employed in the Nevada mineral industry during 1985. The Department reported an annual average of about 4,400 employees in metal mining and 1,800 in other mining categories. The annual payroll for the State's nonfuel mining industry was approximately $181 million.

Statistics collected by the Nevada Division of Mine Inspection, apparently using a different method of computation than does the Employment Security Department, show that 6,400 workers were employed in 401 active operations during 1985. The largest number of employees were in the sand and gravel industry and in gold operations.

Legislation and Government Programs.—State laws governing location and recordation of mining claims on public lands were substantially changed by the passage of Nevada State Legislature Assembly bill 11, which directed the Department of Minerals to adopt regulations ensuring that all maps required for location and identification of mining claims be prepared in a similar manner. The legislation also extended time limits on erection of claim boundary posts, liberalized use of materials for monuments, and required county recorders to distinguish patented claims from unpatented claims on the county map of mining claims. The bill abolished requirements for claim location markers and changed the deadline for recording evidence of annual assessment work. The legislation also repealed a 1911 Nevada law that prohibited employees in the mining industry from working more than 8 hours per day.

A 20% reduction in the net proceeds of mines tax, which is used to calculate property taxes paid by Nevada mines, was approved by the State Tax Commission.

The Mackay School of Mines at the University of Nevada—Reno received a $147,000 grant from the U.S. Bureau of Mines for the operation of the Mining and Minerals Resources Institute Program in 1985. The Bureau also granted $773,000 to the Waste Treatment and Recovery Generic Center at the institute.

Federal legislation was passed in December to provide grants from the National Defense Stockpile Transactions Fund for building construction at the Mackay School of Mines' Generic Center on Recycling of Strategic Metals and also to establish the Policy Center on Strategic Materials (also referred to as the Center for Critical and Strategic Mineral Resource Studies) at the school.

The Nevada Bureau of Mines and Geology (NBMG) published 13 reports and maps on mineral resources during the year and reprinted 2 others. Thirty projects were under way at yearend, including the production of geochemical, gravity, and geologic maps; statewide studies of gold, gypsum, manganese, mercury, and tungsten; and an inventory of mineral occurrences and deposits in several large areas of the State.

A new mapping program was begun to provide more detailed maps for mineral exploration. NBMG expects to produce approximately 70 mineral occurrence and geologic maps at a scale of 1:100,000.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Copper.—Nevada ranked low among the copper-producing States for 1985. Production was principally byproduct copper from Battle Mountain Gold's Battle Mountain Mine in Lander County, and from an Atlantic Richfield Co. subsidiary, The Anaconda Minerals Co.'s Nevada Moly operation in Nye County. The Anaconda operation was closed most of the year.

Gold.—Nevada again increased its margin as the Nation's premier gold-producing State. Production has increased the last 6

consecutive years to 1,276,114 troy ounces valued at more than $405 million in 1985.

Freeport-McMoRan Gold Co.'s (FMG) Jerritt Canyon Mine (Enfield Bell) in Elko County was second in the Nation in gold production during 1985. Exploration during the year added additional reserves to the open pit mine, according to company announcements made in September. The Jerritt Canyon operations were reported to have processed about 1.28 million short tons of ore and produced 255,300 ounces of gold, a 12,000-ounce increase over that reported in 1984.

Carlin Gold Mining Co., a wholly owned subsidiary of Newmont Mining Corp., poured the first gold bar in late July at its No. 2 mill 8 miles north of Carlin near the company's Gold Quarry Mine. The new cyanide mill is designed to treat 2.5 million tons of ore and produce 170,000 ounces of gold per year from the Gold Quarry and adjacent Maggie Creek deposits. Carlin Gold operated eight open pit mines and four treatment facilities in northern Eureka County during 1985.

Several other mines in Eureka County reported significant gold production. Among these were Cominco American Inc.'s Buckhorn Mine, Silver State Mining Co.'s Tonkin Springs Mine, and Western State Mining Co.'s Gold Strike Mine. Silver State poured the first gold at its Tonkin Springs project in October. The $2 million, 30,000-ounce-per-year facility is on the west side of Roberts Creek Mountain in central Eureka County.

Battle Mountain Gold, a spinoff from Pennzoil, completed the first year of mining at its new Fortitude gold and silver mine in Lander County, exposing the higher grade core of the ore body. Mining of the core area was expected to substantially reduce production costs.

Gold production at the Round Mountain Mine in Nye County, reportedly the world's largest heap-leaching operation, increased about 20,000 ounces in 1985 to approximately 140,000 ounces. The Round Mountain operation became a joint venture during 1985 between Echo Bay Inc. (50% interest), Homestake Mining Co. (25% interest), and Case, Pomeroy and Co. (25% interest). Reclassification of extensive mineralization at the mine resulted in a doubling of reserves to about 4.1 million ounces of contained gold.

Pinson Mining Co. announced that testing and evaluation of the new Mag Zone, discovered about 0.5 mile from the Pinson mill in Humboldt County, had resulted in the addition of about 3.1 million tons of milling-grade ore to the reserves of the Pinson Mine. Evaluation of another 1984 discovery, the C-X Zone immediately northeast of the Pinson open pit, was expected to add nearly 500,000 tons of reserves amenable to heap leaching and milling. United Cisco Mines Inc. sold its 26.25% interest in Pinson Mining to American Barrick Resources Corp. in December.

Nevada Gold Mining Inc., a wholly owned subsidiary of AMAX Inc., began construction of processing facilities at its Sleeper gold property, 35 miles northwest of Winnemucca in Humboldt County. Production was planned for mid-1986.

FMC Corp. continued development drilling and began construction of a processing plant at its Paradise Peak gold-silver property, 10 miles southwest of Gabbs in northwestern Nye County.

Pacific Silver Corp. completed construction in June of its $2 million mill at the Buckskin gold-silver mine in Douglas County. Silver King Mines Inc. continued development at the Ward Mountain Mine in White Pine County as work continued on two 4,500-foot inclines being driven into the mountain. Silver King Mines and Pacific Silver began construction in October of a 1,000-ton-per-day leaching plant 5 miles west of Ely in White Pine County. The plant will treat gold-silver ore from the Star-Pointer Mine on the south edge of the Ruth Pit.

Placer U.S. Inc., a wholly owned subsidiary of Placer Development Ltd., of Vancouver, British Columbia, Canada, continued to develop the Bald Mountain Top deposit in White Pine County.

Western Goldfields Co. began development of its Hog Ranch gold deposit 50 miles north of Gerlach in Washoe County. Reserves reportedly are 5 million tons containing up to 400,000 ounces of gold.

Production continued at Standard Slag Co.'s Atlanta Mine, an open pit gold-silver operation in Lincoln County. Production was also reported from Tenneco Minerals Co.'s Manhattan and Borealis Mines; Asamera Minerals (U.S.) Inc.'s Cortez Mine; and the Dee Gold Mining Co., a joint venture of Lacana Gold Inc. and Rayrock Mines Inc., northwest of the Carlin gold mine in Elko County.

Exploration for gold continued at a high pace. Drilling at Franco-Nevada Inc.'s Has-

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

County	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1983, total	r36	4	r16,154,828	r960,657	r$407,318,568	r5,179,394	r$59,252,267
1984, total	r27	1	r24,644,405	r1,020,546	r368,068,083	6,477,032	52,727,314
1985:							
Churchill	2	--	72,647	207	65,755	16,442	100,990
Clark	1	--	W	W	W	W	W
Elko	2	--	W	W	W	--	--
Esmeralda	1	--	232,162	8,968	2,848,766	1,362,318	8,367,630
Eureka	6	--	W	W	W	87,615	538,149
Humboldt	2	--	W	W	W	200	1,228
Lander	2	--	W	W	W	W	W
Lincoln	1	--	W	W	W	W	W
Lyon	1	--	W	W	W	W	W
Mineral	2	--	W	W	W	W	W
Nye	4	--	5,697,863	195,165	61,995,919	W	W
Storey	2	--	W	W	W	W	W
Washoe	--	1	W	W	W	W	W
White Pine	1	--	907,820	48,793	15,499,536	9,287	57,043
Total	27	1	[3]20,738,883	[3]1,276,114	[3]405,369,100	[3]4,946,523	[3]30,382,535

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1983, total	W	W	14	$6,576	--	--	W
1984, total	W	W	W	W	--	--	W
1985:							
Churchill	(4)	$64	(4)	72	--	--	$166,881
Clark	--	--	--	--	--	--	W
Elko	--	--	--	--	--	--	W
Esmeralda	--	--	--	--	--	--	11,216,396
Eureka	--	--	--	--	--	--	W
Humboldt	--	--	--	--	--	--	W
Lander	W	W	--	--	--	--	W
Lincoln	--	--	--	--	--	--	W
Lyon	--	--	--	--	--	--	W
Mineral	--	--	W	W	--	--	W
Nye	172	254,244	--	--	--	--	W
Storey	--	--	--	--	--	--	W
Washoe	--	--	--	--	--	--	W
White Pine	--	--	--	--	--	--	15,556,579
Total	W	W	(4)	72	--	--	W

rRevised. 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 metals are recovered as byproducts of molybdenum ore are not counted as producing mines.
[2]Does not include gravel washed.
[3]Includes data indicated by symbol W.
[4]Less than 1/2 unit.

brouck Mountain property in the Divide mining district south of Tonopah found reserves of 12.9 million tons containing 0.029 ounce of gold and 0.59 ounce of silver per ton. Freeport Exploration Co., a subsidiary of Freeport McMoRan Inc., opened a new international exploration headquarters in Reno in October. Another subsidiary, FMG, announced that additional reserves of 1.5 million tons, averaging 0.21 ounce of gold per ton, were discovered at the Burns Basin and Mill Creek areas near the Jerritt Canyon open pit gold mine in Elko County. FMG also outlined reserves at Big Springs, 10 miles north of the Jerritt Canyon Mine, after drilling 756 holes totaling 231,000 feet.

Gold Fields Mining Corp., the U.S. subsidiary of Consolidated Gold Fields PLC, reported a major new gold discovery at its Chimney Creek Prospect 5 miles northeast of the Getchell Mine in eastern Humboldt County. Preliminary testing, including 180 relatively shallow drill holes, indicated reserves of 20 million tons of ore amenable to open pit mining. An average grade of 0.09 ounce of gold per ton was reported, including 6 million tons averaging 0.18 ounce per ton.

Newmont discovered a new gold deposit 3 miles from its Carlin Mine in northern

Eureka County. The 12 holes drilled to date on the Genesis deposit have delineated 50 million tons averaging 0.1 ounce of gold per ton. Tenneco Minerals explored near Illipah, 35 miles southwest of Ely in White Pine County. Westley Mines Ltd. continued drilling at its Gabbs gold-silver project in northwestern Mineral County. Frank Lewis explored adjacent to the Fortitude open pit gold mine south of Battle Mountain in northern Lander County. Lacana Gold explored near Virginia City and at the Gabbs gold-silver property 3 miles northwest of the Santa Fe gold-silver property near Luning. Additional exploration activity was reported by more than 25 companies throughout the State.

Inspiration Mines Inc. submitted plans to the U.S. Forest Service for development of the Quito gold deposit, 10 miles south of Austin in Lander County.

Amselco Minerals Inc. reduced its work force at the Alligator Ridge gold mine in White Pine County from 147 to 128, reflecting a decrease in the amount of stripping needed. Lacana Gold closed its Relief Canyon open pit mine in Pershing County in October. United Mining Corp. closed its mill and mines in the Virginia City area early in the year.

Table 5.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1985, 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	20	17,970,036	1,246,290	982,180	--	--	--
Gold-silver	2	W	W	W	--	--	--
Silver	5	W	W	3,833,760	(4)	(4)	--
Total	27	W	W	W	(4)	(4)	--
Other lode material:							
Copper precipitates	1	W	--	--	W	--	--
Molybdenum ore	--	--	W	W	W	--	--
Total lode	28	[5]20,738,883	W	W	W	(4)	--
Placer	1	--	W	W	--	--	--
Grand total	28	[5]20,738,883	[5]1,276,114	[5]4,946,523	W	(4)	--

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 were recovered only 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]Less than 1/2 unit.
[5]Includes data indicated by symbol W.

Table 6.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1985, 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	1,271,549	4,940,927	--	--	--
Smelting of concentrates	W	W	W	(1)	--
Direct smelting of:					
Ore	W	W	W	--	--
Precipitates	--	--	W	--	--
Total lode material	W	W	W	(1)	--
Placer	W	W	--	--	--
Grand total	[2]1,276,114	[2]4,946,523	W	(1)	--

W Withheld to avoid disclosing company proprietary data.
[1]Less than 1/2 unit.
[2]Includes data indicated by symbol W.

Iron Ore.—Appreciable declines were noted in both the quantity and value of Nevada's reported 1985 usable iron ore shipments. Two producers shipped iron ore during the year, from Churchill, Eureka, and Pershing Counties. In July, Nevada Barth Corp. suspended operations at its mine in Eureka County.

Mercury.—Nevada accounted for all the mercury production recorded in the Nation in 1985. The McDermitt Mine in Humboldt County, operated by Placer U.S., was the principal producer. Production, excluding byproduct mercury, was 16,530 76-pound flasks or about 13% less than that reported for 1984. Smaller amounts of mercury were produced as a byproduct from gold recovery at the Carlin Mine in Eureka County, the Pinson Mine in Humboldt County, and the Borealis project in Mineral County.

Placer U.S. continued exploration work at the McDermitt Mine. FMC evaluated mercury prospects at its Paradise Peak open pit mine near Gabbs.

Molybdenum.—Nevada's limited molybdenum production was further restricted in January when Anaconda Minerals closed its molybdenum mine near Tonopah, laying off 260 people. Kennecott's Ely and McGill operations in White Pine County remained closed during 1985. Exxon Minerals Co. slowed development of its Mount Hope molybdenum project in Eureka County.

Silver.—Nevada ranked second among the Nation's silver producers in 1985. Production of nearly 5 million troy ounces of silver was almost 24% lower than that of 1984, and value decreased to $30 million.

NERCO Minerals Co.'s Candalaria Mine in Mineral County was the largest producer. Significant production was also reported from the Battle Mountain Mine in Lander County, the Round Mountain and Northumberland Mines in Nye County, and Cominco American's Buckhorn Mine in Eureka County.

Sunshine Mining Co. produced more than 1.3 million ounces of silver during 1985 at its Sixteen-to-One Mine west of Silver Peak in Esmeralda County. Sunshine began accepting gold-silver ores for custom milling at the Sixteen-to-One mill in August.

Asamera suspended operations at its Gooseberry Mine near Reno, attributing the shutdown to continued depressed metal prices. Silver King Mines and Pacific Silver began construction in October of a 1,000-ton-per-day leaching plant 5 miles west of Ely in White Pine County. The plant will treat silver-gold ore from the Star-Pointer Mine on the south edge of the Ruth Pit. Silver King Mines continued development at the Ward Mountain Mine in White Pine County. Work continued on twin 4,500-foot inclines being driven into the mountain.

Coeur-Rochester Inc. began construction at its silver-gold project in the Rochester mining district north of Lovelock, Pershing County, after a feasibility study concluded that 60 million short tons of ore could be mined and heap leached economically at the property. Goldera Resources Inc. began metallurgical testing at its silver property in the Cherry Creek District, White Pine County, using a 100-ton-per-day portable mill.

Titanium.—Titanium Metals Corp. of America (TMCA) produced titanium metal sponge and ingot from imported rutile concentrate at its Henderson plant. TMCA, the largest domestic titanium metal producer, has an annual capacity of about 14,000 short tons of sponge and 17,000 short tons of ingot.

Tungsten.—Most Nevada tungsten operations were closed during 1985, including Union Carbide Corp.'s Emerson Mine and mill at Tempiute in Lincoln County, and General Electric Co.'s Springer Mine, mill, and ammonium paratungstate plant in Pershing County. The Geo-A tungsten mine near Wells, Elko County, shipped concentrate to the Umetco Minerals Corp. plant in California.

Umetco Minerals, a wholly owned subsidiary of Union Carbide, signed a contract to purchase the entire tungsten output from the Victoria milling operation in Nevada, which processes ore from the Yellow-Hammer Mine in Utah.

INDUSTRIAL MINERALS

Barite.—Barite production in 1985 decreased 4% from that of 1984, to 590,306 short tons. However, Nevada remained the leading State in the production of barite, being credited with about 80% of the total production and 51% of the total value reported nationally. The continuing downturn in oil well drilling resulted in lower mine production and grinding plant activities throughout the State.

Dresser Industries Inc.'s Magobar Minerals Div.'s Greystone Mine and mill in Lander County, and NL Industries' Baroid Div.'s Queen Lode Mine in Elko County were the largest producers. Additional production was reported from five mines in Lander

County, one mine in Elko County, and one in Nye County.

Cement.—Nevada Cement Co. continued to produce from a plant near Fernley in Lyon County, utilizing freshwater limestone mined nearby and clay mined in central Washoe County. Genstar Lime Co. produced carbonate rock or lime at three localities in Clark County.

Clays.—The largest producer of Nevada clays, Industrial Mineral Ventures Inc., mined and produced sepiolite and bentonite in southern Nye County. Hectorite from California and bentonite from Wyoming were also processed at the plant to make high-value organo-clad clays for drilling fluid operations. Vanderbilt Minerals Co. continued to produce bentonite from its underground mine near Beatty in Nye County. Nevada Cement produced kaolin clay from its open pit mine northwest of Pyramid Lake in Washoe County.

Diatomite.—Nevada remained the second largest diatomite producing State in 1985. Three companies produced diatomite from Miocene or Pliocene freshwater lake deposits. Eagle-Picher Industries Inc. was the State's largest producer from properties in Lyon, Pershing, and Storey Counties. Grefco Inc. in Esmeralda County and Cyprus Diatomite Co. in Churchill County also produced diatomite during the year.

Fluorspar.—J. Irving Crowell, Jr., and Son mined metallurgical-grade fluorspar at the Daisy Mine near Beatty in Nye County.

Gem Stones.—Gem stones valued at an estimated $1.3 million were produced in Nevada during 1985. Turquoise and opals were the most sought after gems. Lombardo Turquoise Co. Inc. was issued a patent for the Sotang Lode claim covering the Shoshone turquoise mine in Lander County. The mine supplies turquoise for the company's jewelry manufacturing operation in Austin.

Gypsum.—A slight increase in the value of Nevada's gypsum production, attributed to continuing strength in building and construction activities and higher prices, was reported in 1985. Crude gypsum mined remained at about the 1984 level of 1.2 million short tons, but calcined gypsum produced increased to 825,000 short tons. Production was reported from four companies in Clark, Lyon, and Pershing Counties.

Demand for wallboard remained high, and considerable calcined and uncalcined gypsum was shipped to plants in California. Three companies operated wallboard plants in Nevada: Genstar Building Products Co. and Pacific Coast Building Products Inc. in Clark County, and USG Corp. in northern Washoe County. Pacific Coast Building Products continued to supply calcined gypsum to its wallboard plant at Newark, CA, and USG continued to supply its plant at Fremont, CA. The Art Wilson Co. shipped uncalcined gypsum and anhydrite from a mine in Lyon County to the Nevada Cement plant and two cement plants in northern California.

The NBMG issued an open file report at yearend, entitled "Gypsum in Nevada."

Lime.—Genstar Lime produced lime at two locations in Clark County. Production was only slightly lower than that reported in 1984.

Lithium Compounds.—Foote Mineral Co., a subsidiary of Newmont, was the State's sole producer of lithium compounds, which were recovered from brines in Esmeralda County. Lithium carbonate was produced by solar evaporation and chemical processing of lithium-rich brines pumped from beneath the Clayton Valley Lake.

Magnesite.—Basic Inc.'s magnesite operation at Gabbs in Nye County continued to operate intermittently at a low production level. It remained the only magnesite producer in the United States, with output and value below that of 1984. The material was used in refractories, in steel, and to make magnesium oxide.

Perlite.—Nevada's expanded perlite production in 1985 came solely from USG's Empire plant in Washoe County. Delamar-Mackie Perlite Co. shipped crude ore from its mine near Caliente in Lincoln County.

Salt.—The Huck Salt Co. operation in Churchill County, owned by Leslie Salt Co., was the only reported 1985 salt producer in the State.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. The data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Simplot Industries Inc.'s Silica Products Div.'s plant in Clark County was the only reported producer of industrial sand during 1985. Silica sand was used for containers, flux, molding, and silicon carbide production.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates.

Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone was produced from 11 quarries throughout the State, only 1 of which produced more than 500,000 short tons. Centex Corp.'s Nevada Cement, Genstar Lime, and Harney Rock & Paving Inc. were the largest producers. Production was reported from Churchill, Clark, Elko, Humboldt, Lyon, Nye, and Pershing Counties.

[1]State Mineral Officer, Bureau of Mines, Reno, NV.
[2]Director and State geologist, Nevada Bureau of Mines and Geology, Reno, NV.

Table 7.—Nevada: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Combined coarse and fine aggregates: Other construction[2]	525	2,501
Special: Other miscellaneous[3]	808	3,717
Total	[4]1,334	6,218

[1]Includes dolomite, granite, limestone, volcanic cinder (scoria), and miscellaneous stone.
[2]Includes stone used in concrete aggregate (coarse), railroad ballast, unpaved road surfacing, stone sand (concrete), and stone used for other construction and maintenance purposes.
[3]Includes stone used in cement manufacture, lime manufacture, poultry grit and mineral food, and other uses not specified.
[4]Data do not add to total shown because of independent rounding.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
Dresser Industries Inc., Magobar Minerals Div.	Box 370 Battle Mountain, NV 89820	Surface mine and mill	Lander.
NL Industries Inc., Baroid Div	Box 414 Battle Mountain, NV 89820	do	Elko.
Cement:			
Centex Corp., Nevada Cement Co	Box 895 Fernley, NV 89408	Plant	Lyon.
Clays:			
Industrial Mineral Ventures Inc	1800 East Sahara Ave. Suite 107 Las Vegas, NV 89104	Surface mine and mill	Nye.
Copper:			
The Anaconda Minerals Co	Box 1268 Tonopah, NV 89049	do	Do.
Duval Corp	Box 451 Battle Mountain, NV 89820	do	Lander.
Diatomite:			
Eagle-Picher Industries Inc., Minerals Div.	Box 12130 Reno, NV 89510	Surface mine and plants.	Lyon, Pershing, Storey.
Grefco Inc., Dicolite Div	Box 288 Mina, NV 89422	Surface mine and plant	Esmeralda.
Fluorspar:			
J. Irving Crowell, Jr., and Son	Box 96 Beatty, NV 89003	Underground mine	Nye.
Gold:			
Carlin Gold Mining Co., a subsidiary of Newmont Mining Corp.	Box 979 Carlin, NV 89822	Surface mine, mill, refinery.	Eureka.
Copper Range Co., Smokey Valley Mining Div.	Box 480 Round Mountain, NV 89045	do	Nye.
Freeport Gold Co., Joint Venture	Mountain City Star Route Elko, NV 89801	Surface mine and mill	Elko.
Gypsum:			
Genstar Building Products Co	Box 2580 Irving, TX 75061	Surface mine and plant	Clark.
Pacific Coast Building Products Inc	Box 405 37851 Cherry St. Newark, CA 94560	do	Do.
USG Corp	101 South Wacker Dr. Chicago, IL 60606	do	Pershing.
Lime:			
Genstar Lime Co	901 Martiner's Island Blvd. Suite 425 San Mateo, CA 94404	do	Clark.
Lithium compounds:			
Foote Mineral Co	Route 100 Exton, PA 19341	Dry lake brines and plant.	Esmeralda.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Magnesite:			
Basic Inc	845 Hanna Bldg. Cleveland, OH 44115	Surface mine and mill	Nye.
Mercury:			
Placer U.S. Inc., McDermitt JV	Box 497 McDermitt, NV 89421	do	Humboldt.
Perlite:			
USG Corp	Empire, NV 89405	Plant	Washoe.
Salt:			
Leslie Salt Co., Huck Salt Co	895 Harrigan Rd. Fallon, NV 89406	Solar evaporation plant.	Churchill.
Sand and gravel (construction, 1984):			
ARC Materials Corp., WMK Transit Mix.	Box 14697 Las Vegas, NV 89114	Pits and mills	Clark.
Robert L. Helms Construction Co	Drawer 608 Sparks, NV 89432-0608	Pits and mill	Lander and Washoe.
Industrial Construction Inc., Bonanza Materials Inc.	565 Lalif Rd. Henderson, NV 89015	Pit and plant	Clark.
Las Vegas Building Materials Inc	Box 530 Las Vegas, NV 89125	Pit	Do.
Las Vegas Paving Corp	1770 South Industrial Rd. Las Vegas, NV 89102	Pit	Do.
Rilite Aggregate Co. Inc	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 89104	Pit and mill	Do.
Wells Cargo Inc	Box 14037 Las Vegas, NV 89114	do	Do.
Silver:			
NERCO Minerals Co	Box 1246 Hawthorne, NV 89415	Surface mine and plant	Mineral.
Silver King Mines Inc	Box 324 East Ely, NV 89315	do	White Pine.
Sunshine Mining Co	Box 97 Silverpeak, NV 89047	Underground mine and mill.	Esmeralda.
Stone (crushed):			
Centex Corp., Nevada Cement Co	Box 895 Fernley, NV 89408	Quarry	Lyon.
Genstar Lime Co	2551 Green Valley PY 2013 Henderson, NV 89015	Quarries	Clark.
Harney Rock & Paving Inc	Box 800 Hines, OR 97738	Quarry	Elko.

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]

The value of nonfuel mineral production in New Hampshire in 1985 exceeded $30 million for the first time in history. Increased output of crushed and dimension stone and construction sand and gravel accounted for more than a $9.7 million gain in value of mineral production compared with 1984 totals. The State's dimension stone industry benefited from strong demand for granite curbing. Crushed stone and construction sand and gravel sales increased because of improved conditions in the construction industry.

Table 1.—Nonfuel mineral production in New Hampshire[1]

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel (construction) thousand short tons	5,637	$16,054	e6,300	e$19,800
Stone:				
Crushed do.	e850	e2,700	1,612	6,434
Dimension do.	e59	e4,198	79	6,532
Combined value of other industrial minerals	XX	160	XX	134
Total	XX	23,112	XX	32,900

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

Table 2.—Nonfuel minerals produced in New Hampshire in 1984, by county

County	Minerals produced in order of value
Belknap	Sand and gravel.
Carroll	Do.
Cheshire	Do.
Coos	Do.
Grafton	Do.
Hillsborough	Do.
Merrimack	Do.
Rockingham	Do.
Strafford	Sand and gravel, clays.
Sullivan	Sand and gravel.
Undistributed[1]	Stone (crushed and dimension), gem stones.

[1]Data not available by county for minerals listed.

Trends and Developments.—Although New Hampshire ranked 47th nationally in value of mineral production, the 42% increase in value in 1985 was the largest gain recorded among the 50 States. The State's mineral production increased because of strong demand for mineral commodities used by the construction industry. Demand was influenced by inflation and interest rates, both of which continued to decline since 1982 boosting commercial and home building. In 1985, housing starts in New Hampshire increased 50% to about 16,600 units, and the value of nonresidential construction contracts improved 70% to $510 million.[2]

Legislation and Government Programs.—In June, the State enacted House bill 519 (chapter 125-D) establishing an acid rain control act. The bill mandated a two-phase program with a 50% reduction in the State's sulfur dioxide emissions by 1995. The first phase of the program requires a 25% reduction in sulfur dioxide emissions by 1990.

Table 3.—Indicators of New Hampshire business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	959	978	998
Total civilian labor force	do.	500	521	537
Unemployment	percent	5.4	4.3	3.9
Employment (nonagricultural):				
Mining total	thousands	.4	.4	.4
Manufacturing total	do.	113.3	123.4	123.1
Primary metal industries	do.	3.9	4.4	4.3
Stone, clay, and glass products	do.	2.5	2.9	3.0
Chemicals and allied products[1]	do.	.9	1.0	1.0
Construction	do.	24.4	25.2	31.3
Transportation and public utilities	do.	15.0	15.5	15.6
Wholesale and retail trade	do.	94.1	104.6	112.8
Finance, insurance, real estate	do.	21.6	23.4	25.2
Services	do.	84.6	91.5	99.3
Government and government enterprises	do.	56.1	57.5	58.7
Total	do.	409.5	441.5	[2]466.3
Personal income:				
Total	millions	$12,076	$13,574	$14,931
Per capita		$12,598	$13,880	$14,964
Hours and earnings:				
Total average weekly hours, production workers		40.5	41.0	40.7
Total average hourly earnings, production workers		$7.4	$7.9	$8.4
Earnings by industry:				
Farm income	millions	$30	$28	$30
Nonfarm	do.	$8,075	$9,058	$10,142
Mining total	do.	$27	$36	$36
Nonmetallic minerals except fuels	do.	$8	$9	$11
Manufacturing total	do.	$2,445	$2,809	$3,011
Primary metal industries	do.	$97	$116	$125
Stone, clay, and glass products	do.	$54	$65	$74
Chemicals and allied products	do.	$22	$26	$29
Construction	do.	$802	$826	$1,001
Transportation and public utilities	do.	$427	$464	$494
Wholesale and retail trade	do.	$1,341	$1,526	$1,726
Finance, insurance, real estate	do.	$390	$439	$541
Services	do.	$1,622	$1,862	$2,138
Government and government enterprises	do.	$985	$1,060	$1,153
Construction activity:				
Number of private and public residential units authorized[3]		7,809	11,051	17,769
Value of nonresidential construction[3]	millions	$275.8	$300.9	$607.4
Value of State road contract awards	do.	$68.0	$71.5	$73.5
Shipments of portland and masonry cement to and within the State	thousand short tons	268	329	389

See footnotes at end of table.

Table 3.—Indicators of New Hampshire business activity —Continued

		1983[r]	1984	1985[p]
Nonfuel mineral production value:				
Total crude mineral value	millions	$19.1	$23.1	$32.9
Value per capita		$20	$24	$33

[p]Preliminary. [r]Revised.
[1]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2]Data do not add to total shown because of independent rounding.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

INDUSTRIAL MINERALS

Clays.—Kane-Gonic Brick Corp. mined common clays for brick manufacture in Gonic, Strafford County. Most of the brick was marketed in Boston, MA, for use in restoration projects.

Gem Stones.—New Hampshire remained an area of interest to rockhounds and mineral collectors because of a long history of past mining operations. One site, the Chandler Mine in Raymond, was explored for beryl, lepidolite, and columbite specimens. The Whitehall Co. mined feldspar at the Chandler Mine from 1946 to 1948 for use in an abrasive cleanser product.[3]

Gypsum.—National Gypsum Co. operated a manufacturing plant for gypsum wallboard products at Portsmouth, Rockingham County. The crude gypsum was shipped from the company's subsidiary in Canada through the Port of Portsmouth. National Gypsum was one of two gypsum calciners in New England. U.S.G. Corp. operated a facility in Massachusetts.

Sand and Gravel (Construction).—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel production increased for the third consecutive year and surpassed the output of 1983 by nearly 60%. Demand from the construction industry remained strong; the value of construction contracts increased 29% in 1985 compared with that of 1984.[4]

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Output of 1.6 million short tons of crushed stone in 1985 was the second highest total in the State's history. In 1973, 1.8 million tons was produced; the increased production reflected strong demand, which resulted in a 25% increase in the unit price per ton of crushed stone, from nearly $3.18 in 1984 to $3.99 in 1985 (plant f.o.b.).

Dimension.—Nationally, New Hampshire ranked fourth in dimension stone production and accounted for 13% of the dimension granite output. The 78,642 short tons (953,000 cubic feet) of dimension granite quarried in 1985 represented a 34% increase over the 1984 total. Demand for granite curbing in bridge and street construction was the major reason for the improved output.

Late in the year, H. E. Fletcher Co. was sold and renamed the Fletcher Granite Co. Inc. The firm was purchased by a group of investors that included Castellucci & Sons Inc., owner and operator of the Stony Creek granite quarry in New Haven, CT. Fletcher, a leading dimension stone producer in New England, owned or leased quarries in Madison and Mason, NH; Chelmsford and Milford, MA; and Jonesboro and Deer Island, ME.

[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.
[2]Federal Reserve Bank of Boston. New England Economic Indicators. Jan. 1986, p. B-7.
[3]Bailey, K. Raymond Times (Exeter, NH), July 3, 1985, p. 4.
[4]Work cited in footnote 2.

Table 4.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Kane-Gonic Brick Corp	Gonic, NH 03867	Pit	Strafford.
Gypsum (calcined):			
National Gypsum Co	4100 First International Bldg. Dallas, TX 75270	Plant	Rockingham.
Sand and gravel:			
Granite State Concrete Inc	Box 185 Milford, NH 03055	Pit	Hillsborough.
Manchester Sand & Gravel & Cement Co. Inc.	Box 415 Hooksett, NH 03106	Pits and plant	Merrimack.
Ossipee Aggregates Corp	Box 237 Ossipee, NH 03864	Pit	Carroll.
Plourde Sand & Gravel Co. Inc	Suncock, NH 03275	Pit and plant	Merrimack.
A. Whitcomb Inc.[1]	Lancaster Rd. Gorham, NH 03581	Pits	Belknap, Carroll, Cheshire, Coos, Grafton.
F. W. Whitcomb Construction Corp.[1]	Box 429 Bellows Falls, VT 05101	Pit	Cheshire.
Stone:			
Crushed:			
John Isafolla Co	Peverly Hill Rd. Portsmouth, NH 03801	Quarry	Rockingham.
Keene Sand & Gravel Co	725 Main St. Keene, NH 03431	do	Cheshire.
Pike Industries Inc	Route 3 Tilton, NH 03276	do	Merrimack.
Dimension:			
Kitledge Granite Corp	Armory Rd. Milford, NH 03055	do	Hillsborough.
Maine-New Hampshire Granite Corp.	Box 135, Groton Rd. West Chelmsford, MA 01863	do	Do.
J. Swenson Granite Co	North State St. Concord, NH 03301	do	Merrimack.

[1]Also crushed stone.

The Mineral Industry of New Jersey

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey, Division of Water Resources, New Jersey Department of Environmental Protection, for collecting information on all nonfuel minerals.

By Donald K. Harrison[1]

Mineral production in the State was valued at $177.6 million, a $21.4 million increase over the $156.2 million reported in 1984. This increase reflected the continuing economic growth in the State, primarily fueled by a further increase in private, public, and nonresidential construction during the year. Crushed stone, again the leading mineral commodity produced, accounted for 53% of the State's total value. New Jersey was one of two States that produced greensand, used mainly as a water purifier. Other minerals produced, in order of descending value, included construction sand and gravel, industrial sand, zinc, clays, and peat. Mineral commodities processed or manufactured but not listed in table 1 included aluminum, copper, ferroalloys, gypsum, iodine, finished iron oxide pigments, perlite, precious metals, quartz crystal, talc, and vermiculite. Byproduct elemental sulfur was recovered at four oil refineries.

Nationally, New Jersey ranked 35th in the value of nonfuel minerals produced, third in the output of industrial sand, fourth in zinc production, and sixth of 28 States that exfoliated vermiculite.

Table 1.—Nonfuel mineral production in New Jersey[1]

Mineral		1984		1985	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	62	$611	130	$2,050
Gem stones		NA	1	NA	1
Peat	thousand short tons	5	128	W	311
Sand and gravel:					
Construction	do	9,545	31,878	e10,600	e36,700
Industrial	do	2,712	32,287	2,820	31,119
Stone (crushed)	do	e13,500	e75,000	15,692	94,339
Combined value of greensand, stone (dimension, 1984), and zinc		XX	16,331	XX	13,056
Total		XX	156,236	XX	177,576

eEstimated. 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).

Table 2.—Nonfuel minerals produced in New Jersey in 1984, by county[1]

County	Minerals produced in order of value
Atlantic	Sand and gravel.
Bergen	Do.
Burlington	Do.
Camden	Do.
Cape May	Do.
Cumberland	Sand and gravel, clays.
Gloucester	Marl (greensand), sand and gravel.
Middlesex	Sand and gravel.
Monmouth	Do.
Morris	Do.
Ocean	Do.
Passaic	Do.
Salem	Do.
Somerset	Clays.
Sussex	Zinc, sand and gravel, peat.
Warren	Sand and gravel, peat.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of New Jersey business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	7,468	7,517	7,562
Total civilian labor force	do	3,673	3,828	3,853
Unemployment	percent	7.8	6.2	5.7
Employment (nonagricultural):				
Mining total[1]	thousands	2.0	2.1	2.0
Nonmetallic minerals except fuels[2]	do	1.8	2.0	2.0
Manufacturing total	do	715.1	726.8	719.1
Primary metal industries	do	20.7	21.6	21.1
Stone, clay, and glass products	do	26.8	26.2	25.7
Chemicals and allied products	do	119.1	119.9	120.8
Petroleum and coal products	do	10.3	10.0	9.2
Construction	do	112.1	131.3	140.1
Transportation and public utilities	do	203.0	219.4	224.9
Wholesale and retail trade	do	735.3	787.3	813.4
Finance, insurance, real estate	do	172.7	183.0	192.5
Services	do	703.7	757.3	792.6
Government and government enterprises	do	521.2	522.1	534.4
Total	do	3,165.1	[3]3,329.2	3,419.0
Personal income:				
Total	millions	$110,383	$120,745	$130,154
Per capita		$14,781	$16,063	$17,211
Hours and earnings:				
Total average weekly hours, production workers		40.6	41.1	40.8
Total average hourly earnings, production workers		$9.1	$9.5	$9.9
Earnings by industry:				
Farm income	millions	$240	$247	$286
Nonfarm	do	$72,846	$80,706	$87,654
Mining total	do	$220	$281	$260
Nonmetallic minerals except fuels	do	$49	$56	$60
Manufacturing total	do	$18,752	$19,995	$20,853
Primary metal industries	do	$613	$653	$671
Stone, clay, and glass products	do	$649	$679	$688
Chemicals and allied products	do	$3,928	$4,178	$4,423
Petroleum and coal products	do	$555	$541	$542
Construction	do	$3,836	$4,749	$5,277
Transportation and public utilities	do	$6,196	$7,004	$7,527
Wholesale and retail trade	do	$12,874	$14,427	$15,655
Finance, insurance, real estate	do	$3,986	$4,365	$5,253
Services	do	$16,241	$18,327	$20,400
Government and government enterprises	do	$10,492	$11,292	$12,126

See footnotes at end of table.

Table 3.—Indicators of New Jersey business activity —Continued

	1983[r]	1984	1985[p]
Construction activity:			
Number of private and public residential units authorized[4]	36,077	44,031	55,027
Value of nonresidential construction[4] millions	$1,344.8	$1,807.0	$1,915.0
Value of State road contract awards do	$208.0	$244.3	$416.7
Shipments of portland and masonry cement to and within the State[5] thousand short tons	1,393	1,740	1,821
Nonfuel mineral production value:			
Total crude mineral value millions	$154.6	$156.2	$177.6
Value per capita	$21	$21	$23

[p]Preliminary. [r]Revised.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals do not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]Data do not add to total shown because of independent rounding.
[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.
[5]Has no cement producing plants.

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

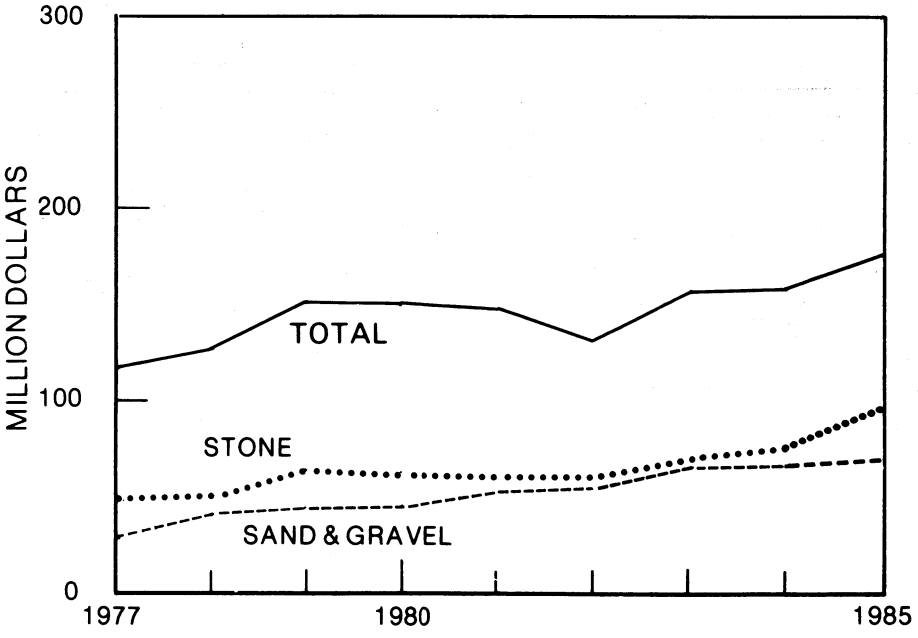

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in New Jersey.

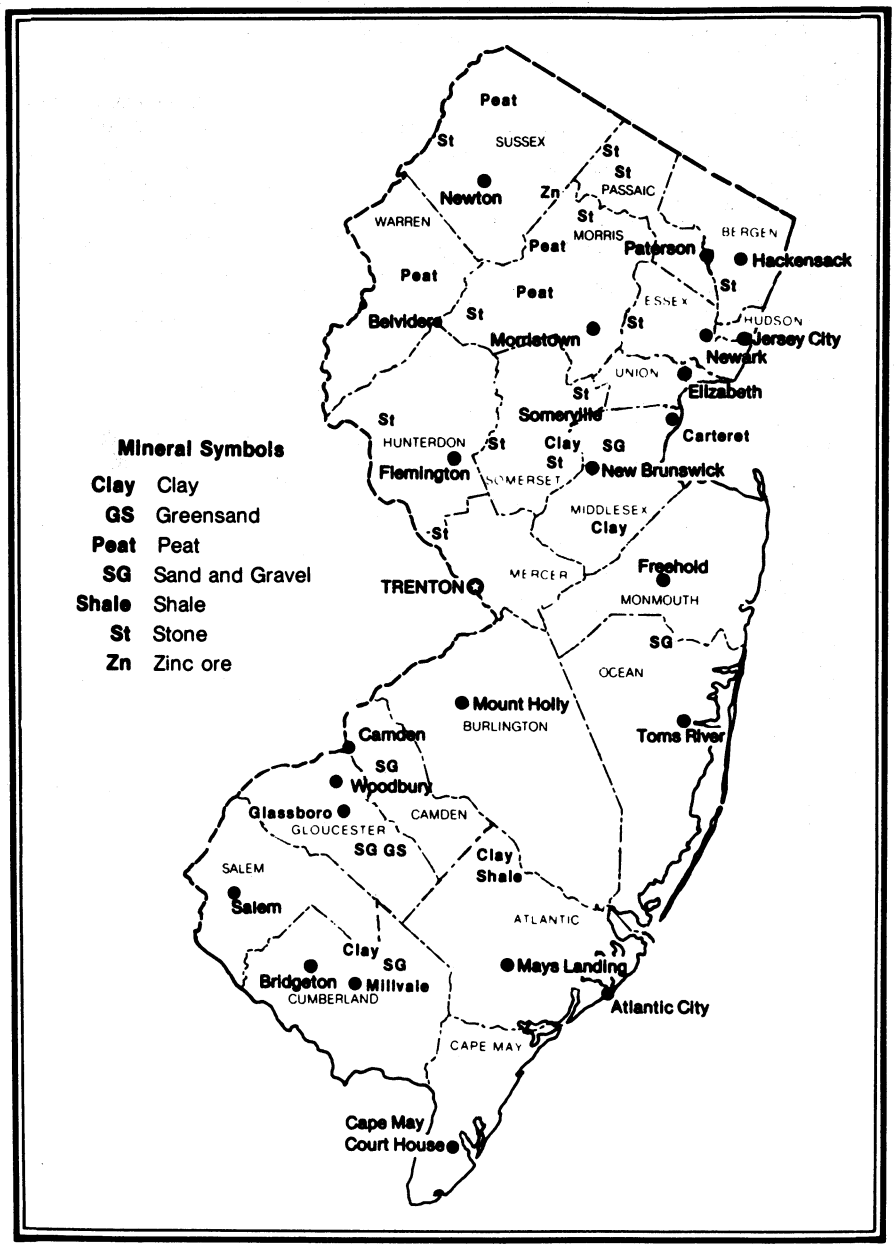

Figure 2.—Principal mineral producing localities in New Jersey.

Trends and Developments.—Fueled by brisk consumer spending and a further demand in construction activity, New Jersey experienced another year of solid economic growth in 1985. The State attained a 13-year high in planned homebuilding when 55,015 units were authorized for construction. For the third consecutive year since the end of the building slump in 1982, the State's over-the-year increase in total number of units authorized far outpaced the Nation's increase—25% versus 3%. The biggest increases were in the homebuilding and public works segments of the industry, although contracts for office, commercial, and other nonresidential building projects also reached another record high, following a very strong expansion in 1984.[2] Also during the year, the State allocated nearly $1 billion to the State Transportation Fund for a 4-year road repair project. These allocations, combined with $2.2 billion in Federal funds, will be spent primarily on major highway projects in the central part of the State. The State legislature adopted and signed the Transportation Trust Fund into law in 1984. As a result of the construction increases and road repair allocations, output of most construction mineral commodities increased in 1985. Increases in quantity were reported for common clay (140%), construction sand and gravel (11%), crushed stone (16%), and shipments of portland and masonry cement to the State (5%).

A major environmental concern in the State was the potential health hazard of high radon gas concentrations that might be seeping into as many as 150,000 northwestern New Jersey buildings and homes. These structures were believed to be sitting on top of the Reading Prong, a geological formation whose uranium deposits reportedly emit radon. This formation underlies 75 communities in Hunterdon, Morris, Passaic, Somerset, and Sussex Counties. To determine the full scope of the problem, the New Jersey Department of Environmental Protection was undertaking a $2 million study to test for sources of radon gas that might be seeping into the structures. The study was to take 6 to 9 months.

Legislation and Government Programs.—Signed into law in July, Senate bill 2547 appropriated $10.8 million from the Shore Protection Fund for shore protection projects. The funds were appropriated from the Shore Protection Fund created under the Shore Protection Bond Act of 1983. The new law (chapter 253, Public Laws of 1985) should benefit local construction aggregate producers.

In June, the State Assembly defeated Assembly bill 794, the Beverage Container and Recycling Act. The bill, reintroduced in 1984 but not acted on until 1985, would have placed a 10-cent deposit on all cans, bottles, and other beverage containers. Bill opponents insisted that it would have adversely affected the State's already depressed glass manufacturing and industrial sand industries. Mandatory deposit laws have virtually eliminated glass containers in other States because glass is breakable and more expensive to recycle.

In 1985, New Jersey followed several other Eastern States when it petitioned the Federal Court to force the U.S. Environmental Protection Agency (EPA) to impose stricter sulfur dioxide emissions controls on powerplants in the Midwest. The State claims that tall stacks in the Midwest, a major contributor to the acid rain problem, were preventing the Northeastern States from meeting air-quality standards.

The New Jersey Geological Survey (NJGS), reorganized within the Division of Water Resources in 1984, is primarily responsible for investigating the State's ground water and mineral resources. The NJGS was divided into three bureaus: the Bureau of Geology and Topography, responsible for mapping and assessing mineral resources; the Bureau of Ground Water Pollution Analysis, for providing hydrogeologic expertise to the Department of Environmental Protection; and the Bureau of Ground Water Resources Evaluation, for evaluating ground water resources and contamination.

During the year, the Bureau of Geology and Topography continued mapping quadrangles in the northern part of the State for incorporation in the New Jersey geologic map (1:100,000) to be published in 1990. The mapping program, a joint venture by the NJGS and the U.S. Geological Survey (USGS), is part of the USGS' COGEOMAP program. The Bureau also began assessing natural radon gas emissions in homes within the Reading Prong and was expected to play a major role in the investigation in 1986.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Clays.—In 1985, two companies produced clay in New Jersey. New Jersey Shale Brick & Tile Corp. produced common clay and shale at one operation in Somerset County, and The Morie Co. Inc. mined fire clay in Cumberland County. Output of common clay, used primarily for manufacturing common brick, was 120,000 short tons valued at $1.8 million. This represents a production increase of nearly 2-1/2 times and a value increase of nearly 4-1/2 times compared with that of 1984. These increases resulted from the continuing upward construction boom in the State that began in 1983. Output of fire clay, which is primarily used in foundries, was 10,166 tons in 1985, 15% less than in 1984.

Gem Stones.—The State is well known for its variety of mineral specimens, especially those associated with the zinc ores of the Franklin-Sussex area in the northern part of the State. Other mineral collecting localities are associated with the basaltic rocks of the Watchung Mountains and at Cape May, where "Cape May Diamonds" (clear quartz pebbles) are collected along the beach.

Greensand.—Inversand Co., a subsidiary of Hungerford & Terry Inc., near Clayton, Gloucester County, produced greensand in 1985. Deposits of greensand, also known as the mineral glauconite, occur from Sandy Hook south to the Delaware Bay near Salem. Glauconite is a hydrous iron potassium silicate containing various amounts of aluminum, magnesium, sodium, and trace elements. Greensand was processed and sold mainly as a filtration medium to remove soluble iron and manganese from well waters. A secondary use of the unprocessed material was as a conditioner for organic soils.

Gypsum (Calcined).—Crude gypsum, imported from Nova Scotia, Canada, was calcined by National Gypsum Co., Burlington County, and Genstar Gypsum Products Co., Camden County. Although calcined gypsum production dropped 2% compared with 1984 production, value rose slightly more than 8%. The calcined gypsum was used primarily in manufacturing wallboard and related plasters.

The Atlantic Gypsum Co., a new company, announced plans for a $34 million gypsum importing and wallboard plant at Port Newark, to be operational by the spring of 1987. The company planned to import a minimum of 250,000 short tons of gypsum annually from Spain. In connection with Atlantic Gypsum's plan, the Port Authority allocated $9.5 million for constructing a high-speed mechanical system for the storage and discharge of the imported gypsum.

Iodine.—Crude iodine shipped into New Jersey was used by eight companies at nine plants to manufacture various iodine-containing compounds. These companies, representing approximately 20% of the domestic companies canvassed for iodine consumption, were Allied Corp., Morristown; Cooper Chemical Co., Long Valley; Fisher Scientific Co., Fair Lawn; GAF Corp., Linden; Ganes Chemicals Inc., Carlstadt; J. T. Baker Chemical Co., Phillipsburg; Troy Chemical Corp., Newark; and White Chemical Corp., Newark. Iodine compounds were used for laboratory reagents and sanitary purposes and in pharmaceuticals and specialty organic and inorganic chemicals.

Iron Oxide Pigments (Finished).—Two companies produced finished pigments during the year—Columbian Chemicals Co., Monmouth Junction, Middlesex County; and American Minerals Inc., Camden, Camden County. Production and value decreased by 6% and 2%, respectively, from 1984 levels.

Peat.—Four companies at five operations in two counties produced peat. Sussex County accounted for most of the production and Warren County for the remainder. Value increased by almost 1-1/2 times that of 1984. Reed sedge and humus were either shipped packaged (86%) or sold in bulk (14%). Packaged sales increased 100% in 1985, up from 43% in 1984. The peat was sold mainly for soil improvement and as an ingredient in potting soil.

Perlite (Expanded).—Crude perlite shipped in from out of State was expanded by The Schundler Co. at Edison in Middlesex County. Expanded perlite was used in roof insulation board, plaster aggregate, insulation, and masonry, and as a soil conditioner.

Quartz Crystal.—James M. Ronon Associates Inc., Wayside, Monmouth County, used cultured quartz crystal primarily for electronic applications.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985.

Data for odd-numbered years are based on annual company estimates made before yearend.

Estimated output in 1985 was 10.6 million short tons valued at $36.7 million, an 11% increase in tonnage and a 15% increase in value compared with that of 1984. In 1984, construction sand and gravel was produced by 63 companies at 74 pits in 15 of the State's 21 counties. Leading counties in order of output were Ocean, Sussex, Cape May, Middlesex, Camden, and Warren. Primary uses were for concrete aggregate, asphaltic concrete aggregate, fill, and road base and coverings.

Industrial.—New Jersey ranked third in industrial sand production in 1985. Production amounted to 2.8 million short tons valued at $31 million, representing an increase in output of 4% but a decrease in value of 4% compared with that of 1984.

Most of the industrial sand was produced in Cumberland County. Other major producing counties were Cape May and Atlantic. Principal uses were for glass products, molding and core, and in sandblasting.

During the year, the Pennsylvania Glass Sand Corp. (PGS), headquartered in Berkeley Springs, WV, was sold to United States Borax & Chemical Corp., a subsidiary of The Rio Tinto Zinc Corp. PLC, London, England, for $80 million. The purchase of PGS' nine producing facilities included an industrial sand operation at Newport Works in Cumberland County.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone, the leading mineral produced, accounted for more than one-half of the State's total mineral value in 1985. Production amounted to 15.7 million short tons valued at $94.3 million, a 16% increase in output and a 26% increase in value compared with 1984 estimated figures. Leading counties in order of output were Somerset, Mercer, Sussex, and Morris. Types of stone included basalt (traprock), granite, and limestone. Major uses were for road base and concrete and bituminous aggregate.

At yearend, litigation continued on the proposed quarry operation at the former Washington Rock Boy Scout camp in West Amwell Township, Hunterdon County. Fort Commanche Inc., purchaser of the 216-acre property, was seeking a use variance to allow operation in a 3-acre tract previously ruled residential by the township's Board of Adjustment.

Table 4.—New Jersey: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	205	1,162
Filter stone	139	714
Coarse aggregate, graded:		
Concrete aggregate, coarse	2,967	18,241
Bituminous aggregate, coarse	2,200	14,888
Bituminous surface-treatment aggregate	769	4,824
Railroad ballast	506	2,713
Fine aggregate (-3/8 inch):		
Stone sand, concrete	142	1,286
Stone sand, bituminous mix or seal	122	829
Screening, undesignated	717	5,102
Combined coarse and fine aggregates:		
Graded road base or subbase	3,209	16,642
Unpaved road surfacing	W	1,504
Crusher run or fill or waste	76	629
Other construction materials[2]	324	2,680
Special uses:		
Other miscellaneous[3]	355	1,064
Other unspecified[4]	3,962	22,061
Total	[5]15,692	94,339

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

[1]Includes granite, limestone, and traprock.

[2]Includes stone used for agricultural limestone, macadam, terrazzo and exposed aggregate, coarse aggregate, and stone used for other construction maintenance purposes.

[3]Includes stone used for agricultural marl and other soil conditioners, flux stone, chemical stone, mine dusting or acid water treatment, asphalt fillers or extenders, other fillers or extenders, roofing granules, and poultry grit and mineral food.

[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.

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

Sulfur (Recovered).—Elemental sulfur was recovered as a nondiscretionary by-product at four petroleum refineries in the State. Mobil Oil Corp. and Texaco Inc. operated plants in Gloucester County. Chevron U.S.A. Inc. continued operating a plant in Middlesex County, and Exxon Co. U.S.A. operated the Bayway refinery in Union County. Shipments in 1985 amounted to 73,500 metric tons valued at $9.4 million. Quantity and value increased 25% and 41%, respectively, compared with those of 1984, reversing a 4-year decline. This increased output paralleled national production and shipment increases during the year, which reached all-time highs because of record-high production from petroleum refineries. Sulfur was used in manufacturing fertilizers, plastics, sulfuric acid, and other products.

Vermiculite (Exfoliated).—Crude vermiculite was shipped into the State and exfoliated by W. R. Grace & Co. at Trenton in Mercer County, and by Schundler at Edison, Middlesex County. Output and value decreased compared with 1984 levels. Principal uses were for concrete aggregate, fireproofing, loose-fill insulation, block insulation, and underfill for swimming pool liners.

METALS

Aluminum.—Although no primary aluminum is produced in the State, Alumet Smelting Corp. operated a 1,400-metric-ton-per-year fully integrated secondary smelter in Newark, Essex County. In September, the Aluminum Co. of America (Alcoa) opened a beverage can recycling center in Edison. The $2 million facility was to process approximately 36 million pounds of cans during the first year of operation. Cans from 11 Eastern States will be shipped to the new recycling center; after processing, they will be sent to the company's remelting and fabrication mills in Indiana and Tennessee.

Copper.—United States Metals Refining Co., a subsidiary of AMAX Inc., continued phasing out its copper smelting and refining operations at its Carteret plant. The plant had a smelting capacity of 68,000 short tons and electrolytic refining capacity of 100,000 short tons per year. Although the smelting and refining operations will be eventually completely phased out, the company planned to continue producing its oxygen-free, high-conductivity copper. Of the 700 workers currently employed, 60 would be retained.

Closure of the operations was delayed in December pending an environmental hearing in U.S. District Court. Although the final smelting run was scheduled for January 6, 1986, the company decided to await the court decision after the New Jersey Department of Environmental Protection expressed concern about lead emissions at the plant and after the EPA stated that the plant was releasing higher than permitted dioxon levels into the atmosphere.

In August, AmRod Corp. began production at its newly constructed $12 million, 60,000-short-ton-per-year continuous cast copper rod mill in Port Newark. Primary markets were fabricators within a 250-mile radius of the plant.

Ferroalloys.—Shieldalloy Corp., a subsidiary of Metallurg Inc., was the sole producer of ferroalloys in the State. The company operated a metallothermic furnace in Newfield, Gloucester County, and produced ferroalloys of aluminum, boron, columbium, titanium, and vanadium. Shipments and value rose 16% and 14%, respectively, compared with those of 1984.

Steel.—During the year, New Jersey Steel Corp., Sayreville, announced plans to increase the raw steel capacity at its minimill from 250,000 to 400,000 short tons per year. Primary modifications will be undertaken at the company's electric arc furnace. New Jersey Steel primarily produced reinforcing bars for markets in a triangle that has Boston, MA, Pittsburgh, PA, and Washington, DC, as its points.

Raritan River Steel Co. recently spent $3.6 million to control high noise levels at its steel mill in Middlesex County. By installing the noise abatement equipment, Raritan River became the first manufacturing operation in the country to comply with the most stringent noise-level controls ever enforced.

Zinc.—New Jersey ranked fourth among the eight States that produced zinc in 1985. The New Jersey Zinc Co. Inc., the State's only producer, operated the Sterling Mine in Sussex County. In terms of total output, the mine was the Nation's seventh leading producer. Direct shipping ore from the mine was railed to the company's Palmerton, PA, plant to produce zinc oxide.

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[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2]New Jersey Department of Labor, Division of Planning and Research. New Jersey Economic Indicators. Dec. 12, 1985, p. 2.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
The Morie Co. Inc.[1]	1201 North High St. Millville, NJ 08322	Pit	Cumberland.
New Jersey Shale Brick & Tile Corp	Box 490 Somerville, NJ 08876	Pit	Somerset.
Greensand:			
Inversand Co., a subsidiary of Hungerford & Terry Inc.	Box 45 Clayton, NJ 08312	Pit	Gloucester.
Gypsum (calcined):			
Genstar Gypsum Products Co	1101 South Front St. Camden, NJ 08103	Plant	Camden.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	do	Burlington.
Iron oxide pigments (finished):			
American Minerals Inc	Foot of Jefferson St. Camden, NJ 08101	do	Camden.
Columbian Chemicals Co	Box 37 Tulsa, OK 74102	do	Middlesex.
Peat:			
Glacial Soils Lab	346 Grand Ave. Englewood, NJ 07631	Bog	Sussex.
Kelsey Humus Co	Kelsey Park Great Meadows, NJ 07838	Bog	Warren.
Netcong Natural Products	R.D. 3, Box 573AA Flemington, NJ 08822	Bog	Sussex.
Stan's Soils	R.D. 2, Box 129 Sussex, NJ 07461	Bog	Do.
Perlite (expanded):			
The Schundler Co.[2]	Box 251 Metuchen, NJ 08840	Plant	Middlesex.
Sand and gravel:			
Construction (1984):			
Ralph Clayton & Sons	Box 928 Lakewood, NJ 08701	Pit	Ocean.
Dallenbach Sand Co. Inc	Box 333 Dayton, NJ 08810	Dredge	Middlesex.
Tri-County Asphalt Corp	Box 247, Wheatsworth Rd. Hamburg, NJ 07419	Pit	Sussex.
Tuckahoe Sand & Gravel	Box 248 Tuckahoe, NJ 08250	Dredge	Cape May.
Industrial:			
Pennsylvania Glass Sand Corp	Box 187 Berkeley Springs, WV 25411	Pit	Cumberland.
Unimin Corp., Dividing Creek Plant	258 Elm St. New Canaan, CT 06840	Pit	Do.
Whitehead Bros. Co	Box 259, River Rd. Leesburg, NJ 08327	Pits	Do.
Stone:			
Granite (crushed and broken):			
Riverdale Quarry Co	125 Hamburg Turnpike Riverdale, NJ 07457	Quarry	Morris.
Tri-County Asphalt Corp	Route 15 Hopatcong, NJ 07843	do	Sussex.
Traprock (basalt, crushed and broken):			
Little Ferry Asphalt Corp	650 Valley Rd. Clifton, NJ 07643	do	Passaic.
Millington Quarry Inc	Box 407 Millington, NJ 07946	do	Somerset.
Stavola Construction Materials Inc	Box 482 Red Bank, NJ 07701	do	Do.
Trap Rock Industries Inc	Box 419 Kingston, NJ 08528	Quarries	Hunterdon, Mercer, Somerset.
Sulfur (recovered):			
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.
Zinc:			
The New Jersey Zinc Co. Inc	Sterling Hill Mine Plant St. Ogdensburg, NJ 07439	Mine	Sussex.

[1]Also industrial sand.
[2]Also exfoliated vermiculite.

The Mineral Industry of New Mexico

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

By Jane P. Ohl[1] and Robert W. Eveleth[2]

The value of New Mexico's minerals increased to nearly $656.9 million in 1985 from $635.8 million in 1984; New Mexico ranked 11th in the Nation in nonfuel mineral output, down from 10th in 1984.

In 1985, 17 nonfuel minerals were produced in the State, 12 industrial minerals and 5 metals. Metals accounted for 63% of the total value; industrial minerals, 37%.

New Mexico ranked first nationwide in production of perlite and potash, and second in copper and pumice. The State also produced noteworthy values of cement, gold, molybdenum, sand and gravel, and stone.

Per capita value of nonfuel mineral production was $98, compared with the national average of $98.

Table 1.—Nonfuel mineral production in New Mexico[1]

Mineral	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
Clays thousand short tons	67	$143	60	$161
Gem stones	NA	200	NA	200
Gold (recoverable content of ores, etc.) troy ounces	W	W	45,045	14,309
Gypsum thousand short tons	318	1,622	350	1,570
Lead (recoverable content of ores, etc.) metric tons	--	--	W	W
Perlite thousand short tons	416	14,115	419	14,521
Potassium salts thousand metric tons	1,418	204,100	1,120	156,000
Pumice thousand short tons	132	1,269	152	1,114
Sand and gravel (construction) do.	8,363	22,389	e8,400	e22,800
Stone:				
Crushed do.	e4,700	e17,000	3,641	15,232
Dimension do.	e19	e149	20	277
Combined value of cement, copper, helium (Grade-A), mica (scrap), molybdenum, salt, silver, tungsten ore and concentrate (1984), and values indicated by symbol W	XX	r374,855	XX	430,705
Total	XX	r635,842	XX	656,889

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.—Nonfuel minerals produced in New Mexico in 1984, by county[1]

County	Minerals produced in order of value
Bernalillo	Cement, sand and gravel (construction), clays.
Catron	Sand and gravel (construction).
Chaves	Do.
Cibola	Perlite, sand and gravel (construction).
Colfax	Sand and gravel (construction).
Curry	Do.
De Baca	Do.
Dona Ana	Sand and gravel (construction), clays.
Eddy	Potassium salts, salt, sand and gravel (construction).
Grant	Copper, silver, gold, molybdenum, sand and gravel (construction).
Guadalupe	Sand and gravel (construction).
Hidalgo	Silver, gold, copper, clays, tungsten.
Lea	Sand and gravel (construction), salt.
Lincoln	Sand and gravel (construction).
Luna	Sand and gravel (construction), clays.
McKinley	Sand and gravel (construction), molybdenum.
Otero	Sand and gravel (construction).
Quay	Do.
Rio Arriba	Sand and gravel (construction), pumice.
Sandoval	Sand and gravel (construction), gypsum, copper, silver, pumice, gold.
San Juan	Sand and gravel (construction), clays.
San Miguel	Sand and gravel (construction).
Santa Fe	Gold, sand and gravel (construction), pumice, gypsum.
Sierra	Silver, copper, gold, sand and gravel (construction).
Socorro	Perlite, sand and gravel (construction).
Taos	Molybdenum, perlite, mica (scrap), sand and gravel (construction).
Torrance	Sand and gravel (construction).
Valencia	Do.
Undistributed[2]	Stone (crushed and dimension), helium (Grade-A), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of New Mexico business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	1,402	1,426	1,450
Total civilian labor force	do	609	629	646
Unemployment	percent	10.1	7.5	8.8
Employment (nonagricultural):				
Mining total[1]	thousands	21.0	21.6	20.6
Metal mining	do	4.0	3.9	3.2
Nonmetallic minerals except fuels[2]	do	W	W	2.1
Coal mining[2]	do	W	W	2.1
Oil and gas extraction	do	13.0	13.4	13.4
Manufacturing total	do	34.4	36.5	37.3
Primary metal industries[2]	do	1.3	1.4	1.2
Stone, clay, and glass products[2]	do	2.4	2.7	2.8
Chemicals and allied products[2]	do	.8	1.0	.8
Petroleum and coal products[2]	do	W	.9	1.0
Construction	do	33.7	36.6	37.0
Transportation and public utilities	do	29.5	29.9	29.8
Wholesale and retail trade	do	110.7	117.5	122.8
Finance, insurance, real estate	do	23.2	24.7	25.6
Services	do	99.7	106.3	113.0
Government and government enterprises	do	127.2	129.7	132.0
Total	do	[3]479.5	502.8	518.1
Personal income:				
Total	millions	$13,691	$14,839	$15,828
Per capita		$9,628	$10,262	$10,914
Hours and earnings:				
Total average weekly hours, production workers		39.7	39.9	39.9
Mining		42.4	41.9	42.3
Total average hourly earnings, production workers		$7.6	$8.0	$8.4
Mining		$11.2	$11.5	$11.9

See footnotes at end of table.

Table 3.—Indicators of New Mexico business activity —Continued

		1983[r]	1984	1985[p]
Earnings by industry:				
Farm income	millions	$153	$163	$215
Nonfarm	do	$9,922	$10,776	$11,549
Mining total	do	$659	$707	$710
Metal mining	do	$134	$131	$117
Nonmetallic minerals except fuels	do	$71	$75	$68
Coal mining	do	$86	$103	$123
Oil and gas extraction	do	$371	$398	$403
Manufacturing total	do	$703	$779	$853
Primary metal industries	do	$38	$43	$39
Stone, clay, and glass products	do	$48	$56	$60
Chemicals and allied products	do	$16	$22	$19
Petroleum and coal products	do	$42	$40	$47
Construction	do	$835	$929	$943
Transportation and public utilities	do	$867	$930	$975
Wholesale and retail trade	do	$1,546	$1,667	$1,786
Finance, insurance, real estate	do	$421	$464	$535
Services	do	$2,110	$2,352	$2,594
Government and government enterprises	do	$2,738	$2,903	$3,104
Construction activity:				
Number of private and public residential units authorized[4]		$10,742	$16,525	$11,790
Value of nonresidential construction[4]	millions	$390.1	$441.8	$450.5
Value of State road contract awards	do	$164.0	$220.1	$209.5
Shipments of portland and masonry cement to and within the State	thousand short tons	610	628	630
Nonfuel mineral production value:				
Total crude mineral value	millions	$517.2	$635.8	$656.9
Value per capita		$369	$446	$453

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]Data do not add to total shown because of independent rounding.
[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

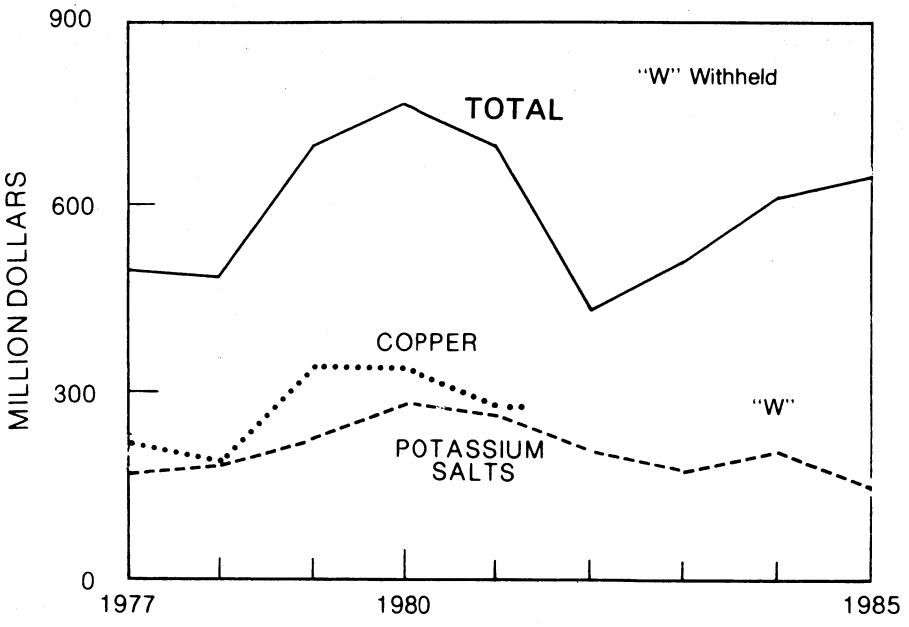

Figure 1.—Value of potassium salts and copper and total value of nonfuel mineral production in New Mexico.

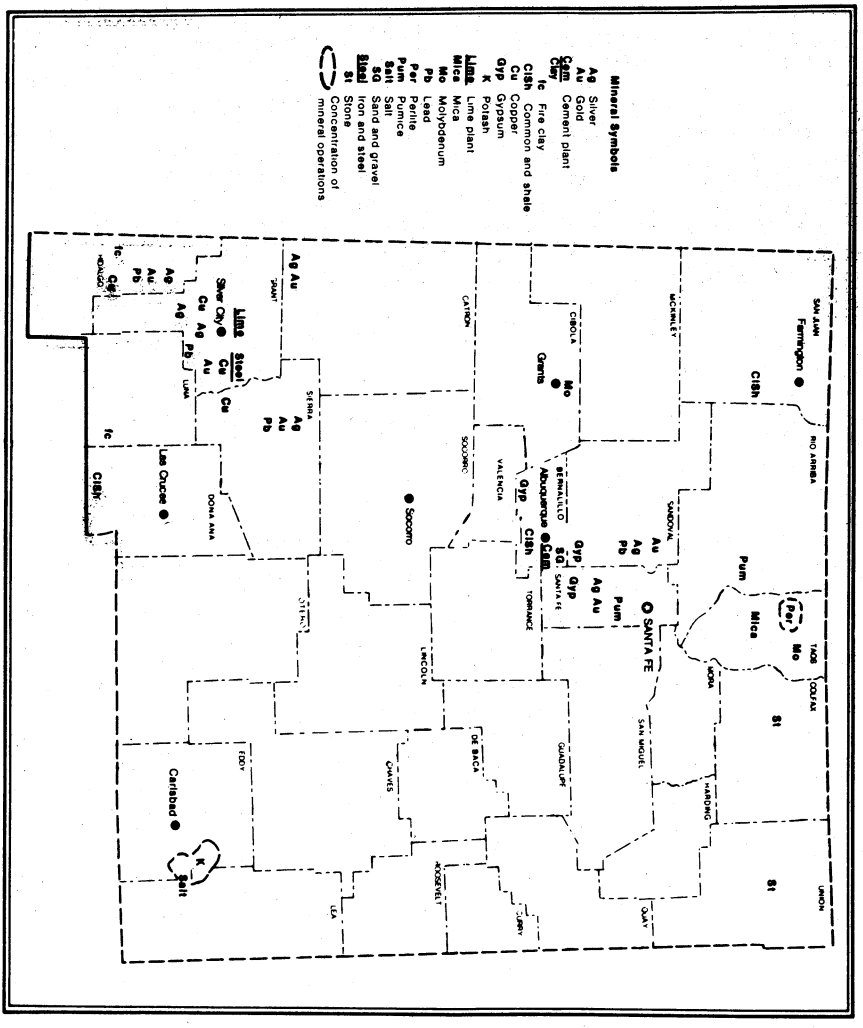

Figure 2.—Principal mineral producing localities in New Mexico.

Trends and Developments.—New Mexico's economy was negatively affected during the year by mine closures, work-stopping accidents, and heightened competition from foreign mining companies. Such developments, in turn, negatively affected mineral revenue collections, employment levels, public education budgets, and the tax revenues of local governments.

Beginning January 15, union representatives of the Nonferrous Coordinated Bargaining Committee and copper company officials met in Albuquerque to discuss possible solutions to the copper industry's economic problems. Several operators in New Mexico and Arizona wanted to eliminate cost-of-living coverage, reduce basic wages by as much as $3.50 per hour, and cut back on benefits, for an average giveback totaling about $6 per hour. No conclusions were reached by yearend.

The New Mexico Bureau of Mines and Mineral Resources and New Mexico Geology published an evaluation of the State's mineral resource potential and a summary of taxes on natural resource production in New Mexico.[3]

A rash of fraudulent gold mining investment schemes encouraged the New Mexico Bureau of Mines and Mineral Resources at Socorro to join other mining organizations in trying to control such activities.

Employment.—The annual average employment in metal mining declined from 3,900 in 1984 to 3,200 in 1985. The New Mexico Employment Security Department reported that metal mining employment decreased 900 positions from January through December 1985, to 2,900, a decrease of about 24%. Employment in bituminous coal, quarrying, and oil and gas businesses declined by 1,100 persons.[4]

Average hourly wages in the mining sector were $11.55 in November 1985, $0.26 above that of November 1984.[5]

Early in 1985, the U.S. Department of Labor granted $600,000 to New Mexico for retraining copper and steel workers displaced by plant and mine closings.

Environment.—The U.S. Department of Energy directed the McKinley County Commission to clean up 2.7 million yards of contaminated material in a 105-acre tailings pile at the Ambrosia Lake uranium-vanadium tailings pile. The medium-priority cleanup project was to be completed by the fall of 1987.

Kennecott's newly renovated Hurley smelter in Grant County came closer to meeting air standard requirements as 94.5% of SO_2 offgases was captured from its INCO flash furnace.

Exploration Activities.—In mid-December 1985, FMC Corp., Minerals Div., Reno, NV, obtained a 3-year mining lease on 359.5 acres of State trust land in Luna County, covering metallic and nonmetallic minerals.

Long Lac Exploration Inc., a wholly owned subsidiary of Lac Minerals Ltd. of Canada, drilled in Lukas Canyon, Santa Fe County, resulting in the discovery of 5.9 million short tons of low-grade ore at 0.03 troy ounce of gold per ton.

Other gold and silver exploration activities were undertaken by Dome Exploration (U.S.) Ltd. in the Sheep Mountain area, Luna County; by The Goldfield Corp. on several properties in the area north of Winston; by Newmont Mining Corp. in the Cooke's Peak area, Luna County; by Santa Fe Mining Inc. near Antelope Pass, Hidalgo County; and by Summit Minerals Co. at Steeple Rock District in Grant County. Individual prospectors were active at the Mountain Key Mine at Pinos Altos and in the Malone District south of Silver City.

Legislation and Government Programs.—About 930 of the estimated 3,500 owners of unpatented mining claims in New Mexico were affected by a U.S. Supreme Court decision declaring mining claims abandoned if statements of assessment or intent to hold were filed late.[6]

A special session of the State legislature, May 11-18, 1985, passed Senate bill 22 lowering the excise tax on copper processing from 0.75% to 0.25% for the next 3 years; "processing" included all activities through refining.

One of several bills introduced in the Congress during the year was H.R. 1562: Textile and Apparel Industry bill with Copper Free Market Restoration Act of 1985 attached. This bill proposed to limit copper production and stabilize foreign copper production. H.R. 1562 was passed by the Congress and vetoed by the President. A later bill, H.R. 2577, called for U.S. trade officials to undertake negotiations (similar to those that were addressed in H.R. 1562) with countries producing more than 200,000 metric tons of copper per year, to limit their production; however, the reported language of H.R. 2577 was nonbinding. H.R. 2577 was signed into law August 15, 1985 (Public Law 99-88).

Public Laws 99-61 and 99-185 (the Statue of Liberty-Ellis Island Commemorative Coin Act and the Gold Bullion Coin Act of 1985) were expected to increase local demand on

gold resources. The gold used in minting new coins was required to come from U.S. mines and, in the absence of adequate available supplies at world prices, from Treasury bullion reserves.

The Federal Highway Administration gave New Mexico $121.9 million to aid highway programs.[7]

The U.S. Bureau of Mines developed an alkaline leach method for recovering metal values from copper converter flue dust containing copper, lead, tin, and zinc.[8]

At Kennecott's request, U.S. Bureau of Mines scientists conducted flotation tests at its Hurley concentrator to solve problems in handling complex ores from the Santa Rita pit.

The U.S. Bureau of Mines also published a report on its mineral investigation of part of the Gila Lower Box Wilderness Study Area.[9]

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Copper, gold, lead, molybdenum, and silver were produced from eight mines during 1985. These and several less common metals were also smelted and/or refined in New Mexico. No iron ore or tungsten ore were reportedly mined in 1985.

Metal mining companies in the State were as follows:

1. Chino Mines Co. (owned two-thirds by Kennecott and one-third by Mitsubishi Metal Corp.) operated the Santa Rita copper pit and Hurley smelter, Grant County.
2. Gold Fields Mining Corp. (a subsidiary of Consolidated Gold Fields PLC) worked the Ortiz gold mine, Santa Fe County.
3. Molycorp Inc. (a division of Unocal Corp.) operated the Questa underground molybdenum mine and mill, Taos County.
4. Phelps Dodge Corp. operated the Tyrone copper mine, Grant County, and Playas smelter, Hidalgo County.
5. Burro Chief Copper Co. (a subsidiary of Phelps Dodge) operated the solvent-extraction electrowinning (SX-EW) copper plant at Tyrone, Grant County.
6. Royal Minerals (Duncan, AZ) mined copper, gold, lead, and silver from the Center Mine, Grant County.
7. St. Cloud Mining Co. (a subsidiary of The Goldfield Corp. of Melbourne, FL) extracted copper, gold, lead, and silver from the St. Cloud Mine, Sierra County.
8. The privately owned Wild Irishman Mine was a producer of copper, gold, lead, and silver in Hidalgo County.

Copper.—New Mexico ranked second of 12 copper producing States. Output and total value figures increased 27% over those for 1984. Greatly expanded mining at Grant County's two porphyry copper mines and shutdowns at major properties in other States because of low copper prices made "Grant County the largest copper producing region in North America" in 1985. Grant County copper was valued at $381 million, compared with number two, Greenlee County, AZ, whose copper output was valued at $347 million.[10] Average price per pound was about $0.67 during the year. Phelps Dodge was the State's leading copper producer, followed by Chino Mines; other smaller producers were St. Cloud Mining, Royal Minerals, and the Wild Irishman Mine.

Phelps Dodge's Tyrone Mine produced 16,022,000 metric tons of ore grading 0.89% copper during 1985. Copper production totaled 132,400 tons: 108,100 tons smelted from concentrate, 5,700 tons from precipitates, and 18,600 tons from the SX-EW plant, according to the firm's 1985 10K Annual Report.

From 1982 through 1984, Phelps Dodge lost a total of $405 million. In 1985, however, owing mainly to the SX-EW plant at the Tyrone Mine and improvements made to the Playas smelter, the firm earned $29.5 million, despite the lower 1985 copper prices.

Phelps Dodge doubled the capacity of the SX-EW plant operated by its subsidiary, Burro Chief Copper, from about 22,000 tons to 41,000 tons. Dumps being leached at the mine remained very rich and would sustain this additional production. The expansion cost about $10 million and lowered SX-EW unit costs to less than $0.30 per pound.

Additionally, cost savings were realized at the Tyrone Mine by reducing the number of trucks from 54 85- and 100-ton trucks to 26 computer-dispatched 170-ton trucks.

Copper sulfide reserves at Tyrone, estimated to be 149 million tons grading 0.80% copper, were projected to be depleted about 1995. Proposed additional exploration drilling could extend that date. Operating life of the initial SX-EW plant was projected at 20 to 30 years, and, although the new expansion would reduce that projection by

using up reserves at a faster rate, copper output from leaching at Tyrone was expected to continue through the end of the century.

At Phelps Dodge's smelter, south of Playas in Hidalgo County, a $10 million project to relocate a relatively new oxygen plant from the closed Morenci smelter was expected to increase smelter capacity by 21%, improve smelter efficiency, and enable the smelter to meet environmental regulations. The flash furnace at Playas, an Outokumpu Oy product, had been extensively rebuilt in 1984.

The Playas smelter produced a record high 153,300 tons of copper in 1985 at a 28% reduction in cost per ton of concentrate smelted. The plant also produced 2,200 tons per day of sulfuric acid at a reported cost of about $54 per ton (losing about $20 on each ton of acid produced). More than one-half of the sulfuric acid was shipped to markets in Texas (Houston), Louisiana, and Florida.

The Chino Mines operations experienced several shutdowns during the year. Smelting at Hurley was shut down in February because of an accident at the acid plant, which caused about $2.5 million in damages and a production loss of about $1.5 million. Mining and milling continued through the month-long smelter shutdown. Chino Mines also closed the smelter in September for about a month to rebrick the furnace following the temporary shutdown of the mill owing to an accident at the mine. On August 13, a radial arm stacker attached to and supporting the coarse ore conveyor belt collapsed, cutting off feed to the Santa Rita concentrator for about 6 weeks.

The modernized smelter at Chino was started up in October 1984, marking the completion of a $350 million mine, concentrator, and smelter modernization and expansion project that started in 1981. The new flash furnace raised annual smelter capacity to 120,000 metric tons of copper metal per year and substantially reduced operating cost. In July 1985, Chino Mines approved installation of a $4.5 million anode furnace and expected to begin production by January 1986. Chino Mines had ceased fire-refining in July 1984. Kennecott again reported a loss for the year, and stated that if Chino Mines could not be made profitable, it would be closed.

Boliden Minerals Inc., a Swedish firm, continued evaluation and development work at its Pinos Altos prospect north of Silver City. Underground development included a 200-foot lengthening of the decline and diamond drill work designed to locate extensions, if any, of previously discovered ore bodies. A one-time sale of 7,250 tons of ore generated by the development activity was sold and shipped to Chino Mines for smelting.

The firm filed plans with the U.S. Forest Service to place a tailings impoundment dam in a narrow canyon about one-quarter of a mile southeast of the millsite. The dam could eventually impound 1.5 million tons of tailings. One-half of the mill tailings, however, were to be used for mine backfilling. Boliden's mill was being designed to treat 210,000 tons of tailings annually.

Ok Tedi Mining Ltd., a joint venture between the Papua New Guinean Government, Broken Hill Proprietary Ltd., Amoco Corp., and a West German consortium, exercised its option to purchase Quintana Minerals Corp.'s concentrator at Copper Flat for $8.5 million. The Copper Flat concentrator was to be disassembled and shipped to Papua New Guinea. The Copper Flat plant operated from mid-March until June 30, 1982, when operations were suspended.

Gold.—New Mexico ranked eighth in the Nation in gold production.

The Ortiz Mine, operated by Gold Fields Mining, was the State's leading producer of gold; its output was 36,361 troy ounces. Following Ortiz, in decreasing order of gold output, were the Tyrone Mine (copper), the St. Cloud Mine (gold and silver), the Center Mine (gold and silver), and the Wild Irishman Mine (silver).

Gold Fields Mining announced in July that it would begin the first part of a four-stage closedown of the Ortiz Mine, to be completed about June 1986, with environmental monitoring for possible ground water contamination continuing several years after that. Later, the closure date was pushed forward to December 1986 because the mine was being operated at reduced levels and reserves were somewhat greater than originally determined. Despite a $2.2 million loss reported by Consolidated Gold Fields in its 1985 annual report, its Ortiz Mine had returned nearly 2.5 times capital cost during its 6-year life.

In the Hillsboro gold district, Sierra County, Sierra Corp. started a 470-foot decline in 1985 to further explore the Rattlesnake vein and to develop the ore body for production. The ore grade averaged 0.2 to 2.3 ounces of gold per short ton, 3 to 4 ounces of silver, and 3% to 4% copper. In a reportedly unique mining method, the 8-

foot-wide vein was undercut and the material allowed to cave freely. The ore was shipped to ASARCO Incorporated at El Paso, TX, for processing. The product was sold as siliceous copper flux, and other values were not recovered.[11]

The New Mexico Bureau of Mines and Mineral Resources prepared a report and map on gold and silver in New Mexico to be published in early 1986.[12]

Iron and Steel and Manganese.—H. N. LaRue & Sons shipped a 50% magnetite iron ore from the Smoky Mine at Capitan, Lincoln County, to Ideal Basic Industries Inc.'s Tijeras cement plant in Bernalillo County.

In November, a heavy-medium extraction metallurgical plant at Boston Hill, southwest of Silver City in Grant County, which had been intended to process manganese and iron, was dismantled and returned to Black Pine Mining Co. in Montana. Roth Properties of San Francisco, CA, moved the plant from Montana to Boston Hill in 1979 but never used it because of the collapse of the steel market.

Sharon Steel Corp. facilities at Fierro, Grant County, northeast of Silver City, remained closed. The company continued assessment work on its extensive mineral property holdings in the Hanover-Fierro, Central, Pinos Altos, and other districts in the southwestern part of the State. Byproduct iron ore was shipped from its Continental Mine stockpile.

Zia Steel Corp. continued to plan construction of a specialty steel minimill about 10 miles north of Carrizozo, at Coyote. The site was next to the Southern Pacific Railroad in Lincoln County.

Lead.—A small quantity of lead was reported produced in 1985 as a byproduct at some of the smaller copper mining operations in New Mexico. Lead production had been reported in 1983, but not in 1984.

A new $4.5 million lead leaching facility was opened at Molycorp's Questa mill in November 1985. The plant removed lead, an undesirable impurity, from the processed molybdenum concentrate. This step formerly was done at Molycorp's roasting plant in Washington, PA, where the concentrate was sent from Questa.

Molybdenum.—New Mexico again ranked fourth among the Nation's seven molybdenum producing States. Despite expectations to the contrary, the market for molybdenum did not improve in 1985. Posted dealer prices for molybdenum oxide began the year at about $4.50 per pound; spot prices were below $3 per pound. Production again outstripped demand.

Molybdenum was removed from processed molybdenum concentrate at Molycorp's Questa mill and recovered as a byproduct of copper smelting at Chino Mines' Hurley smelter.

According to Unocal's 1985 annual report, 13,866,000 pounds (6,289.6 metric tons) of molybdenum in concentrates was produced at the underground Questa Mine in 1985, an increase of about 33% over that of 1984. The average sales price of molybdenum disulfide MoS_2, however, fell below the $5 price Unocal stated was necessary to keep the Questa operation going. Subsequently, on October 14, Molycorp cut back production 25% from the 11,800 tons of ore per day it had been mining and laid off 150 mine, mill, and salaried workers, reducing the work force to 650 from peak employment of 875 in 1983. The layoff cut $6 million off the Molycorp annual payroll of $28 million and was a significant loss to Taos County revenues.

Molybdenum disulfide reserves at the Questa operation were about 115 million tons, averaging 0.288% MoS_2 content. Reserves at the inactive pit averaged 0.188% MoS_2.

In an attempt to reduce costs by $200,000 per month, Molycorp negotiated with its electrical suppliers for a revision of its electrical contract to reduce kilowatt hours per month to one-half of that called for in an earlier contract. Contract negotiations, begun in December, were incomplete at yearend, and it appeared that if union members refused to accept pay and benefit reductions, the mill and renovated 63-year-old-mine would be forced to shut down in early 1986.

Despite an impending shutdown, Molycorp continued with plans for a new tailings disposal site, even though the present one might last 10 more years at reduced levels of production.

Chino Mines began producing byproduct MoS_2 in November 1985. Molybenum content of the Santa Rita ore body was low—0.017%; nevertheless, by utilizing new recovery techniques, the new concentrator produced more than 1 million pounds annually of high-grade concentrate. New, more efficient, column-type flotation cells were installed. Nitrogen gas (recovered from the oxygen plant), instead of oxygen, was used successfully in the flotation circuit to retard oxidation and extend reagent life, thereby providing additional cost reductions.

Silver.—Silver was produced at five mines in Grant, Hidalgo, Santa Fe, and Sierra Counties in 1985. State output fell 4% despite a fall in the market price of silver from $8.14 per troy ounce in 1984 to $6.14 in 1985. This fairly constant output of silver in New Mexico was probably due to its being a byproduct of other mining and relatively insensitive to price fluctuations.

The Tyrone Mine was New Mexico's leading silver producer (10th most productive silver mine in the Nation), followed by the St. Cloud, Center, Ortiz, and Wild Irishman Mines.

Goldfield's St. Cloud Mine ore grade was about 6 ounces of silver and 0.1 ounce of gold per short ton. Production was cut back to 5,000 tons per month in August 1984 and further reduced to 2,000 tons per month in March 1985. In September, Goldfield granted an option to Sunshine Mining Co. of Dallas, TX, to buy the St. Cloud-U.S. Treasury Mine and mill in Sierra County. Goldfield planned to treat the property as a discontinued operation after December 31, 1985. Sunshine's option on the St. Cloud was good until June 1, 1986.[13]

Goldfield also owned the San Pedro gold and copper mine in Santa Fe County. The firm granted a 1-year option on this property to Silver Bar Mining Co., beginning May 15, 1985. The San Pedro property consisted of 20 patented and 16 unpatented mining claims, totaling nearly 500 acres, and a 250-ton-per-day flotation mill. The mill was used as recently as 1983 to process St. Cloud ore.

Uranium-Vanadium.—New Mexico's uranium-vanadium employment, concentrated in the Grants-Milan and Gallup areas (Cibola and McKinley Counties), plummeted from more than 8,000 workers at 45 mines in 1979 to 250 to 300 workers at 2 mines in late 1985 because of the continuing low price for yellow cake.

In January, Quivira Mining Co., a subsidiary of Kerr-McGee Corp., began placing all of its mining and milling operations in the Grants region on indefinite standby. During the year, Quivira laid off 204 employees at Ambrosia Lake and another 31 at the Church Rock Mine near Gallup.

In March, Western Nuclear Inc. suspended operations at its recently reopened Ruby Mines near Thoreau, McKinley County, because the Ruby ores could no longer be processed at Quivira's idled mill. Western Nuclear, until this time a wholly owned subsidiary of Phelps Dodge, was sold in February-March 1985 to an unnamed buyer.

Homestake Mining Co. shut down its Section 23 Mine at Ambrosia Lake in Cibola County April 4, laying off 100 employees. Homestake continued to leach abandoned stopes, and milling operations were to continue, although curtailed, until yearend. Before 1982, the operation had been a significant source of byproduct vanadium.

The Mount Taylor Project of Chevron Resources Co. in McKinley County was the only uranium mine operating in the State in the fall of 1985. The Mount Taylor property was acquired by Chevron Resources from Gulf Mineral Resources Co. in 1984. Both companies had spent several million dollars on power for the bank of pumps that kept the mine from flooding. Chevron Resources hoped to increase production at the Mount Taylor from 50 short tons to 500 tons per day, and employment to 125 persons if the price of uranium were to rise above the $15 per pound that prevailed in late 1985. Ore would be shipped to Chevron Resources' Panna Maria mine-mill complex at Hobson, southeast of San Antonio, TX.

No significant amount of byproduct vanadium has been recovered in New Mexico since 1981.

INDUSTRIAL MINERALS

During 1985, the construction industry in New Mexico bid more than $236 million on more than 50 major construction jobs requiring industrial minerals. These construction activities include airport runways, dams, highways, hotels, laboratories, libraries, schools, sewer systems, shopping centers, and wastewater treatment plants.[14]

Ammonia (Anhydrous).—The Southwest Div. of N-ReN Corp.'s (Cincinnati, OH) anhydrous plant in Carlsbad was shut down in early December and sold to International Nitrogen and Chemical Corp. of Phoenix, AZ. The plant, to be reopened in the near future, had employed approximately 65 workers before the shutdown.[15]

Barite.—Economically promising barite occurrences in north-central New Mexico were described in the literature.[16]

Cement.—Portland and masonry cement values declined from figures for 1984. Portland cement output also declined, but masonry cement output increased insignificantly. The average price of masonry cement fell in 1985 from that in 1984. The average price of portland cement also declined.

Ideal Cement Co.'s Tijeras plant in Bernalillo County, the State's only cement

plant, produced finished portland cement and masonry cement. Two dry-process kilns consumed limestone quarried nearby, iron ore, gypsum, and other materials. Natural gas was the predominant fuel used, but some bituminous coal also was used.

During the third quarter of 1985, the Tijeras plant experienced a brief strike by members of the Cement, Lime, Gypsum and Allied Workers but continued to operate using salaried personnel. On September 20, 56 of the striking hourly workers were permanently replaced. The leased-back plant (owned by General Electric Credit Corp.) was 1 of 10 Ideal Basic cement plants nationwide, only 6 of which, including Tijeras, operated profitably in 1985, according to the company's 1985 annual report.

In June, it was announced that sulfurcrete, developed by the U.S. Bureau of Mines, was to be used in the new Phelps Dodge SX-EW plant near Silver City. About 200 cubic yards of sulfur concrete was to be poured, primarily for walls and floors.

Carder Concrete Products Co., a subsidiary of CRH American Inc., Los Angeles, CA, which, in turn, was owned by Cement Roadstone Holdings PLC of Dublin, Ireland, planned to build a $4 million concrete products plant about 10 miles west of Bernalillo in Sandoval County. The 20,000-square-foot plant, scheduled to be completed in March 1986, was to initially employ about 40 people, increasing to about 70 workers by 1989.[17] Products were to be sewer pipes, box culverts, and toxic waste containers.

Clays.—Common clay and shale was produced by El Paso Brick Co. Inc., New Mexico Brick Co. Inc., and Garcia & Son from three mines in Dona Ana, Bernalillo, and San Juan Counties. Fire clay was produced by Phelps Dodge and Mathis & Mathis Mining & Exploration Co. from two mines in Hidalgo and Luna Counties.

Output of clays used for brickmaking declined nearly 14% from that of 1984 as brick sales sagged, owing in part to the decline in residential construction. New Mexico clays also were used as roofing granules and in quarry tiles.

In December, the Belen City Council approved the issuance of $3.8 million in refunded industrial development revenue bonds, allowing United Dessicants Inc. to continue its clay mineral processing and packing facility in Valencia County. United Dessicants, a wholly owned subsidiary of United Catalysts Inc., used clay mined and shipped from Sanders, AZ. The clay was dried by solar-powered processes and gas-powered driers to reduce its moisture content from 35% to 16%. The dried clay was used as packing for shipping sensitive items, such as microelectronic instruments and photographic equipment.

Gem Stones.—New Mexico mines and collectors produced an estimated $200,000 worth of gem materials in 1985.

Gypsum.—Output of crude gypsum from New Mexico mines increased 10% above that of 1984; however, its value continued to decline. In 1985, the price of crude gypsum was nearly $4.49 per short ton, down from $5.10 in 1984 and $6.01 in 1983.

Gypsum was mined in Sandoval County by Centex American Gypsum Co. (at the former White Mesa Gypsum Co. mine) and by Ernest Teeter, at the San Felipe Mine, in Santa Fe County.

Western Gypsum Co. at Rosario and Centex American Gypsum in Albuquerque calcined gypsum. The Centex American plant was formerly owned by Allied American Gypsum Co.

Helium (Grade-A).—Production of Grade-A helium fell nearly 10% from that of 1984.

In 1985, the privately owned Navajo Refined Helium Co. extraction plant produced Grade-A helium from natural gas at Shiprock, San Juan County, northwestern New Mexico. During 1984, a helium liquefier had been installed and put into use at the facility.

The discovery of additional reserves of helium in the Pecos Slope area of east-central New Mexico added 736 million cubic feet of helium to the Nation's measured and indicated resources, as of January 1, 1985.

The major domestic end uses of helium were cryogenics, welding, and pressurizing and purging. Liquid helium demand from the Federal sector continued to grow as national defense, space, and energy research and development projects proliferated.

Mica.—Output of scrap and flake (crude) mica from the State remained unchanged from that of 1984, but total value increased about 6%.

Mineral Industrial Commodities of America Inc. (M.I.C.A.), Santa Fe, was the Nation's third ranking producer of scrap (flake) mica and fourth ranking producer of ground mica in 1985.

Perlite.—Sold and used quantities of processed perlite ore increased slightly over that of 1984. Processed perlite ore sold at an average of $34.66 per short ton. Five mines

in the State accounted for about 83% of the Nation's total production. Producers were Grefco Inc. in Socorro and Taos Counties, Manville Products Corp. and Silbrico Corp. in Taos County, and United States Gypsum Co. (a subsidiary of USG Corp.) in Cibola County.

Some perlite from New Mexico was shipped to The Schundler Co., an expanded perlite manufacturer at Metuchen, NJ; however, that company was investigating the prospect of importing its perlite supplies from Greece. Greek perlite, shipped by ocean transport, was expected to be cheaper than New Mexico perlite sent by railroad.

Potash.—New Mexico potash producers accounted for 85% of the Nation's total output. The State's producers had a bad year, one filled with layoffs, production cutbacks, mine closures, and property sales. Potash was used for fertilizer, and fertilizer sales were down 21% from that of 1984, partly because of the poor condition of the agricultural community, and because potash imports from Canada and other nations were cheaper than domestic products. Crude potash mine production was 11.3 million metric tons, with an average K_2O content of 13.3%, valued at $156 million, down from 13.9 million tons and $204 million in 1984.

At the beginning of 1985, five companies produced potash from underground, bedded sylvinite and langbeinite deposits east of Carlsbad. These New Mexico potash producers were AMAX Chemical Corp., a subsidiary of AMAX Inc.; International Minerals & Chemical Corp. (IMC); Kerr-McGee Chemical Corp., a subsidiary of Kerr-McGee Corp.; Potash Co. of America (PCA), a subsidiary of Ideal Basic; and Potash Producers Inc. (formerly Duval Corp.), a subsidiary of Pennzoil Co.

AMAX Chemical, Ideal Basic, Kerr-McGee Chemical, and Pennzoil sought buyers for their potash properties during the year.

AMAX Chemical laid off 90 mine and mill employees after a June 1985 maintenance shutdown. On October 7, AMAX Chemical suspended production activities for an indefinite period, laying off about 225 more employees. The suspension of production was a result of deteriorating market conditions created by diminishing demand and depressed prices. The original capacity of the mine and mill was 850,000 short tons per year, but the facility had been running at one-half capacity for several months. According to AMAX Inc.'s 1985 10K Annual Report, the firm declared its yearend intention to conduct an orderly phaseout of its potash operation—in 1984, the company had written down $195 million worth of agricultural chemical assets—and intended to put the AMAX Chemical property up for sale.

The sale of Ideal Basic's PCA to Rio Algom Ltd. of Canada was pending in the fall of 1985. On December 31, 1985, however, the PCA mine and plant were sold to Lundberg Industries Inc., of Dallas, TX. The PCA mine had been shut down on December 1, and the new buyer intended to return the property to operating status in early 1986. The 52-year-old PCA mine had about 6 more years of reserves remaining at current rates of mining. Lundberg also was considering combining the PCA mine with the AMAX Chemical potash mine and plant, immediately to the north, which was to be put up for sale.

Kerr-McGee Chemical's potash mining operation at Hobbs was purchased April 9, 1985, by the newly formed New Mexico Potash Corp., a wholly owned subsidiary of Vertac Chemical Corp., of Memphis, TN. Vertac had been a longtime Kerr-McGee Chemical customer. In December 1985, Fermentab AB (Sweden) reached an agreement in principle with Vertac to purchase that part of Vertac that included its New Mexico Potash subsidiary. Operating at about one-half the annual rated capacity, with about 55% of the former work force, Vertac sold potash primarily to its potassium nitrate manufacturing plant in Vicksburg, TN, and to the oil drilling and chemical industries; only excess material was sold to the agricultural industry.

Pennzoil, Duval's parent company, reorganized its potash plant near Carlsbad in May 1985 as Potash Producers Inc. to facilitate its sale. In November 1985, Pennzoil sold the Potash Producers property to a New York venture banking firm and a Canadian minerals company: Warburg, Pincus Capital Partners of New York (75% owner) and Rayrock Resources Ltd. of Toronto (25%). The new partnership was called Western Ag-Minerals Co., and operations continued at the former Duval (Nash Draw) potash mine without interruption. Western Ag-Minerals employed 175 persons and was 1 of only 2 worldwide sources of refined langbeinite. Reserves at the mine in 1984 were 30.8 million short tons (langbeinite), grading 8.7% K_2O equivalent, according to Pennzoil's 1984 10K Annual Report.

IMC reported that it mined and refined

potash from 38,600 acres of reserves that it controlled in Eddy County under long-term leases. The reserves contained an estimated 187 million short tons of recoverable ore, averaging 10% combined K_2O content, in four beds, ranging from 5.5 to 8.5 feet in thickness. IMC unit production costs at Carlsbad increased 8% from 1984 to 1985. The firm's production costs at its Canadian properties, by comparison, increased 1%.[18]

For the fiscal year ending June 30, 1985, IMC mined 812,000 short tons of potash compared with 836,000 tons in 1984.

At average refinery recovery rates, IMC estimated its reserves to be sufficient to yield 14.6 million short tons of concentrate from sylvinite ore having an average grade of 60.0% K_2O. The yield from langbeinite reserves was estimated to be 33.0 million tons of langbeinite concentrate having an average grade of 22.2% K_2O.

Still down at yearend were the Mississippi Chemical Corp., of Yazoo City, MS, mine, closed in January 1983, and the National Potash Co. mine, closed in February 1982. Mississippi Chemical purchased National Potash in April from National Potash's parent, Freeport-McMoRan Inc.; the consolidation of reserves was expected to improve Mississippi Chemical's reentry to active mining when potash prices rise. The firm conducted core drilling tests to determine the extent and quality of its ore body and if langbeinite was present.[19]

Table 4.—Production and sales of potash in New Mexico

(Thousand metric tons and thousand dollars)

Period	Crude salts[1] (mine production)		Marketable potassium salts				
			Production		Sold or used		
	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Value[2]
1984:							
January-June	7,209	973	1,434	733	1,575	801	118,000
July-December	r6,903	r919	1,302	655	1,225	618	86,100
Total[3]	r14,112	r1,892	2,735	1,388	2,799	1,418	204,100
1985:							
January-June	6,160	827	1,221	623	1,322	666	93,900
July-December	5,152	683	1,014	479	927	454	62,100
Total	11,312	1,519	2,235	1,102	2,249	1,120	156,000

rRevised.
[1]Sylvinite and langbeinite.
[2]F.o.b. mine.
[3]Data may not add to totals shown because of independent rounding.

Pumice and Pumicite.—Among the Nation's top producers of pumice were New Mexico's four producers: American Pumice Co. and Copar Pumice Co. Inc., both in Santa Fe County; General Pumice Corp., Rio Arriba County; and Utility Block Co., Sandoval County.

The quantity of pumice produced rose 15%, but value fell more than 12% from 1984 figures. Processed New Mexico pumice was used in building and decorative blocks (77.7% of output), abrasive cleaning compounds and hand soap (11.5%), concrete aggregate (8.3%), and other uses (2.5%).

Salt.—Four companies produced evaporated salt in Eddy and Lea Counties. In decreasing order of output, the companies were United Salt Corp., Pioneer Water Co. Inc., New Mexico Salt & Mineral Corp., and Williams Brine Service. Total value and quantity produced statewide increased 12.7% and 3.7%, respectively, over those of 1984. Quantity used and sold, however, decreased 34.9% from that of 1984. Solar salt was sold for an average of $23.40 per short ton, $9.83 more than in 1984.

Sand and Gravel (Construction).—Construction sand and gravel production is surveyed by the U.S. Bureau Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel estimated output and value for 1985 remained substantially the same as those reported for 1984.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on

annual company estimates made before yearend.

Of the 44 quarries reporting output in 1985, 4 produced dimension limestone and marble and 40 produced crushed limestone, granite, quartzite, traprock, and volcanic cinder. Operators quarried crushed stone in 19 of the State's 33 counties, and dimension stone in 3—Dona Ana, Socorro, and Valencia.

Rock Products Inc. of Susanville, CA (known locally as Bee Bee Contractors), quarried granite in Torrance County and contributed significantly to New Mexico's total crushed stone output in 1985. Rock Products was followed, in decreasing order of output, by Ideal Basic, which used its limestone to manufacture cement at its Tijeras plant, and 27 other private firms, two county-government producers, and the U.S. Forest Service.

Crushed.—The quantity of crushed stone produced in 1985 declined more than 22% from that estimated for 1984. Average value, however, rose about $0.57 per short ton.

Value of crushed limestone ranged from $1.75 per ton for that used for road surface treatment to $7.98 for that used as flux stone. Other uses included bituminous aggregate, cement manufacture, dense-graded road base stone, fill, and riprap and jetty stone.

Traprock from five quarries was used for bituminous aggregate, dense-graded road base, fill, surface treatment, and unpaved road surface. Volcanic cinder from eight quarries ranged in price from $1.25 for cinder used in concrete aggregate to $17.00 for cinder used in terrazzo and exposed aggregate.

More than 94% of crushed stone was transported by truck, nearly 3% by railroad, and the remainder by unspecified methods.

Table 5.—New Mexico: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	242	1,442
Coarse aggregate, graded:		
Concrete aggregate, coarse	380	943
Bituminous aggregate, coarse	196	708
Fine aggregate (-3/8 inch):		
Stone sand, concrete	4	W
Stone sand, bituminous mix or seal	83	424
Combined coarse and fine aggregates:		
Graded road base or subbase	843	3,198
Unpaved road surfacing	32	W
Crusher run or fill or waste	78	382
Other construction[2]	940	5,364
Chemical and metallurgical: Flux stone	12	W
Special:		
Other miscellaneous[3]	632	2,281
Other unspecified[4]	200	489
Total[5]	3,641	15,232

W Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."
[1]Includes granite, limestone, quartzite, traprock, and volcanic cinder and scoria.
[2]Includes stone used in bituminous surface treatment aggregate, railroad ballast, terrazzo and exposed aggregate, and stone used for other construction and maintenance purposes.
[3]Includes stone used in cement manufacture, other fillers or extenders, lightweight aggregate, roofing granules, and data indicated by symbol W.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Dimension.—Dimension limestone was produced by Guillen Construction in Dona Ana County. Dimension marble was produced by Rocky Mountain Stone Co. in Socorro and Valencia Counties and by Apache Springs Co. in Dona Ana County.

Sulfur (Recovered).—Elemental sulfur was recovered from natural gas operations in Eddy, Lea, Roosevelt, and San Juan Counties.

Lea County output accounted for 45% of the State's recovered sulfur; production amounted to 24,722 metric tons, less than in 1984. Producing companies were El Paso Natural Gas, at Jal and Eunice; Northern Natural Gas Co., at Hobbs; Chevron USA Inc., at Monument; and Phillips Petroleum Co., at Buckeye.

Other producers were Marathon Oil Co., Standard Oil Co. of Indiana (Amoco Production Co.), and Phillips, in Eddy County; Cities Service Oil Co., in Roosevelt County; and El Paso Natural Gas, in San Juan County.

Total production in 1985 was 54,608 tons, about 13% less than that of 1984, and was valued at $4,281,376, compared with $4,245,392 in 1984.

[1]State Mineral Officer, Bureau of Mines, Denver, CO.

[2]Mining engineer, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM.

[3]McLemore, V. T. Evaluation of Mineral-Resource Potential in New Mexico. N. Mex. Geol., v. 7, No. 3, Aug. 1985, pp. 50-53.

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[4]New Mexico Employment Security Department. New Mexico Labor Market Review. V. 15, No. 1, Feb. 28, 1986, p. 2.

[5]———. New Mexico Labor Market Review. V. 14, No. 11, Dec. 31, 1985, p. 5.

[6]U.S. Bureau of Land Management, Office of Public Affairs. U.S. Supreme Court Decision Affects New Mexico Miners. Adviser, May 1985, p. 5 (unnumbered).

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New Mexico Business Journal. V. 6, No. 11, Dec. 1985, p. 1.

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[14]New Mexico Business Journal. New Mexico's 50 Largest Bid Construction Jobs in 1985. V. 10, No. 3, p. 21.

[15]New Mexico Labor Market Review. V. 15, No. 3, Apr. 30, 1986, p. 7.

[16]McLemore, V. T., and J. M. Barker. Barite in North-Central New Mexico. N. Mex. Geol., v. 7, No. 2, May 1985, pp. 21-25.

[17]New Mexico Labor Market Review. V. 14, No. 8, Sept. 30, 1985, p. 6.

[18]International Minerals & Chemical Corp. 1985 10K Annual Report.

[19]New Mexico Mining Association. Mississippi Chemical Tests Langbeinite Ores. N. Mex. Miner, v. 48, No. 1, Jan. 1986, p. 1.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ideal Basic Industries Inc., Ideal Cement Co. (Tijeras plant).[1]	Box 8789 Denver, CO 80201	Dry process, 2 rotary-kiln plants.	Bernalillo.
Clays:			
El Paso Brick Co. Inc	Box 12336 El Paso, TX 79912	Open pit mine	Dona Ana.
New Mexico Brick Co. Inc. (doing business as Kinney Brick Co.).	Box 1804 100 Prosperity Ave., SE. Albuquerque, NM 87102	do	Bernalillo.
Copper:			
Burro Chief Copper Co., a subsidiary of Phelps Dodge Corp.	Drawer B Tyrone, NM 88065	Solvent-extraction electrowinning plant.	Grant.
Chino Mines Co., a Kennecott-Mitsubishi Metal Corp. partnership.[2]	Hurley, NM 88043	Open pit mine, flotation mill, precipitation plant, smelter.	Do.
The Goldfield Corp.[3] (St. Cloud Mining Co.).	65 East Nasa Blvd. Suite 101 Melbourne, FL 32901	Underground mine and flotation mill.	Sierra.
Phelps Dodge Corp.:			
Hidalgo Smelter[4]	Box 67 Playas, NM 88009	Smelter	Hidalgo.
Tyrone Branch[5]	Drawer B Tyrone, NM 88065	Open pit mine and mill	Grant.
Gold:			
Gold Fields Mining Corp	Box 97 Cerrillos, NM 87010	Pit and heap leaching operation.	Santa Fe.
Gypsum:			
Centex American Gypsum Co	10147 North 2d St. Albuquerque, NM 87114	Pits and plants	Bernallilo and Sandoval.
Western Gypsum Co., a subsidiary of Drywall Supply Inc.	Box 2636 Sante Fe, NM 87501	Open pit and wallboard plant.	Sante Fe.
Mica:			
Mineral Industrial Commodities of America Inc.	Box 2403 Santa Fe, NM 87501	Open pit	Taos.
Molybdenum:			
Molycorp Inc., a division of Unocal Corp. (Questa Div.).	Box 760 Los Angeles, CA 90051	Underground mine and flotation mill.	Do.
Perlite:			
Grefco Inc., Minerals Div., a subsidiary of General Refractories Co.	3435 West Lomita Blvd. Torrance, CA 90509	Open pit mines; crushing, screening, air separation.	Socorro and Taos.
Manville Sales Corp., a division of Manville Products Corp.	Box 338 Antonito, CO 81120	do	Taos.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Perlite —Continued			
Silbrico Corp	6300 River Rd. Hodgkins, IL 60525	Open pit	Taos.
United States Gypsum Co., a subsidiary of USG Corp.	101 South Wacker Dr. Chicago, IL 60606	Open pit mine and crushing plant.	Cibola.
Potash:			
AMAX Chemical Corp., a subsidiary of AMAX Inc.	Box 279 Carlsbad, NM 88220	Underground mine and plant.	Eddy.
International Minerals & Chemical Corp.	Box 71 Carlsbad, NM 88220	do	Do.
Kerr-McGee Chemical Corp., a subsidiary of Kerr-McGee Corp.	Kerr-McGee Bldg. Oklahoma City, OK 73102	do	Do.
Potash Co. of America, a subsidiary of Ideal Basic Industries Inc.[3]	Box 31 Carlsbad, NM 88220	do	Do.
Potash Producers Inc., a subsidiary of Pennzoil Co.[6]	Box 511 Carlsbad, NM 88220	do	Do.
Pumice:			
American Pumice Co., a division of Beatrice Foods Co. (Rhodes Pumice).	Box 4305 Santa Fe, NM 87502	Mill and mine	Santa Fe.
Copar Pumice Co. Inc	Box 38 Espanola, NM 87532	Open pit	Do.
General Pumice Corp	Box 449 Santa Fe, NM 87502	Open pit mine and crushing and screening plant.	Rio Arriba.
Utility Block Co	7200 2d St., NW Box 6036 Albuquerque, NM 87197	Open pit mines and crushing and screening plants.	Bernalillo and Sandoval.
Salt:			
Pioneer Water Co. Inc	Box 1196 Eunice, NM 88321	Salt lake	Lea.
United Salt Corp., Carlsbad Div	2000 West Loop South Suite 990 Houston, TX 77027	do	Eddy.
Sand and gravel (construction):			
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:			
Big Chief Stone Inc	833 Clark Lane Las Cruces, NM 88005	Quarries	Colfax, Dona Ana, Santa Fe.
K & B Constructors Inc	1437 Furneaux Rd. Marysville, CA 95901	Quarry	Socorro.
Rock Products Inc. (doing business as Bee Bee Contractors).	Box 1057 Susanville, CA 96130	do	Torrance.

[1]Also clays and stone in Bernalillo County.
[2]Also byproduct molybdenum in Grant County.
[3]Also silver.
[4]Also fire clay and quartzite in Hidalgo County.
[5]Also gold and silver in Grant County.
[6]Also salt.

The Mineral Industry of New York

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

By Donald K. Harrison[1] and William M. Kelly[2]

The value of nonfuel mineral production in New York was $657.3 million, a $44.8 million increase compared with that of 1984. Leading mineral commodities produced in terms of value were crushed stone, portland cement, salt, construction sand and gravel, zinc, and lime.

Nationally, the State ranked 10th in the value of nonfuel minerals produced, up from 12th place in 1984. New York continued to be the only State that produced emery and accounted for all of the Nation's wollastonite production. The State ranked first in synthetic calcium chloride production; second in primary aluminum and synthetic graphite production; third in garnet, salt, and zinc output; and fourth in lead and talc.

Table 1.—Nonfuel mineral production in New York[1]

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	[2]543	[2]$2,435	700	$3,129
Gem stones	NA	30	NA	30
Salt thousand short tons	5,644	123,755	6,928	142,318
Sand and gravel:				
Construction do.	25,968	80,866	e28,000	e88,500
Industrial do.	25	260	W	W
Stone:				
Crushed do.	e33,100	e135,000	35,139	165,136
Dimension do.	e15	e4,271	16	3,666
Combined value of cement, clays (ball clay, 1984), emery, garnet (abrasive), gypsum, lead, lime, peat, silver, talc, titanium concentrate (ilmenite, 1984), wollastonite, zinc, and value indicated by symbol W	XX	265,873	XX	254,529
Total	XX	612,490	XX	657,308

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

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

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

Table 2.—Nonfuel minerals produced in New York in 1984, by county[1]

County	Minerals produced in order of value
Albany	Cement, clays, sand and gravel.
Allegany	Sand and gravel.
Broome	Sand and gravel, peat, clays.
Cattaraugus	Sand and gravel, peat.
Cayuga	Sand and gravel.
Chautauqua	Do.
Chemung	Do.
Chenango	Do.
Clinton	Do.
Columbia	Do.
Cortland	Do.
Delaware	Do.
Dutchess	Sand and gravel, peat.
Erie	Sand and gravel, clays.
Essex	Wollastonite, iron ore, sand and gravel, titanium, abrasives.
Franklin	Sand and gravel.
Fulton	Do.
Genesee	Gypsum, sand and gravel.
Greene	Cement, sand and gravel.
Herkimer	Sand and gravel.
Jefferson	Do.
Lewis	Wollastonite, sand and gravel.
Livingston	Salt, sand and gravel.
Madison	Sand and gravel.
Monroe	Do.
Montgomery	Do.
Nassau	Do.
Oneida	Do.
Onondaga	Lime, salt, sand and gravel, clays.
Ontario	Sand and gravel.
Orange	Sand and gravel, clays.
Orleans	Sand and gravel.
Oswego	Do.
Otsego	Do.
Putnam	Do.
Rensselaer	Do.
St. Lawrence	Zinc, talc, lead, sand and gravel, silver.
Saratoga	Sand and gravel.
Schenectady	Do.
Schoharie	Cement, sand and gravel.
Schuyler	Salt, sand and gravel.
Seneca	Sand and gravel.
Steuben	Do.
Suffolk	Do.
Sullivan	Do.
Tioga	Do.
Tompkins	Salt, sand and gravel.
Ulster	Sand and gravel, clays.
Warren	Cement, abrasives, sand and gravel.
Washington	Sand and gravel.
Wayne	Do.
Westchester	Abrasives, peat, sand and gravel.
Wyoming	Sand and gravel.
Yates	Salt, sand and gravel.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of New York business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	17,685	17,746	17,783
Total civilian labor force	do.	8,051	8,090	8,308
Unemployment	percent	8.6	7.2	6.5
Employment (nonagricultural):				
Mining total[1]	thousands	6.7	6.8	6.7
Metal mining[2]	do.	W	1.1	W
Nonmetallic minerals except fuels[2]	do.	3.7	3.8	3.9
Oil and gas extraction[2]	do.	2.7	2.6	2.6
Manufacturing total	do.	1,302.4	1,326.3	1,295.2
Primary metal industries	do.	35.4	33.5	30.8
Stone, clay, and glass products	do.	31.8	31.9	30.1
Chemicals and allied products	do.	64.7	65.6	64.5
Petroleum and coal products	do.	6.2	5.6	5.1
Construction	do.	230.8	255.2	284.8
Transportation and public utilities	do.	406.7	418.5	416.1
Wholesale and retail trade	do.	1,503.4	1,576.9	1,633.6
Finance, insurance, real estate	do.	686.7	704.4	718.9
Services	do.	1,876.9	1,966.1	2,049.5
Government and government enterprises	do.	1,299.6	1,318.2	1,349.9
Total[3]	do.	7,313.3	7,572.3	7,754.7
Personal income:				
Total	millions	$242,410	$266,265	$285,419
Per capita		$13,707	$15,004	$16,050
Hours and earnings:				
Total average weekly hours, production workers		39.3	39.8	39.8
Total average hourly earnings, production workers		$8.8	$9.2	$9.7
Earnings by industry:				
Farm income	millions	$373	$518	$469
Nonfarm	do.	$177,695	$194,324	$209,903
Mining total	do.	$679	$769	$719
Metal mining	do.	$51	$35	$29
Nonmetallic minerals except fuels	do.	$99	$113	$122
Coal mining	do.	$6	$8	$8
Oil and gas extraction	do.	$524	$612	$560
Manufacturing total	do.	$34,897	$37,124	$38,534
Primary metal industries	do.	$1,141	$1,119	$1,039
Stone, clay, and glass products	do.	$898	$936	$924
Chemicals and allied products	do.	$2,081	$2,221	$2,326
Petroleum and coal products	do.	$1,092	$968	$922
Construction	do.	$7,582	$8,823	$9,970
Transportation and public utilities	do.	$13,646	$14,717	$15,299
Wholesale and retail trade	do.	$26,918	$29,340	$31,510
Finance, insurance, real estate	do.	$22,054	$23,753	$26,919
Services	do.	$44,793	$50,378	$55,345
Government and government enterprises	do.	$26,576	$28,847	$30,983
Construction activity:				
Number of private and public residential units authorized[4]		37,958	44,869	61,927
Value of nonresidential construction[4]	millions	$1,644.3	$2,243.5	$3,172.1
Value of State road contract awards	do.	$570.0	$979.9	$992.3
Shipments of portland and masonry cement to and within the State	thousand short tons	2,533	2,785	3,284
Nonfuel mineral production value:				
Total crude mineral value	millions	$503.4	$612.5	$657.3
Value per capita		$28	$35	$37

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

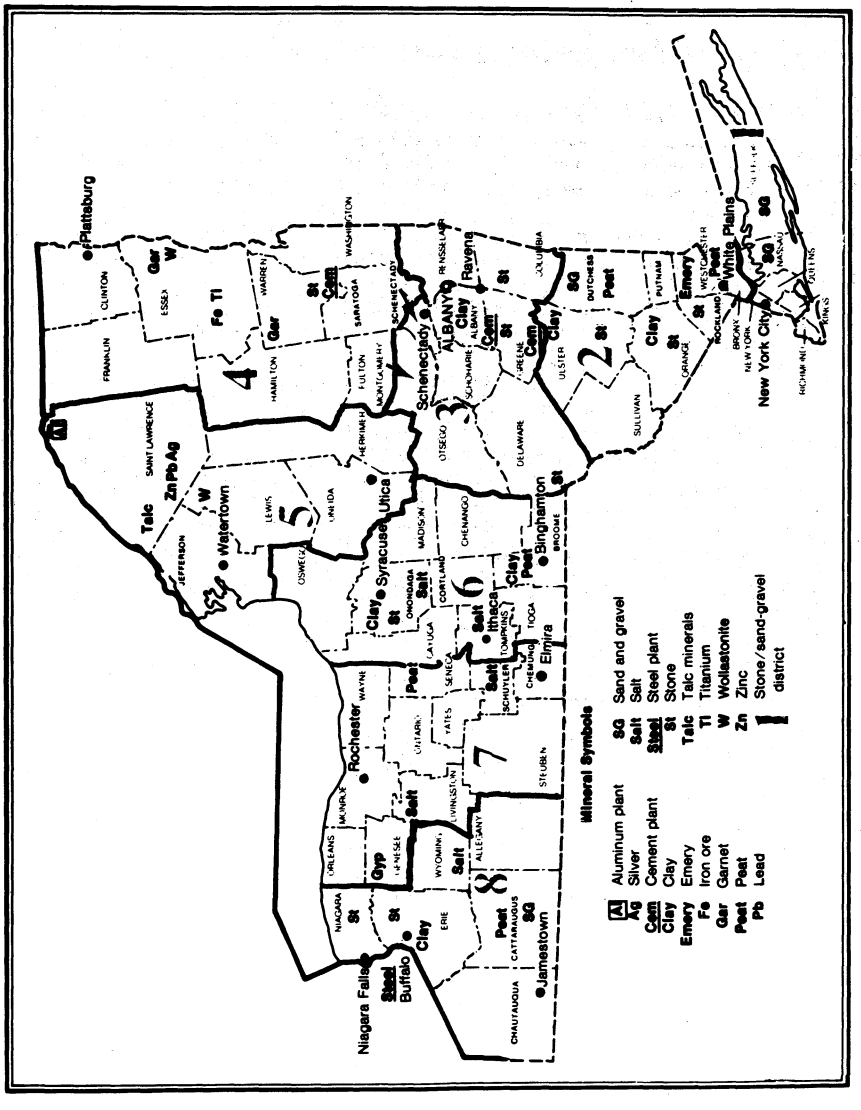

Figure 1.—Principal mineral producing localities in New York.

Legislation and Government Programs.—Chapter 184, signed into law in June, provides that members of the New York State Oil, Gas, and Solution Mining Advisory Board continue in office until their successors are appointed and qualified, while chapter 185 increases the membership of this advisory board from 11 to 13. Chapter 869, signed into law in August, requires the State Board of Equalization and Assessment to develop annual economic profiles for gas and oil production value and provides for the separate assessment of such oil and gas economic units.

The New York State Geological Survey, which has been in continuous operation since 1836, performs two basic functions: (1) provides geological information to government agencies, industry, and the public, and (2) acts as the geological research arm of the State museum. In 1985, major projects in which the Survey was involved concerned environmental, engineering, and regional geologic studies. Projects dealing with environmental and engineering investigations included (1) statewide evaluation of data pertinent to the siting of a high-level radioactive waste repository in crystalline rock, funded by the U.S. Department of Energy, (2) engineering classification of soils in Albany County, (3) compilation of the engineering geology of the New York City Water Supply System, (4) study of Outer Continental Shelf petroleum development, funded by the Minerals Management Service, and (5) a statewide landslide inventory.

Regional geologic studies included (1) quadrangle mapping of the Adirondack Mountains at 1:24,000 and 1:62,500, (2) Cambro-Ordovician biostratigraphy, funded by the National Science Foundation, (3) seismic investigation of the structure of the Adirondack Mountains using quarry blasts as an energy source, (4) quaternary geologic mapping of New York, funded by the New York State Electric & Gas Corp., (5) cataloging of mineral resource localities in the Adirondacks, funded by the U.S. Geological Survey, and (6) stratigraphy of the subsurface Lower and Middle Devonian in New York, northern Pennsylvania, northeastern Ohio, and southeastern Ontario, Canada.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Abrasives (Manufactured).—Crude artificial abrasives were produced by two companies in 1985. High-purity fused aluminum oxide was produced by Sohio Electro Minerals Co. and General Abrasives, a division of Dresser Industries Inc., both in Niagara Falls. General Abrasives also produced regular fused aluminum oxide. Both production and value decreased in 1985.

Cut wire shot used for abrasives was produced by Pellets Inc. at a plant in Tonawanda, Erie County.

Calcium Chloride (Synthetic).—New York continued to rank first of three States that produced synthetic calcium chloride, producing most of the Nation's total output. Allied Chemical Corp. recovered the calcium chloride as a byproduct of soda ash production at its Solvay plant near Syracuse. In 1985, both production and value increased 17% and 7%, respectively, compared with those of 1984. The calcium chloride was used for ice and snow removal and as a dust suppressant. During the year, Allied Chemical announced that it intended to close the Solvay plant in early 1986 because of weak demand and high production costs. As a result of the closure and in order to continue serving calcium chloride customers in the Northeastern United States, the company was expanding its much smaller synthetic soda ash plant at Amherstburg, Ontario, Canada.

Cement.—In 1985, four companies operated five cement plants in the State. Portland cement was produced at all five plants, and masonry cement was produced at two of the plants. The plants producing portland cement were Lehigh Portland Cement Co. at Cementon; Atlantic Cement Co. Inc. at Ravena; Independent Cement Corp. at Catskill; and Moore McCormack Resources Inc. at Glens Falls and Howe Cove. Both the Glens Falls and Catskill plants also produced masonry cement. In 1985, both shipments and value of portland cement increased 10% and 5%, respectively, compared with those of 1984. Shipments and value of masonry cement decreased 8% and 4%, respectively, offsetting increases attained in 1984.

During the year, Blue Circle Ltd., a worldwide producer and distributor of cement with headquarters in London, England, purchased Atlantic Cement in Ravena. The $145 million sale also included a slag cement plant in Baltimore, MD; several distribution terminals along the east coast; and a fleet of cement-carrying barges.

Moore McCormack began undertaking a program to upgrade and increase grinding operations at its 500,000-short-ton-per-year

plant at Glens Falls. The initial phase of this project will focus on reducing existing costs of transportation and providing better handling and storage of clinker at the operation. Two concrete storage silos will also be added at the production facility, one of 13,000-ton capacity; the other, of 20,000 tons.

Clays.—In 1985, both production and value of common clay increased 29% compared with 1984 data. It was produced by eight companies in six counties, and was used principally in the manufacture of portland cement, face brick, concrete block, and structural concrete.

Emery.—In 1985, only one company mined emery in the State, one less than in 1984. John Leardi Emery Mine operated a mine near Peekskill in Westchester County. The crude material was processed by two out-of-State companies—Washington Mills Abrasive Co., North Grafton, MA, and Emeri-Crete Inc., New Castle, NH. The emery was mainly used as a nonslip additive for floors, pavements, and stair treads. Minor uses were for coated abrasives and as a tumbling and deburring media.

Garnet.—New York was one of only three States in the Nation that produced garnet; Idaho and Maine were the other two. Garnet was produced by only one company. Barton Mines Corp. mined garnet from a surface mine near North Creek, Warren County, and sold the material for use in coated abrasives, glass grinding and polishing, and metal lapping. The NYCO Div. of Processed Minerals Inc., which operated a mine in Essex County in 1984, reported that its wollastonite byproduct garnet was not recovered in 1985.

Gem Stones.—Value of gem stones and mineral specimens collected by mineral dealers and amateur collectors in New York, based on a survey by the curator of mineralogy of the State museum, was estimated at $100,000 in 1985. Of this amount, approximately $70,000 entered the market as specimens and educational-grade samples and $30,000 remained in private collections and museums. Popular gem- and mineral-collecting areas included Gore Mountain near North Creek, Warren County; sphalerite, galena, and talc refuse areas of St. Joe Resources Co. and Gouverneur Talc Co. Inc. near Balmat, St. Lawrence County; and southern Herkimer County where "Herkimer Diamonds," doubly terminated clear quartz crystals are found.

Graphite (Synthetic).—New York ranked second in the Nation in the shipments of synthetic graphite, down from first place in 1984. Shipments amounted to 45,882 short tons valued at $98.7 million. Shipments were 30% lower in 1985, the result of Union Carbide Corp. closing its Niagara Falls plant. The company cited the high cost of natural gas and the strong U.S. dollar that enabled the company's customers to purchase low-price products from rival manufacturers in Italy and Japan.[3] Three companies, all in Niagara County, produced and shipped synthetic graphite during the year. The three companies were Airco Carbon, a division of Airco Inc.; The Carborundum Co., Graphite Products Div.; and Great Lakes Carbon Corp. The synthetic graphite produced was primarily in the form of electrodes, anodes, unmachined graphite shapes, and lubricants.

Gypsum.—The sole producer of crude gypsum in the State was USG Corp., which operated an underground mine at Oakfield in Genesee County. Ore from the 80-foot-deep mine is extracted from a 3- to 4-foot-thick seam using room-and-pillar methods. The crude gypsum is then calcined and made into wallboard at an adjoining plant. In 1985, production and value of crude gypsum increased 3% and 7%, respectively, compared with those of 1984. USG also calcined gypsum imported from Nova Scotia at a plant in Stony Point, Rockland County. In terms of total output, the Stony Point plant ranked seventh of 71 plants that calcined gypsum in the United States.

In addition to USG's two facilities, two other companies calcined gypsum in the State using imported ore. National Gypsum Co. operated at Rensselaer in Rensselaer County and Georgia-Pacific Corp. operated a plant at Buchanan in Westchester County. Total State output and value of calcined gypsum increased 6% and 24%, respectively, over those of 1984, primarily the result of increased construction and demand for wallboard.

Iodine.—Crude iodine was shipped into the State by RSA Corp., Westchester County, and Sterling Organics U.S., a division of Sterling Drug Inc., Rensselaer County. RSA, the largest producer in New York, produced specialty organic chemicals. Sterling used the iodine for the manufacture of pharmaceuticals, catalysts, and sanitation products.

Lime.—Allied Chemical, the State's only lime producer, mined limestone at its Jamesville quarry and shipped the material to its Solvay plant near Syracuse to manufacture quicklime. In terms of total output,

the Syracuse plant was the Nation's sixth leading individual lime plant. The quicklime was used to manufacture soda ash, which in turn was consumed by the glass, chemical, paper, leather tanning, and water treatment industries.

Near yearend, the company shut down the Jamesville quarry, which supplied about 15,000 tons of chemical-grade limestone to the Solvay plant. The closure was the result of the company's planned shutdown of the synthetic soda ash plant. Allied Chemical cited high production costs and a declining market for soda ash as reasons for the closure. The quarry closure resulted in the layoff of nearly 130 workers.

Mullite (Synthetic).—Electric-furnace-fused mullite was produced by Sohio Electro Minerals at Niagara Falls. Sohio Electro Minerals (formerly Carborundum's Electrominerals Div.) was formed in 1983 when Carborundum consolidated with the Processed Mineral Sector of Sohio Chemical & Industrial Products Co. The mullite was primarily used by the steel industry for furnace linings.

Peat.—New York ranked seventh of 21 States that produced peat in 1985. Five companies mined peat at five operations in Broome, Cattaraugus, Dutchess, Seneca, and Westchester Counties. Both production and value increased 26% and 40%, respectively, compared with 1984 levels. Of the total amount of peat sold, 91% was packaged; the remainder was sold in bulk form. Primary uses for the material was for soil improvement and potting soil.

Perlite (Expanded).—Crude perlite mined in other States was shipped into New York and expanded by Buffalo Perlite Corp., a division of Pine Hill Concrete Mix Corp., Erie County, and by Solite International Corp., Rensselaer County. Both quantity and value of material sold declined 12% and 10%, respectively, in 1985 after rebounding in 1984. The expanded perlite was used in lightweight acoustical building plaster, loose-fill insulation, soil conditioning, and for filtration.

Salt.—New York continued to rank third in the Nation in salt sold or used and second in value. In 1985, the State's salt sold or used totaled 6.9 million short tons (17.5% of the national total) valued at $142.3 million. This represents an increase of 23% in volume and 15% in value compared with those of 1984. Both rock salt and brine were produced by five companies at seven operations in five counties. Rock salt was produced by Cargill Inc. in Tompkins County and by International Salt Co. in Livingston County. Evaporated salt was produced by Cargill and International, each operating a plant in Tompkins County, and by Morton Thiokol Inc. and Hooker Chemical Inc. in Wyoming County. Brine was produced by Allied Chemical in Onondaga County. Rock salt was used primarily for snow and ice removal while brine and evaporated salt were used in the manufacture of soda ash, chlorine, and other chemicals.

Olin Corp. and E.I. du Pont de Nemours & Co. Inc. announced plans to construct a chloralkali plant at Niagara Falls. The $100 million joint venture, scheduled to be completed in 1987, will have an annual capacity of 230,000 short tons per year. A 60-mile pipeline system will connect the proposed new plant and brine wells near the town of Wyoming, to deliver sodium chloride, the basic raw material used in the production of chlorine and caustic soda.[4]

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Based on these estimates, output and value of construction sand and gravel increased 8% and 9%, respectively, over 1984 levels. In 1984, the leading counties, in descending order of output, were Suffolk and Nassau (both on Long Island), Cattaraugus, and Dutchess. Main uses were for road base and coverings, concrete aggregate, and fill.

Great Lakes International Inc. announced that it planned to invest $8 million into mining equipment and facilities to dredge sand and gravel in the harbors of New York City. Because of urban encroachment and zoning, land-based deposits are either scarce or unavailable in the sprawling metropolitan areas. Under a permit from the U.S. Army Corps of Engineers, Great Lakes will dredge the Ambrose Channel to a depth of 53 feet below the main water level, removing 800,000 cubic yards (1.3 million tons) of sand annually. The sand will then be transported by hopper dredge to a moored barge off the New Jersey shore and then moved via a hydraulic pipeline to an upland stockpiling area in South Amboy, NJ.[5]

Industrial.—Whitehead Bros. Co. was the only producer of industrial sand in the State. The company operated two pits, one in Oneida County, and the other in Sarato-

ga County. Major uses were for moldings and foundry applications.

Slag.—*Iron.*—Buffalo Crushed Stone Corp. processed air-cooled iron (blast furnace) slag at a plant in Buffalo. The company, which employed about 35 workers, had increased sales of almost 13% compared with those of 1984. Main uses for slag were for road base, asphaltic concrete aggregate, fill, and railroad ballast.

Sodium Carbonate (Synthetic).—New York was the only State that produced synthetic sodium carbonate in 1985. Allied Chemical mined a chemical-grade limestone at its Jamesville quarry south of Syracuse and shipped the material approximately 6 miles to its chemical plant in Solvay. Primary uses of sodium carbonate were for the manufacture of glass, chemicals, and paper; for leather tanning; and for water treatment.

During the year, Allied Chemical announced that it intended to close the synthetic soda ash plant in Solvay sometime in 1986, making the Nation totally dependent on natural soda ash. The company stated that the plant had become unprofitable, sustaining substantial financial losses in the past 2 years—partly because production costs were much higher than those for natural soda ash. Moreover, the market for soda ash in glass, its major end use, had declined. The shutdown of the synthetic soda ash plant also resulted in the closure of the Jamesville quarry and the salt brine operation, which supplied the plant with the raw material.[6]

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Crushed stone accounted for one-quarter of the State's total nonfuel mineral value. In 1985, both quantity and value increased 6% and 22%, respectively, compared with 1984 estimated figures. In 1985, the U.S. Bureau of Mines began compiling crushed stone production statistics by districts for some States.

Limestone was the leading type of stone produced, accounting for nearly three-quarters of the State's production. Other types produced, in descending order of value, were dolomite, traprock, sandstone, granite, and slate. A total of 59 companies operated 95 quarries in 37 counties. Main uses for the crushed stone were for road base, bituminous aggregate, cement manufacture, and fill.

Table 4.—New York: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Concrete aggregate (+1-1/2 inch):		
Macadam	163	1,238
Riprap and jetty stone	603	2,986
Filter stone	144	693
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,104	5,623
Bituminous aggregate, coarse	4,925	25,239
Bituminous surface-treatment aggregate	793	4,258
Railroad ballast	287	1,231
Fine aggregate (-3/8 inch):		
Stone sand, concrete	99	496
Stone sand, bituminous mix or seal	386	1,892
Screening, undesignated	82	213
Combined coarse and fine aggregates:		
Graded road base or subbase	3,075	14,401
Unpaved road surfacing	241	1,164
Crusher run or fill or waste	2,453	9,553
Other construction[2]	230	1,034
Agricultural: Agricultural limestone	525	2,878
Chemical and metallurgical: Chemical manufacture	4,221	9,432
Special:		
Roofing granules	2	5
Other miscellaneous[3]	1,175	4,700
Other unspecified[4]	14,633	78,099
Total[5]	35,139	165,136

[1]Includes dolomite, granite, limestone, sandstone, slate, traprock, and miscellaneous stone.
[2]Includes stone used in terrazzo and exposed aggregate and stone used for other construction and maintenance purposes.
[3]Includes stone used in agricultural marl and other soil conditioners, other fillers or extenders, lightweight aggregate, and uses not specified.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Table 5.—New York: Crushed stone sold and used by producers in 1985, by district and use

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3		District 4	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	--	--	292	1,967	208	1,128	49	200
Coarse aggregate, graded	--	--	1,505	10,399	1,431	6,890	1,098	4,166
Fine aggregate (-3/8 inch)	--	--	160	767	171	850	173	730
Combined coarse and fine aggregates	--	--	408	2,615	219	914	483	1,459
Other construction	--	--	--	--	--	--	128	484
Agricultural limestone	--	--	(1)	(1)	(2)	(2)	(2)	(2)
Cement manufacture	--	--	--	--	(2)	(2)	(2)	(2)
Lime manufacture	--	--	--	--	--	--	(2)	(2)
Lightweight aggregate	--	--	(1)	(1)	--	--	1	10
Other miscellaneous	--	--	--	--	4,355	11,885	1,107	2,474
Other unspecified[3]	--	--	7,899	50,673	95	406	--	--
Total[4]	--	--	10,264	66,423	6,480	22,074	3,039	9,525

	District 5		District 6		District 7		District 8	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	(5)	(5)	42	273	(5)	(5)	(6)	(6)
Coarse aggregate, graded	(5)	(5)	631	3,232	842	4,204	(6)	(6)
Fine aggregate (-3/8 inch)	(5)	(5)	8	33	(5)	(5)	(6)	(6)
Combined coarse and fine aggregates	(5)	(5)	1,363	5,343	1,332	6,343	(6)	(6)
Other construction	1,868	8,332	81	429	269	1,127	(6)	(6)
Agricultural limestone	(2)	(2)	(2)	(2)	(1)	(1)	3	12
Other fillers or extenders	(2)	(2)	--	--	--	--	--	--
Roofing granules	--	--	--	--	--	--	(6)	(6)
Other miscellaneous	117	982	37	392	--	--	--	--
Other unspecified[3]	894	3,801	2,864	9,161	1,786	9,587	(6)	(6)
Total[4]	2,879	13,114	5,026	18,863	4,229	21,261	3,222	13,876

[1]Withheld to avoid disclosing company proprietary data; included with "Other unspecified."
[2]Withheld to avoid individual company proprietary data; included with "Other miscellaneous."
[3]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[4]Data may not add to totals shown because of independent rounding.
[5]Withheld to avoid disclosing individual company proprietary data; included with "Other construction."
[6]Withheld to avoid disclosing individual company proprietary data; included in "Total."

Dimension.—Dimension stone was produced by 12 companies operating 18 quarries in 7 counties. Dimension stone production in 1985 amounted to 16,032 short tons (198,000 cubic feet) valued at $3.7 million. Leading counties in order of output were Essex, Albany, Washington, Delaware, Tompkins, Franklin, and Orleans. Types of stone quarried were sandstone, granite, and slate.

Table 6.—New York: Dimension stone[1] sold or used by producers in 1985, by use

Use	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Rough blocks for building and construction	2,938	37	$476
Irregular-shaped stone	4,515	57	198
Other rough stone	516	7	W
Dressed stone:			
Ashlars and partially squared pieces	1,174	15	96
Slabs and blocks	5,214	63	2,292
Flagging	789	9	111
Roofing slate	441	5	W
Flooring slate	445	5	132
Total	16,032	198	3,666

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Includes granite, sandstone, and slate.

Talc.—The State was ranked fourth of 10 States that produced talc in 1985. Gouverneur Talc, a subsidiary of R. T. Vanderbilt Co. Inc., extracted talc by both open pit and underground methods. Three main types of ore were produced—hard- and ceramic-

grades for use in the ceramic industry, and medium-grade for use in paint. Lesser amounts are sold to the plastic and rubber industries.[7] Clark Minerals Inc., Jefferson County, milled purchased talc for use mainly in cosmetics and for manufacturing rubber and plastics.

Vermiculite (Exfoliated).—W. R. Grace & Co.'s Construction Products Div. shipped vermiculite into the State and exfoliated the material at a plant in Weedsport, Cayuga County. The exfoliated product was used for block and loose-fill insulation, horticultural use, lightweight concrete aggregate, and soil conditioning.

Wollastonite.—New York was the only State in the Nation that produced wollastonite. Two companies mined wollastonite in the State in 1985. The largest producer, NYCO, a division of Processed Minerals, operated the Lewis surface operation near Willsboro, Essex County. The crushed ore, which averages 60% wollastonite and 40% garnet and impurities, was transported 14 miles to a mill at Willsboro for processing. R. T. Vanderbilt, the State's other producer, operated the Valentine underground mine in Lewis County.

In 1985, the tonnage of wollastonite sold or used was approximately the same as that of 1984. Major uses of wollastonite are as a filler in ceramic tile, marine wallboard, paint, plastics, and refractory liners in steel mills. Another use is as a partial replacement for short-fibered asbestos in certain applications such as brake linings.

METALS

Aluminum.—In 1985, New York ranked second in output and value among the 16 States that had primary aluminum production facilities. Two companies, both in Massena, St. Lawrence County, operated plants. Aluminum Co. of America (Alcoa) operated a 205,000-metric-ton-per-year smelter, and Reynolds Metals Co. operated a 114,000-ton-per-year smelter.

In October, Alcoa shut down a 36,300-metric-ton potline at the Massena plant reducing the plant's capacity to 168,700 tons per year. The closure, which resulted in the layoff of 125 employees, was the result of high production costs, coupled with the depressed and oversupplied primary aluminum market.

Iron Ore.—Stockpiled byproduct magnetite from NL Industries Inc.'s MacIntyre Mine was shipped by rail for use in coal preparation plants. Both shipments and value increased over 1984 levels.

Iron and Steel.—In 1985, there were no reported shipments of pig iron from New York. Raw steel production, which has steadily declined in the past 5 years, continued to decline. In 1985, raw steel production amounted to 456,000 short tons, down from 515,000 tons in 1984. In 1981, more than 3 million tons of raw steel was produced in the State.

In February, Allegheny Ludlum Steel Corp. started melting operations at its new Special Materials Div. of Lockport. The facility, formerly owned and operated by Guterl Special Steel Corp., was purchased by Allegheny Ludlum in a bankruptcy sale in October 1984. Products produced included special stainless steel grades, corrosion-resistant alloys, and nickel-base alloys with electronic applications. When the plant gets into full production, however, most melting will involve high-temperature alloys with aerospace applications.[8]

Near midyear, Roblin Industries Inc., Buffalo, filed for protection from creditors under chapter 11 of the Federal Bankruptcy Code. The company, which produced special-quality steel bars at its Roblin Steel Co. division, primarily blamed import competition for its financial problems. In the first quarter of 1985, Roblin posted a net loss of $818,300 on sales of $9.2 million. In 1984, the company reported a net loss of $5 million for the New York operations.[9]

Al Tech Specialty Steel Corp., Dunkirk, began producing a new alloy (Croloy 16-6PH) under a sublicense from Earle M. Jorgensen Co., Los Angeles, CA. Croloy 16-6PH was developed and produced by Babcock & Wilcox Co. until last year when it ceased stainless steel production. Jorgensen then acquired the license for the product but never produced it. Under the sublicense, Al Tech has the exclusive North American rights to manufacture and market the product in all its forms. Croloy 16-6PH can be hardened with relatively low-temperature heat treatment, which enables the alloy to be machined in the soft, solution-annealed condition and then hardened with little material distortion.[10]

Ferroalloys.—Three companies produced ferroalloys in the State in 1985. Elkem Metals Co., SKW Alloys Inc., and Umetco Minerals Corp., formerly Union Carbide's Metals Div., each operated a plant in Niagara Falls.

Lead and Silver.—A lead-silver concentrate was recovered from zinc concentrating

operations at St. Joe Resources' Balmat mill, St. Lawrence County.

Zinc.—New York ranked third in zinc output and value in 1985, down from second place in 1984. St Joe Resources, the State's only producer, operated the Balmat and Pierrepont underground mines in St. Lawrence County. In terms of total zinc output, the Balmat and Pierrepont were the Nation's third and fourth leading zinc mines, respectively. All the ore was milled at the company's Balmat mill, which had an ore milling capacity of about 3,900 metric tons per day. According to the company's 10K report, for the fiscal year ending October 31, the company mined and milled 531,000 metric tons of ore averaging 10.65% zinc, and produced 53,300 metric tons of zinc concentrate. Most of the concentrates were shipped to the company's Monaca, PA, zinc smelter.

In July, approximately 350 members of the United Steelworkers of America walked off their jobs at St. Joe's mines and mill at Balmat and Pierrepont after a labor contract expired. The workers struck over issues concerning health insurance, seniority clauses, safety, and a proposed two-tiered pay system using nonunion workers. Despite the strike, the company continued production at a reduced rate having replaced some of the strikers with two dozen salaried personnel in both mine and mill production. Near yearend, production from both mines amounted to 1,350 tons per day, down from 3,000 tons per day prior to the strike.

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[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2]Senior scientist, New York Geological Survey, Albany, NY.

[3]Chemical Week. At the Brink in Niagara Falls. V. 136, No. 23, June 5, 1985, pp. 10-11.

[4]———. A Chlor-Alkali Power Struggle. V. 136, No. 15, Apr. 10, 1985, p. 10.

[5]Staten Island Advance. Sand Mining Work Dredging Up Profits. Feb. 28, 1986.

[6]Chemical Week. For Synthetic Soda Ash in the United States, the End is Near. V. 136, No. 18, May 1, 1985, p. 9.

[7]Harben, P. New York's Industrial Minerals. Ind. Miner. (London), No. 226, July 1986, pp. 50-66.

[8]American Metal Market. A-L Steel Running New Specialty Unit. V. 93, No. 3, Feb. 8, 1985, p. 2.

[9]———. Roblin Files for Protection From Creditors Under Chapter 11. V. 93, No. 142, July 2, 1985, p. 4.

[10]———. Al Tech Making New Alloy Under a Sublicensing. V. 93, No. 208, Oct. 28, 1985, p. 8.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives (manufactured):			
The Carborundum Co.[1]	Box 423 Niagara Falls, NY 14302	Plant	Niagara.
General Abrasives Div. of Dresser Industries Inc.	2000 College Ave. Niagara Falls, NY 14305	do	Do.
Pellets Inc	531 South Niagara St. Tonawanda, NY 14150	do	Erie.
Aluminum (primary):			
Aluminum Co. of America	1210 Alcoa Bldg. Pittsburgh, PA 15222	Smelter	St. Lawrence.
Reynolds Metals Co	Box 27003-2A Richmond, VA 23215	do	Do.
Cement:			
Atlantic Cement Co. Inc., a subsidiary of Newmont Mining Corp.[2 3]	Box 3 Ravena, NY 12143	Quarry and plant.	Albany.
The Glens Falls Portland Cement Co. Inc., a subsidiary of Moore McCormack Resources Inc.[2]	Box 440 Glens Falls, NY 12801	Quarries and plants.	Schoharie and Warren.
Independent Cement Corp	Box 12-310 Albany, NY 12212	Quarry and plant.	Greene.
Lehigh Portland Cement Co.[2]	718 Hamilton Mall Allentown, PA 18105	do	Do.
Clays:			
Norlite Corp., a subsidiary of P. J. Keating Co.	Box 367 Fitchburg, MA 01420	Pit	Albany.
Northeast Solite Corp., a subsidiary of Solite Corp.	Box 27211 Richmond, VA 23261	Pit	Ulster.
Powell & Minnock Brick Works Inc	Route 144 Coeymans, NY 12045	Pit	Do.
Emery:			
John Leardi Emery Mine	Gillman Lane Peekskill, NY 10566	Pit	Westchester.
Garnet:			
Barton Mines Corp	North Creek, NY 12853	Pit	Warren.
Gypsum:			
Georgia-Pacific Corp	Box 105605 133 Peachtree St., NE. Atlanta, GA 30348	Plant	Westchester.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	do	Rensselaer.
United States Gypsum Co., a subsidiary of USG Corp.	101 South Wacker Dr. Chicago, IL 60606	Underground mines and plants.	Genesee and Rockland.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Iron ore:			
NL Industries Inc	Tahawus, NY 12879	Pit	Essex.
Lime:			
Allied Chemical Corp.[3 4]	Box 70 Morristown, NJ 07960	Quarry and plant.	Onondaga.
Peat:			
Good Earth Organics Corp	5960 Broadway Lancaster, NY 14086	Bog	Cattaraugus.
Hyponex Corp	20135 Anthony Blvd. Fort Wayne, IN 46803	Bog	Dutchess.
Perlite (expanded):			
Buffalo Perlite Corp	100 Sugg Rd. Buffalo, NY 14225	Plant	Erie.
Solite International Corp	6 Madison St. Troy, NY 12181	do	Rensselaer.
Salt:			
Cargill Inc	Box 5621 Minneapolis, MN 55440	Underground mine.	Tompkins.
International Salt Co	Clarks Summit, PA 18411	Underground mines.	Livingston and Schuyler.
Morton Thiokol Inc	110 North Wacker Dr. Chicago, IL 60606	Well	Wyoming.
Sand and gravel (1984):			
Broad Hollow Estates Inc	Box 483 Farmingdale, NY 11735	Pit	Suffolk.
Buffalo Crushed Stone Inc	861K Wherle Dr. Williamsville, NY 14221	Pits	Cattaraugus.
McCormack Sand Co	Box 448 Port Washington, NY 11050	Pit	Nassau.
Slag—iron:			
Buffalo Crushed Stone Corp.[3]	2544 Clinton St. Buffalo, NY 14216	Plant	Erie.
Stone:			
Crushed:			
Callahan Industries Inc	South St. South Bethlehem, NY 12161	Quarries	Albany, Madison, Rensselaer, Ulster.
Dolomite Products Inc	1150 Penfield Rd. Rochester, NY 14625	do	Genessee and Ulster.
The General Crushed Stone Co., a subsidiary of Koppers Co. Inc.	Box 231 Easton, PA 18042	do	Herkimer, Jefferson, Livingston, Onondaga, Ontario, Wayne.
New York Trap Rock Corp., a subsidiary of Lone Star Industries Inc.	Box 432 Montvale, NJ 07645	Quarry	Rockland.
Peckham Materials Corp	20 Haarlem Ave. White Plains, NY 10603	Quarries	Greene, Putnam, Warren, Washington.
Tilcon Quarries Inc	Box 362 Haverstown, NY 10927	do	Rockland and Ulster.
Dimension:			
Finger Lakes Stone Co. Inc	Box 401 Ithaca, NY 14850	Quarry	Tompkins.
Heldeberg Bluestone & Marble Co	Box 36 East Berne, NY 12059	Quarries	Albany and Delaware.
Hilltop Slate Co	Middle Granville, NY 12849	Quarry	Washington.
Johnson & Rhodes Bluestone Co	East Branch, NY 13756	do	Delaware.
Lake Placid Granite Co	202 South 3d Ave. Cold Spring, MN 56320	do	Essex.
Northern Adirondack Quarries	86 Catherine St. Malone, NY 12953	do	Franklin.
Ritchie Bros. Slate Co. Inc	Main St. Middle Granville, NY 12849	Quarries	Washington.
Talc:			
Gouverneur Talc Co. Inc., a subsidiary of R. T. Vanderbilt Co. Inc.	Box 89 Gouverneur, NY 13642	Underground mine.	St. Lawrence.
Vermiculite:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Cayuga.
Wollastonite:			
NYCO Div. of Processed Minerals Inc	Box 368 Willsboro, NY 12996	Surface mine	Essex.
R. T. Vanderbilt Co. Inc	30 Winfield St. Norwalk, CT 06855	Underground mine.	Lewis.
Zinc:			
St. Joe Resources Co.[5]	250 Park Ave. New York, NY 10017	Underground mines.	St. Lawrence.

[1]Also synthetic mullite and synthetic graphite.
[2]Also clays.
[3]Also stone.
[4]Also salt.
[5]Also byproduct 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]

In 1985, North Carolina nonfuel mineral sales fell $19 million below the record high established in 1984. Of the 13 nonfuel mineral commodities mined in the State, 5—dimension stone, feldspar, lithium minerals, olivine, and phosphate rock—experienced a downturn in demand and sales. Mica production rose slightly but value fell below the 1984 level; production of construction sand and gravel, pyrophyllite, and talc fell below the previous year's output although a rise in unit price increased the total value of these commodities above that of 1984. Only clays, industrial sand, and crushed stone producers experienced an increase in both output and sales over the 1984 levels.

Despite the downturn, North Carolina continued to lead the Nation in the production of feldspar, lithium minerals, scrap mica, olivine, and pyrophyllite. The State ranked second in output of common clay and shale, crushed granite, and phosphate rock.

Table 1.—Nonfuel mineral production in North Carolina[1]

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	2,327	$8,987	2,688	$10,477
Feldspar short tons	510,275	13,994	490,993	13,351
Gem stones	NA	50	NA	50
Mica (scrap) thousand short tons	79	3,762	80	3,726
Sand and gravel:				
Construction do.	6,312	18,159	e6,100	e19,500
Industrial do.	1,158	12,864	1,294	13,086
Stone:				
Crushed do.	e38,100	e168,000	41,771	194,818
Dimension do.	W	W	35	6,132
Talc and pyrophyllite do.	87	1,587	85	1,604
Combined value of lithium compounds, olivine, peat, phosphate rock, and value indicated by symbol W	XX	224,077	XX	170,012
Total	XX	451,480	XX	432,756

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

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

Table 2.—Nonfuel minerals produced in North Carolina in 1984, by county[1]

County	Minerals produced in order of value
Alamance	Clays.
Anson	Sand and gravel.
Avery	Olivine, clays, mica.
Beaufort	Phosphate rock, sand and gravel.
Bertie	Sand and gravel.
Bladen	Do.
Buncombe	Sand and gravel, clays.
Cabarrus	Clays, sand and gravel.
Caldwell	Sand and gravel.
Camden	Do.
Catawba	Do.
Chatham	Clays.
Cherokee	Talc and pyrophyllite.
Chowan	Sand and gravel.
Cleveland	Lithium, feldspar, mica, sand and gravel, clays.
Columbus	Sand and gravel.
Craven	Do.
Cumberland	Do.
Dare	Do.
Davidson	Clays.
Davie	Sand and gravel.
Duplin	Do.
Durham	Clays.
Edgecombe	Sand and gravel.
Franklin	Do.
Gaston	Lithium, mica, feldspar.
Greene	Sand and gravel.
Guilford	Clays, sand and gravel.
Halifax	Clays.
Harnett	Sand and gravel, clays.
Henderson	Clays.
Hertford	Sand and gravel.
Hyde	Peat, sand and gravel.
Iredell	Clays.
Jackson	Olivine.
Johnston	Sand and gravel.
Lee	Clays, sand and gravel.
Lenoir	Sand and gravel.
McDowell	Do.
Macon	Do.
Martin	Do.
Mitchell	Feldspar, mica, olivine, sand and gravel.
Montgomery	Clays, sand and gravel.
Moore	Talc and pyrophyllite, sand and gravel, clays.
New Hanover	Sand and gravel.
Northampton	Do.
Orange	Talc and pyrophyllite.
Pasquotank	Sand and gravel.
Pender	Do.
Pitt	Do.
Richmond	Do.
Rockingham	Clays, sand and gravel.
Rowan	Clays.
Rutherford	Sand and gravel.
Sampson	Clays.
Scotland	Sand and gravel.
Stanly	Clays.
Stokes	Clays, sand and gravel.
Surry	Sand and gravel.
Tyrrell	Do.
Union	Clays.
Wake	Do.
Washington	Sand and gravel, peat.
Wayne	Sand and gravel.
Wilkes	Do.
Wilson	Do.
Yadkin	Do.
Yancey	Olivine, mica, sand and gravel.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of North Carolina business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	6,077	6,166	6,255
Total civilian labor force	do.	2,935	3,031	3,106
Unemployment	percent	8.9	6.7	5.4
Employment (nonagricultural):				
Mining total	thousands	4.3	4.6	4.8
Manufacturing total	do.	796.1	835.6	827.4
Primary metal industries	do.	9.3	10.6	10.6
Stone, clay, and glass products	do.	16.9	19.1	19.4
Chemicals and allied products	do.	37.9	38.4	37.6
Petroleum and coal products[1]	do.	.7	.7	.7
Construction	do.	112.4	132.6	149.2
Transportation and public utilities	do.	120.5	126.6	128.8
Wholesale and retail trade	do.	508.0	548.9	576.2
Finance, insurance, real estate	do.	100.4	103.8	108.6
Services	do.	370.4	399.3	427.6
Government and government enterprises	do.	407.1	413.7	422.8
Total[2]	do.	2,419.2	2,565.2	2,645.6
Personal income:				
Total	millions	$60,661	$67,808	$72,670
Per capita		$9,982	$10,998	$11,617
Hours and earnings:				
Total average weekly hours, production workers		40.0	39.9	39.6
Mining		39.7	42.7	46.5
Total average hourly earnings, production workers		$6.7	$7.0	$7.3
Mining		$7.2	$7.7	$8.0
Earnings by industry:				
Farm income	millions	$783	$1,509	$1,094
Nonfarm	do.	$45,410	$50,726	$55,069
Mining total	do.	$167	$207	$207
Manufacturing total	do.	$14,641	$16,023	$16,619
Primary metal industries	do.	$236	$291	$295
Stone, clay, and glass products	do.	$332	$409	$437
Chemicals and allied products	do.	$955	$1,008	$1,041
Petroleum and coal products	do.	$19	$20	$22
Construction	do.	$2,581	$3,230	$3,703
Transportation and public utilities	do.	$3,286	$3,613	$3,882
Wholesale and retail trade	do.	$7,422	$8,389	$9,277
Finance, insurance, real estate	do.	$1,981	$2,125	$2,482
Services	do.	$7,090	$8,227	$9,154
Government and government enterprises	do.	$8,031	$8,705	$9,514
Construction activity:				
Number of private and public residential units authorized[3]		54,762	63,037	70,727
Value of nonresidential construction[3]	millions	$1,438.1	$1,632.5	$2,076.2
Value of State road contract awards	do.	$202.5	$403.5	$380.0
Shipments of portland and masonry cement to and within the State	thousand short tons	1,668	1,948	2,034
Nonfuel mineral production value:				
Total crude mineral value	millions	$398.6	$451.5	$432.8
Value per capita		$66	$73	$69

[p]Preliminary. [r]Revised.
[1]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2]Data may not add to totals shown because of independent rounding.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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.—Foreign mineral production continued as a thorn in the side of several segments of the State's mineral industry. Imports of Scandinavian olivine, Canadian nepheline syenite (a feldspar substitute), South American lithium compounds, and Korean talc had a negative impact on these segments of the North Carolina mineral industry.

Mica prices were somewhat lower than 1984 levels, partially owing to the depressed demand for mica for oil well drilling mud.

A bright spot was the raw material demands of the State's construction industry. Buoyed by falling interest rates, construction experienced a banner year, which had a positive effect on clay for brick, industrial sand for glass products, and crushed stone for concrete applications.

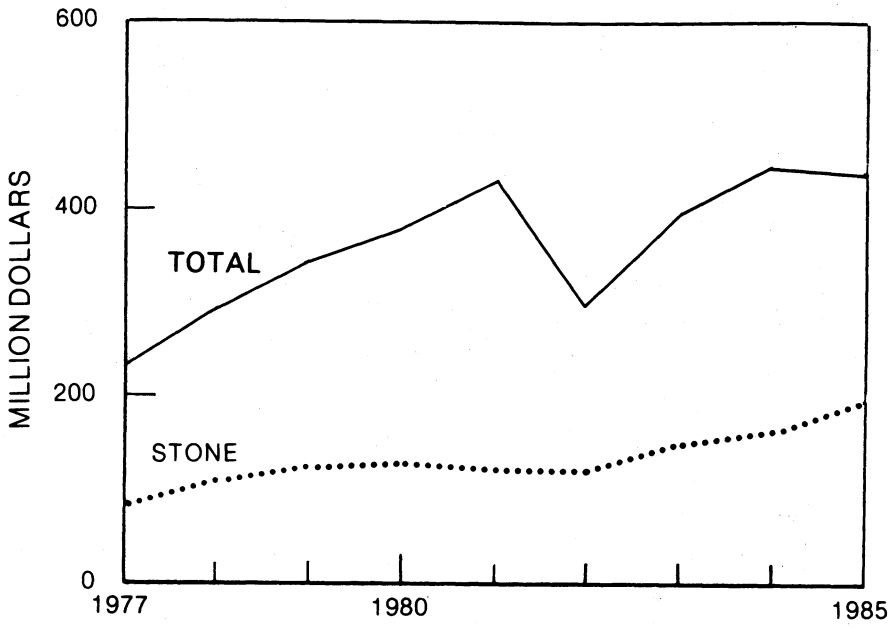

Figure 1.—Value of stone and total value of nonfuel minerals produced in North Carolina.

Despite the disappointing year following the 1984 record high, several companies involved with mineral recovery or production announced or completed construction plans. Among these were the following:

Company	Location	Remarks
E. I. duPont de Nemours & Co. Inc.	Arden	Completed construction on a plant to separate silver from photographic film waste.
The Feldspar Corp	Spruce Pine	Announced plans to construct a $7 million high-purity silica beneficiation facility.
International Minerals & Chemical Corp.	do	Completed expansion of high-grade silica chemical leach facility at its feldspar beneficiation complex in Mitchell County.

A number of North Carolina mineral companies were sold during the year, and at least one terminated production. Among these were the following:

Company	Location	Remarks
Great Lakes Carbon Corp	Morganton	The anode, electrode, crucible, and graphite vessel company was purchased by Horsehead Industries.
Lithium Corp. of America	Gastonia	Purchased by FMC Corp. of Chicago, IL, for $150 million.
National Olivine Co	Dillsboro	Terminated production and disposed of assets.
North Carolina Phosphate Corp	Beaufort County	Purchased by Texasgulf Inc., the State's only active phosphate producer.

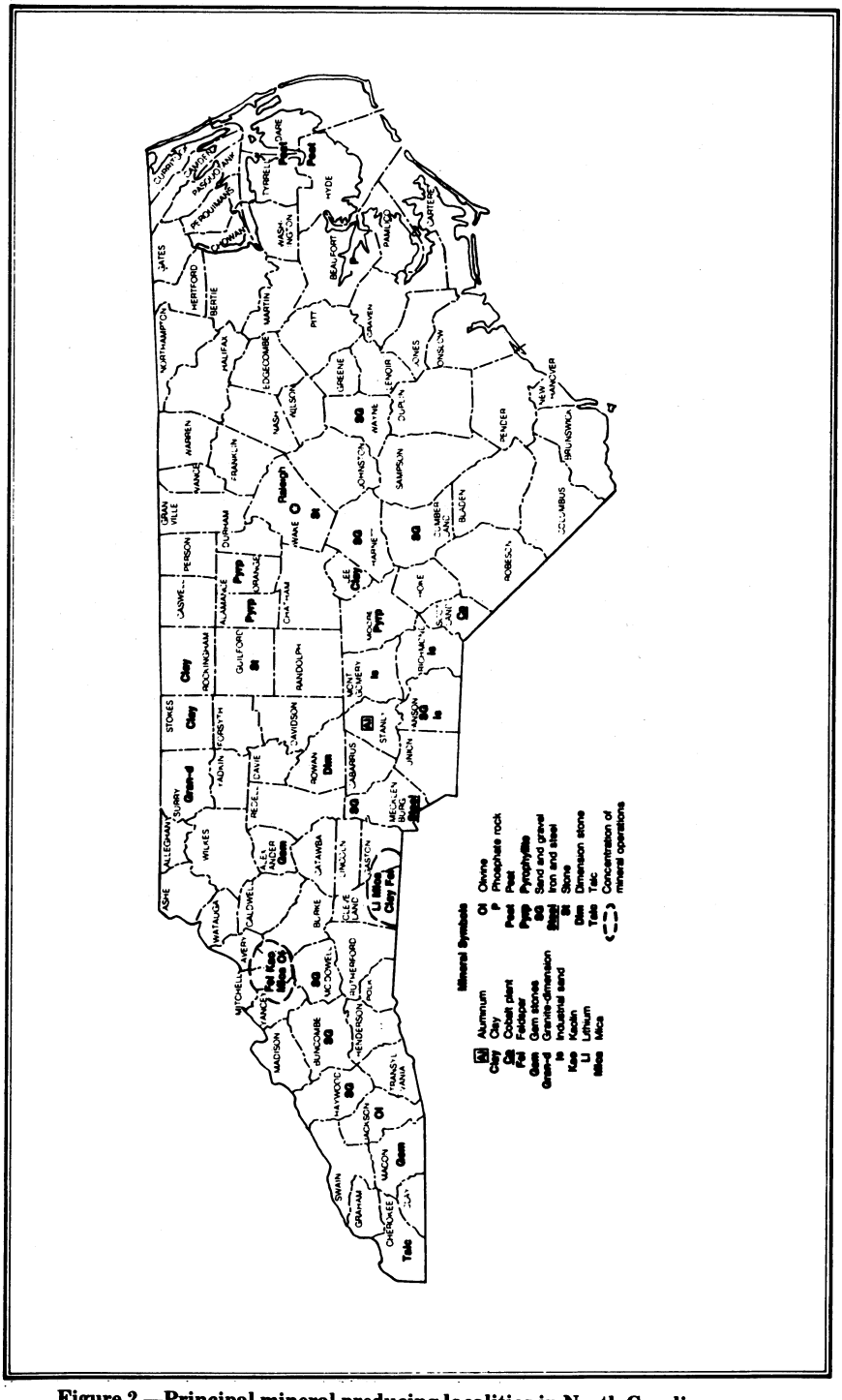

Figure 2.—Principal mineral producing localities in North Carolina.

Legislation and Government Programs.—The North Carolina Legislature, which convenes from mid-January to May on a biennial basis, amended an act (G.S. 1-42.9) that requires all persons who retained mineral rights upon selling property to record the mineral rights with the Register of Deeds' office for ad valorem tax purposes not later than January 1, 1988. If the rights are not recorded, ownership becomes null and void and the surface owner can gain fee simple title to the subsurface rights.

In other actions affecting the mining industry, the Cabarrus County commissioners requested the county planning board to define "extraction of earth products" in the county zoning ordinance. The definition was to agree with the 1971 State Mining Act. The request for a ruling on the definition followed a stone company's attempt to open a granite quarry in the Flower's Store area.

Several programs conducted by Federal agencies affected North Carolina mineral producers. The U.S. Bureau of Mines contacted State mineral producers to determine (1) water requirements in mineral processing and (2) reagent types and uses in froth flotation facilities.

The Bureau's Tuscaloosa Research Center in Tuscaloosa, AL, worked with engineers of a Franklin mica company to develop improved dewatering methods of fine particulate waste from mica grinding. The Bureau's Bruceton Research Center in Pennsylvania renewed the lease on the Lake Lynn limestone mine in southern Pennsylvania with Martin Marietta Corp. of Raleigh. The Lake Lynn facility is used to develop experimental mining and safety techniques.

Geologists with the U.S. Geological Survey (USGS) mapped in the Eastern Slate Belt as well as sampled offshore areas for heavy mineral deposits. The latter project was to determine the mineral potential of the Exclusive Economic Zone, an area extending 200 nautical miles offshore, which was proclaimed by the President in 1983. During 1985, the USGS published "Distribution of Beryllium in Heavy-Mineral-Concentrate Samples From the Charlotte 1° by 2° Quadrangle, North Carolina and South Carolina" (OF 84-0843-G), "Distribution of Barium in Heavy-Mineral-Concentrate Samples From the Charlotte 1° by 2° Quadrangle, North Carolina and South Carolina" (OF 84-0843-N), "Cassiterite Occurrences in the Shelby Area, North and South Carolina" (B 1569), and "High-Alumina Hydrothermal Systems in Volcanic Rocks and Their Significance to Mineral Prospecting in the Carolina Slate Belt" (B 1562).

The Tennessee Valley Authority (TVA) and the State continued work on their cooperative 5-year program to reclaim approximately 600 acres of abandoned feldspar and mica mines in a three-county area in the western part of the State. TVA has spent $400,000 on the project and, in 1985, contracted with the North Carolina Forest Service to transplant $25,000 worth of trees and wildlife shrubbery.

The North Carolina Geological Survey (NCGS), a section of the Division of Land Resources, completed compilation of a new State geologic map, scale 1:500,000. The map includes an explanatory legend, a lithotectonic map showing geologic belts and structures, and a map showing Paleozoic metamorphic facies. It was expected to be published in January 1986. A sample collection containing representative rock types from each State map unit was also established. The NCGS continued its cooperative 7.5-minute topographic map program with the USGS. The NCGS maintains a file of North Carolina topographic maps and sells diazo prints of 7.5-minute orthophoto quadrangles. Work continued on geologic descriptions of the State parks and on a geologic road guide to the Blue Ridge Parkway.

The Land Quality Section, also a section of the Division of Land Resources, administers the "State Mining Act." During the year, the section permitted 51 new mines and released 40 mines from permits. Of the new mines, 41 were sand and gravel operations, 3 were clay and shale, 3 were crushed stone, 2 were gem stone, 1 was dimension stone, and 1 was an industrial mineral. Total acres affected by mining in North Carolina in 1985 was approximately 19,770 acres with approximately 816 acres reclaimed.

The Minerals Research Laboratory in Asheville, part of the North Carolina State University system, is a recognized leader in the development and use of minerals beneficiation technology. Among the areas researched during the year were (1) secondary recovery of minerals currently discarded; (2) fine particle technology, grinding, sizing, and size characteristics; (3) development of environmentally safe processing systems; and (4) energy conservation. Work on the following mineral commodities was begun and/or completed during the year: barite, feldspar, kaolin, limestone, mica, magnesite, olivine, phosphate rock, pyrophyllite, quartz, spodumene, talc, vermiculite, and zinc.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

In 1985, North Carolina ranked 13th in industrial mineral output. All of the extractive mineral production in the State was in the industrial minerals category.

Cement.—Atlanta Cement Co. (ACC) operated a distribution terminal at Durham. The facility, with a 675-short-ton storage silo, serves the central and eastern North Carolina markets and portions of Virginia. The center distributes NewCem, the finely ground, water-granulated blast furnace slag produced by ACC at Sparrows Point, MD.[3] Blue Circle PLC acquired ACC during the year, and Blue Circle announced plans to construct a 30,000-piece-per-year sanitary ware manufacturing plant in North Carolina.[4]

Clays.—North Carolina's clay industry, 20 companies operating 49 mines in a 22-county area, produced 2.6 million short tons of common clay and shale and almost 77,000 tons of kaolin. This was an increase of 30,000 tons over the 1984 kaolin output. Almost all of the State's clay production is used to manufacture products used by the construction industry, and the strong showing in the residential and industrial construction sectors was a major factor in the higher clay output.

Common clay and shale and their metamorphic equivalent were the principal materials mined, and almost all of the production was used in the manufacture of brick. For the past several years North Carolina has been the leading State in the Nation in brick production, and the State's brickmakers have an annual capacity of 1.2 billion brick.[5] Brick production was at capacity in 1972 but fell to 341 million as a result of the recession in the early 1980's. In the past 3 years, the industry rebounded and produced 477 million brick in 1983, 535 million in 1984, and 539 million in 1985. Nineteen brick producers were active in North Carolina during 1985.

Kaolin was recovered as a coproduct of mica beneficiation by Unimin Inc., formerly Harris Mining Co., in Avery County and KMG Minerals Inc., formerly Kings Mountain Mica Co. Inc., at Kings Mountain. Principal markets for the kaolin were for ceramics and insulator and specialty brick manufacture.

Feldspar.—North Carolina again led the Nation in feldspar production, although production fell approximately 20,000 short tons below the 1984 level. The decline was primarily in the "other" category used by producers to report sales of feldspar for enamel, fillers, and miscellaneous uses.

Gem Stones.—The State ranked first in the Eastern United States in the mining and marketing of gem stones and mineral specimens. Several dozen small mining operations in the western and southwestern part of the State were open to the hobbyist and provided the opportunity to collect a variety of precious and semiprecious stones at a minimal cost. In the average operation, gem-bearing gravels were mined with a bulldozer or front-end loader and were offered for sale in 5-gallon containers. Screens and a water-filled flume provided the means to separate earth from the stone content of the container, which allowed the collector to examine the remaining rock fraction for gem content.

Principal gem stones and gem stone areas in the western part of North Carolina are as follows:

County	Nearest city	Principal gem stones
Alexander	Hiddenite	Emeralds and hiddenite.
Macon	Franklin	Rubies, sapphires, garnets.
Mitchell	Spruce Pine	Emeralds and aquamarine.

The Yukon Mine in Macon County was the scene of a 630-carat and 361-carat ruby discovery. The two had an uncut value of $39,640.

Graphite (Synthetic).—Morganite Inc., in Dunn, manufactured carbon brushes, bearings, and seals. The company, one of the largest employers in the Dunn area, employed over 500 workers. In January, the company's Fayetteville division was transferred to Dunn. In April, the company began work on a $200,000, 12,000-square-foot addition to its Ashe Avenue plant. The addition will double the size of the raw material preparation unit in which carbon powder is pressed to form carbon brushes.[6]

In April, Horsehead Industries Inc. purchased Great Lakes Carbon Corp. Included was the synthetic graphite plant in Morganton, which produces anodes, electrodes, crucibles, and graphite vessels.

Gypsum.—Texasgulf Inc. produced gypsum as a waste byproduct of phosphoric acid manufacture at Lee Creek in Beaufort County. A limited amount was used by local farmers, and a portion was used in the reclamation of mined-out pits. National Gypsum Co., in Wilmington, imported gypsum from Nova Scotia, Canada, for wallboard manufacture.

Lithium.—Although North Carolina continued to lead the Nation in lithium output, 1985 was a year of transition for the State's two lithium producers. Foote Mineral Co., with operations at Kings Mountain, reduced its work force and permanently eliminated one mining shift. Foote's lithium output will be maintained from its Silver Peak, NV, and Chilean operations. At yearend, Foote's North Carolina lithium carbonate plant, which has an 18-million-pound-per-year capacity, was operating at 45% capacity.[7]

Lithium Corp. of America Inc. (Lithco), with a mine and plant at Cherryville and offices in Gastonia, was purchased by FMC Corp. of Chicago, IL, for $150 million. The purchase price included an engineering firm in Houston, TX. Lithco, a former Gulf Resources & Chemical Corp. subsidiary, produces lithium carbonate and lithium metal.[8]

In May, Lithco gave Belmont Abbey College a $15,000 grant. The gift will enable the college to endow the Belmont Abbey College Lithium Chemistry Scholarship.[9]

In September, Lithco and Honjo Chemical Co. entered into a joint venture agreement to produce lithium chemicals in Japan. The agreement includes the construction of a new plant scheduled for completion by mid-1986. The plant will produce n-butyllithium, an initiator in polymer manufacture and an agent used in organic synthesis.

Mica.—North Carolina continued as the major scrap (flake) mica producing State in the United States. In 1985, the State's three primary producers and five secondary producers accounted for approximately 58% of the Nation's output. The demand for dry-ground mica, used largely in oil well drilling mud, was down owing to the depressed state of the world market. Nationally, the dry-ground mica production decreased 8%. However, the markets for wet-ground mica, used in paint, plastics, and a myriad of uses, remained strong.

Table 4.—North Carolina: Mica industry in 1985

Company	Location	Grinding process	Comments
Producers:			
Mica:			
Deneen Mica Co	Spruce Pine	Dry	Primary mica.
The Feldspar Corp	Kings Mountain	XX	Byproduct mica; sold USG Corp.
Foote Mineral Co	do	XX	Byproduct mica; sold to Asheville Mica Co.
Harris Mining Co.[1]	Spruce Pine	Dry	Primary mica.
J. M. Huber Corp	Bakersville	Wet	Processes mica schist and scrap from mica fabricators.
Indusmin Inc	Spruce Pine	XX	Byproduct mica; sold to Harris Mining Co.
International Minerals & Chemical Corp.[1]	do	XX	Do.
Kings Mountain Mica Co. Inc.[2]	Kings Mountain	Dry and wet	Primary mica.
Lithium Corp. of America Inc.	Cherryville	XX	Byproduct mica; sold to various firms.
Sericite:			
Piedmont Minerals Co	Hillsboro	XX	Sold to brick and ceramics industries.
Processors of purchased mica:			
Asheville Mica Co	Asheville	Dry	
Franklin Mineral Co	Franklin	Wet	Mica received from Georgia.
USG Corp	Spruce Pine and Kings Mountain.	Dry	
Fabricators:			
Spruce Pine Mica Co	Spruce Pine	XX	Mica obtained from foreign sources.
Tar Heel Mica Co	Plumtree	XX	Do.

XX Not applicable.
[1]Purchased by Unimin Corp. in 1985.
[2]Name changed to KMG Minerals Inc. in 1985.

Olivine.—North Carolina continued as the major olivine producing State in the Nation. Olivine, a magnesium silicate used in refractory applications, was mined by two companies by open pit methods from deposits in the western part of the State. Both wet- and dry-beneficiation methods were used. A third company terminated production in 1984, and its property and equipment were sold at auction in the spring of 1985.

Table 5.—North Carolina: Olivine industry in 1985

Company	Plant location	Mine	Nearest city	Process	Capacity
International Minerals & Chemical Corp. (purchased by AIMCOR in 1985).	Addie	--	Sylva	Dry	75 tons per hour.
Do	Green Mountain.	Dry Brook	Green Mountain.	Wet	115 tons per hour.
Spruce Pine Olivine Co	Mitchell County.	--	Mitchell County.	Dry	40,000 to 50,000 tons per year.

Phosphate Rock.—In 1984, North Carolina's phosphate rock output surpassed that of Idaho and the State moved to second place behind Florida in national rankings. All of North Carolina's phosphate rock production came from Texasgulf's mine at Lee Creek in Beaufort County. The Texasgulf mine used dredges to remove the upper section of the 100-foot-thick overburden. Following dredging and pit dewatering, draglines removed the remaining overburden and mined the matrix. The phosphate-bearing matrix was slurried to a nearby beneficiation plant where the phosphate rock was separated from impurities and used to manufacture phosphoric acid for fertilizer production.

In February, the 325-foot boom of the company's 8050 dragline fell because of a failure of the welds on the right masthead. The dragline, which normally produces about 43% of the ore mined, was out of production approximately 2 months.[10]

In March, company officials decided to close one of Texasgulf's five sulfuric acid plants, the No. 1 facility built in the 1960's, when a new plant becomes operational. The decision was based on computer predictions that indicated that with the existing plants and the new facility on-stream there was a possibility of air quality violations "under the worst possible" weather conditions.[11]

At yearend, Texasgulf purchased North Carolina Phosphate Corp. The latter, a subsidiary of The Williams Corp., had been developing a mine and calcining plant adjacent to the Texasgulf operation. As part of the transition, a Williams subsidiary, Agrico Chemical Co., obtained 15% of Texasgulf's stock and a waiver to purchase an additional 4.9%.

In the 1960's and 1970's, North Carolina Phosphate purchased approximately 70,000 acres and mineral rights to an additional 15,000 acres in the Beaufort County area in the vicinity of the Texasgulf operation.[12]

Pyrophyllite.—Three companies mined pyrophyllite, a hydrous aluminum silicate used in extender and filler applications and in the manufacture of refractories, in Moore and Orange Counties. Two companies with mines in Moore County produced a pyrophyllite product used as an insecticide filler and carrier, wallboard, and latex foam filler. The Orange County operation produced an andalusite pyrophyllite used in refractory applications.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend. In 1984, the last year construction sand and gravel output was surveyed, 107 companies operated 114 pits in a 51-county area.

Industrial.—Industrial sand and gravel was produced for industrial markets by five companies operating five pits in the Anson-Richmond contiguous area in the extreme south-central part of the State and in Harnett County in central North Carolina. The production and value noted in table 1 was reported by these producers.

International Minerals & Chemical Corp. produced a high-purity silica product from

silica recovered during feldspar beneficiation at its plant near Spruce Pine in the western part of the State.

The leading market for the State's industrial silica output, excluding high-technology electronic applications, was for glass container manufacture, followed in decreasing order of sales by flat glass, silica for sandblasting applications, filtration uses, and traction.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—The crushed stone industry in North Carolina consisted of 39 companies operating 86 quarries in a 51-county area. The three leading counties, in descending order of production, were Wake, Mecklenburg, and Guilford, accounting for almost 30% of the total output.

Table 6.—North Carolina: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	624	3,609
Filter stone	236	1,475
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,822	21,225
Bituminous aggregate, coarse	1,332	6,412
Bituminous surface-treatment aggregate	1,369	7,506
Railroad ballast	1,947	6,751
Fine aggregate (-3/8 inch):		
Stone sand, concrete	3,301	16,482
Stone sand, bituminous mix or seal	438	1,788
Screening, undesignated	2,103	7,733
Combined coarse and fine aggregates:		
Graded road base or subbase	9,951	39,910
Unpaved road surfacing	383	2,007
Crusher run or fill or waste	10,888	56,327
Other construction[2]	1,961	9,657
Agricultural: Poultry grit and mineral food	4	50
Special:		
Other fillers or extenders	8	93
Other miscellaneous[3]	24	99
Other unspecified[4]	3,381	13,692
Total[5]	41,771	194,818

[1]Includes granite, limestone, marl, quartzite, slate, traprock, and miscellaneous stone.
[2]Includes stone used in agricultural limestone, terrazzo and exposed aggregate, and stone used for other construction and maintenance purposes.
[3]Includes other uses not listed.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Dimension.—Dimension stone for traditional uses was produced by 8 companies from 12 quarries in a 9-county area in the western part of the State. Leading sales categories included curbing, rough blocks, and sawed stone. A summary of county, company, and stone types quarried is as follows:

County	Company	Stone type
Cherokee	Moretti-Harrah Marble Co	Marble.
Davidson and Montgomery	Jacob's Creek Stone Co	Slate (argillite).
McDowell, Polk, Watauga	O. J. Wilson Stone Co	Sandstone.
Mitchell	Boone Stone Co	Granite.
Rowan	Florida Crushed Stone Co	Do.
Do.	Nickville Granite Co. Inc	Do.
Do.	L. S. Starrett Co.	Do.
Surry	North Carolina Granite Corp.	Do.

Table 7.—North Carolina: Dimension stone[1] sold or used by producers in 1985, by use

Use	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Rough blocks for building and construction	4,361	53	$324
Irregular-shaped stone	1,949	24	54
Dressed stone:			
Ashlars and partially squared pieces	1,006	12	227
Other[2]	28,017	336	5,526
Total[3]	35,333	424	6,132

[1]Includes limestone, marble, and sandstone.
[2]Dressed slabs and blocks for building and construction, monumental, and flagging.
[3]Data may not add to totals shown because of independent rounding.

Talc.—Warner Corp. in Murphy operated the State's only underground mine to produce crude talc from deposits associated with the Murphy marble. The crude material was milled into a cosmetic powder and sawed into talc pencils for the metal industry. Foreign imports have displaced a major portion of the talc pencil market.

METALS

Aluminum.—Aluminum Co. of America (Alcoa) operated a 115,000-metric-ton-per-year smelter at Badin in Stanly County. At yearend, the facility was operating at approximately 75% of capacity. In midyear, the North Carolina Supreme Court ruled that Alcoa must refund a portion of the utility fees collected from customers from 1977 to 1981. Alcoa operates a series of dams for power generation for the Badin smelter, and excess power is marketed through the company's subsidiary, Nanatahala Power and Light Co.

Chromium.—Diamond Shamrock Chemical Co. operated one of the two remaining chromium chemical plants in the United States at Castle Hayne. Early in the year, Diamond Shamrock signed an agreement with Allied Chemical Co. to convert chrome ore and other Allied-supplied raw materials into a chromium bisulfate liquor for Allied's Baltimore, MD, plant for processing into finished products. However, economics forced Allied to close the Baltimore facility, negating the agreement.

Cobalt.—Carolmet Inc., a subsidiary of Métallurgie Hoboken-Overpelt SA of Belgium, operated a cobalt processing facility near Laurinburg. Electrolytic cobalt imported from Zaire was processed at the Laurinburg plant into extra-fine cobalt powder used primarily to manufacture tungsten carbide. In processing, cobalt was converted to cobalt oxalate, which was thermally decomposed in an electric furnace, producing a metallic sponge. The sponge was ground to an average particle diameter of 1.5 micrometers. The North Carolina cobalt facility, the only one in the United States, was built at the invitation of the U.S. Department of Defense.

Copper.—SCM Co., Glidden Metals Div., operated a powdered copper plant at Durham. The 5,000-pound-capacity facility used scrap for feed and produced powder used primarily in the manufacture of aircraft brake parts and off-highway transmission parts.

Gold.—The Parker gold mine, closed since the 1930's, was the scene of renewed activity during 1985. A three-person crew was renovating the property west of New London in Stanly County and began mining late in the year.

Lithium.—North Carolina's two lithium producers, Foote and Lithco, used molten salt electrolysis to produce lithium metal ingots, rod, wire, shot, and dispersions.

Silver.—E. I. duPont de Nemours & Co. Inc. began operation of a plant to separate silver emulsions from film waste. The plant, in Arden, separated silver halide emulsion from unprocessed photographic film waste obtained from the company's photo systems and electronics products department in Brevard. The dilute emulsion is returned to Brevard where it is processed into powder and sold to recyclers for silver recovery.

Steel.—Florida Steel Co. operated the State's only steel mill in Charlotte. The facility is equipped with two electric arc 18,000-kilovolt-ampere furnaces, one 12-1/2 feet in diameter and the second 13-1/2 feet in diameter, and two 2-stand continuous casters that produce billets, reinforcing bars, hot-rolled bars, and bar-size light shapes. The facility has an annual billet capacity on a 120-hour-per-week schedule of 200,000 net tons.

Titanium.—Teledyne Allvac, a subsidiary of Teledyne Inc., produced various bar con-

figurations of nickel-based superalloy and titanium superalloys. The nickel superalloys are used in parts fabrication for jet and gas turbine engines and chemical processing plants and for sour gas deep-drilling applications. The titanium alloys are used primarily in the aerospace and biomedical industries.

[1]State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.
[2]Geologist, North Carolina Geological Survey Section, Raleigh, NC.
[3]Rock Products. V. 88, No. 3, Mar. 1985, p. 51.
[4]Industrial Minerals (London). World of Minerals: USA. No. 212, May 1985, p. 13.
[5]News and Observer (Raleigh). Brick Industries Heritage Was Solid Base for Growth. July 21, 1985.
[6]Daily Record (Dunn). Morganite on Rebound After Recent Layoffs. Oct. 25, 1985.
[7]Metals Week. Foote Follows Lithco Hike. Jan. 13, 1986, p. 3.
[8]Gazette (Gastonia). Lithco Sold to FMC for $150 Million. May 31, 1985.
[9]Banner (Belmont). Belmont Abbey Gets Grant. June 5, 1985.
[10]Lee Creek News. Down But Not Out. Mar.-Apr. 1985, p. 2.
[11]Daily News (Washington). TG to Close Plant, Another Will Open. May 31, 1985.
[12]News and Observer. NC Phosphate Merges With Biggest NC Rival. Oct. 25, 1985.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum, smelter:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Stanly.
Clays:			
Hammill Construction Co	Route 2, Box 33H Gold Hill, NC 28071	Open pit mines and plant.	Cabarrus and Rowan.
Pine Hall Brick & Pipe Co	Box 11044 Winston-Salem, NC 27105	do	Rockingham and Stokes.
Virginia Solite Corp	Box 27211 Richmond, VA 23261	do	Rockingham and Stanly.
Feldspar:			
The Feldspar Corp.[1]	Box 99 Spruce Pine, NC 28777	Open pit mines and plants.	Mitchell.
Indusmin Inc.[1]	Box 309 Spruce Pine, NC 28777	do	Do.
International Minerals & Chemical Corp.[1] (purchased by Unimin Corp. in 1985).	23157 Sanders Rd. Northbrook, IL 60062	do	Do.
Lithium:			
Foote Mineral Co.[2]	Box 792 Kings Mountain, NC 28086	Open pit mine and plant.	Cleveland.
Lithium Corp. of America Inc.[1 2]	449 North Cox Rd. Gastonia, NC 28052	do	Gaston.
Mica:			
Deneen Mica Co	Box 28 Micaville, NC 28755	Open pit mines	Yancey.
Harris Mining Co.[3] (purchased by Unimin Corp. in 1985).	Box 628 Spruce Pine, NC 28777	do	Avery.
Kings Mountain Mica Co. Inc.[2] (name changed to KMG Minerals Inc. in 1985).	Box 709 Kings Mountain, NC 28086	do	Cleveland.
Olivine:			
International Minerals & Chemical Corp. (purchased by AIMCOR in 1985).	Box 672 Spruce Pine, NC 28777	Open pit mine and plant.	Jackson and Yancey.
Perlite (expanded):			
Carolina Perlite Co. Inc	Box 741 Hillside, NJ 07205	Plant	Rowan.
Phosphate rock:			
Texasgulf Inc.[4]	Box 48 Aurora, NC 27806	Open pit mine and plant.	Beaufort.
Pyrophyllite:			
Glendon Pyrophyllite Inc	Box 306 Carthage, NC 28327	Open pit mines and plant.	Alamance and Moore.
Piedmont Minerals Co.[5]	Box 7247 Hillsborough, NC 27407	Open pit mine and plant.	Orange.
Standard Minerals Co. Inc	Box 278 Robbins, NC 27325	do	Moore.
Sand and gravel (construction, 1984):			
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 8 Lilesville, NC 28091	do	Buncombe.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Martin Marietta Corp	Box 30013 Raleigh, NC 27622	Pits	Various.
Nello L. Teer Co	Box 1131 Durham, NC 27702	----do	Do.
Vulcan Materials Co., Mideast Div.	Box 4195 Winston-Salem, NC 27109	----do	Do.
Talc:			
Warner Corp	Box 672 Murphy, NC 28906	Underground mine	Cherokee.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Guilford.

[1]Also mica.
[2]Also feldspar.
[3]Also clays.
[4]Also byproduct gypsum.
[5]Also sericite.

The Mineral Industry of North Dakota

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

By Doss H. White, Jr.,[1] David W. Brekke,[2] and Wanda J. West[3]

North Dakota's nonfuel mineral production was valued at $24.2 million in 1985, an increase of $2.4 million over the value of production reported for 1984, but $1.2 million below the record high value reported for 1983. The State ranked 48th nationally in nonfuel mineral production, accounting for less than 1% of the U.S. total. Construction sand and gravel continued to contribute the greatest amount to the State's nonfuel mineral value, followed in order of value by lime, salt, clays, crushed stone, and peat. Sales increased for construction sand and gravel, salt, and peat and declined for lime and clays. Crushed stone production was reported for the first time since 1975.

Table 1.—Nonfuel mineral production in North Dakota[1]

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$2	NA	$2
Lime thousand short tons	60	5,912	56	5,562
Sand and gravel (construction) do.	6,426	11,351	e6,900	e13,800
Combined value of clays, peat, salt, and stone (crushed, 1985)	XX	4,529	XX	4,820
Total	XX	21,794	XX	24,184

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

Table 2.—Nonfuel minerals produced in 1984, by county[1]

County	Minerals produced in order of value
Adams	Sand and gravel (construction).
Barnes	Do.
Benson	Do.
Billings	Do.
Bottineau	Peat.
Bowman	Sand and gravel (construction), salt.
Burke	Sand and gravel (construction).
Burleigh	Do.

See footnotes at end of table.

Table 2.—Nonfuel minerals produced in 1984, by county[1] —Continued

County	Minerals produced in order of value
Dickey	Sand and gravel (construction).
Dunn	Do.
Eddy	Do.
Foster	Do.
Golden Valley	Do.
Grand Forks	Do.
Grant	Do.
Griggs	Do.
Hettinger	Do.
Kidder	Do.
La Moure	Do.
Logan	Do.
McHenry	Do.
McIntosh	Do.
McKenzie	Sand and gravel (construction), salt.
McLean	Sand and gravel (construction).
Mercer	Do.
Morton	Sand and gravel (construction), clays.
Mountrail	Sand and gravel (construction).
Oliver	Do.
Pembina	Lime.
Pierce	Sand and gravel (construction).
Ramsey	Do.
Ransom	Do.
Renville	Do.
Richland	Lime, sand and gravel (construction).
Rolette	Sand and gravel (construction).
Sargent	Do.
Sheridan	Do.
Sioux	Do.
Slope	Do.
Stark	Do.
Stutsman	Do.
Towner	Do.
Traill	Lime, sand and gravel (construction).
Walsh	Sand and gravel (construction).
Ward	Do.
Williams	Salt, sand and gravel (construction).
Undistributed[2]	Gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of North Dakota business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	681	687	685
Total civilian labor force	do	319	327	336
Unemployment	percent	5.6	5.1	5.9
Employment (nonagricultural):				
Mining total	thousands	7.0	7.5	6.9
Nonmetallic minerals except fuels[1]	do	.4	.4	.4
Coal mining[2]	do	1.2	1.3	1.4
Oil and gas extraction	do	5.4	5.8	5.1
Manufacturing total	do	14.8	15.5	15.4
Stone, clay, and glass products	do	.8	.8	.8
Chemicals and allied products[2]	do	.1	.1	.1
Petroleum and coal products[2]	do	.4	.4	.4
Construction	do	17.3	13.7	11.7
Transportation and public utilities	do	16.1	16.4	16.4
Wholesale and retail trade	do	66.1	67.6	67.5
Finance, insurance, real estate	do	12.0	12.2	12.4
Services	do	56.0	57.4	57.8
Government and government enterprises	do	61.3	62.2	63.1
Total	do	250.6	252.5	251.2
Personal income:				
Total	millions	$7,388	$7,984	$8,255
Per capita		$10,846	$11,629	$12,052
Hours and earnings:				
Total average weekly hours, production workers		38.0	38.4	38.6
Total average hourly earnings, production workers		$7.7	$7.9	$8.1

See footnotes at end of table.

Table 3.—Indicators of North Dakota business activity —Continued

		1983[r]	1984	1985[p]
Earnings by industry:				
Farm income	millions	$278	$617	$655
Nonfarm	do	$4,793	$4,970	$5,089
Mining total	do	$203	$226	$216
Nonmetallic minerals except fuels	do	$10	$11	$10
Coal mining	do	$52	$57	$64
Oil and gas extraction	do	$142	$158	$141
Manufacturing total	do	$298	$320	$333
Primary metal industries	do	(3)	(3)	(3)
Stone, clay, and glass products	do	$18	$17	$17
Chemicals and allied products	do	$3	$3	$3
Construction	do	$546	$437	$371
Transportation and public utilities	do	$493	$542	$564
Wholesale and retail trade	do	$988	$1,027	$1,040
Finance, insurance, real estate	do	$232	$249	$274
Services	do	$960	$1,042	$1,092
Government and government enterprises	do	$1,038	$1,093	$1,167
Construction activity:				
Number of private and public residential units authorized[4]		4,392	3,185	2,641
Value of nonresidential construction[4]	millions	$102.4	$97.7	$88.1
Value of State road contract awards	do	$102.8	$119.6	$137.7
Shipments of portland and masonry cement to and within the State[5]	thousand short tons	323	352	291
Nonfuel mineral production value:				
Total crude mineral value	millions	$25.4	$21.8	$24.2
Value per capita		$37	$32	$35

[p]Preliminary. [r]Revised.
[1]Job Service North Dakota.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]Less than 1/2 unit.
[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.
[5]Has no cement producing plants.

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

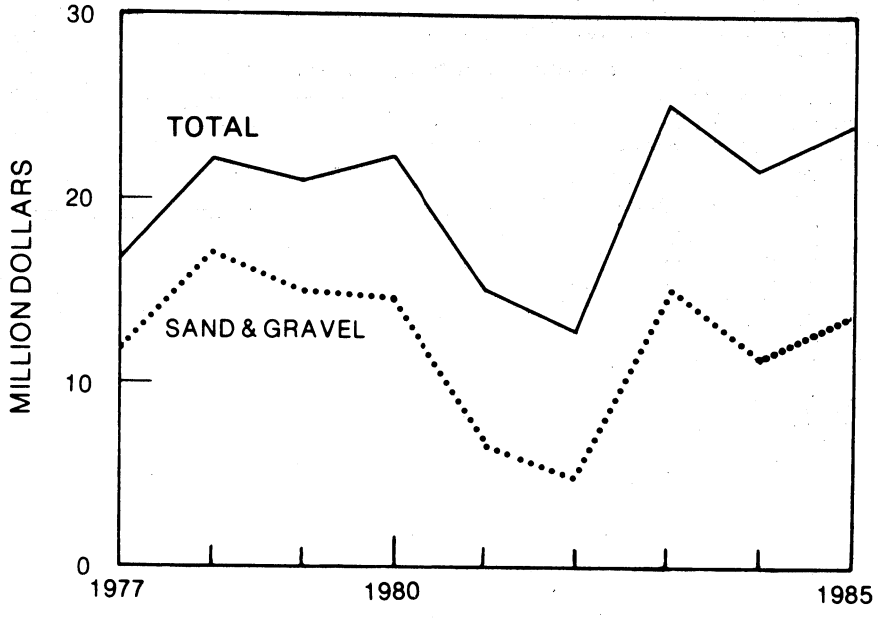

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in North Dakota.

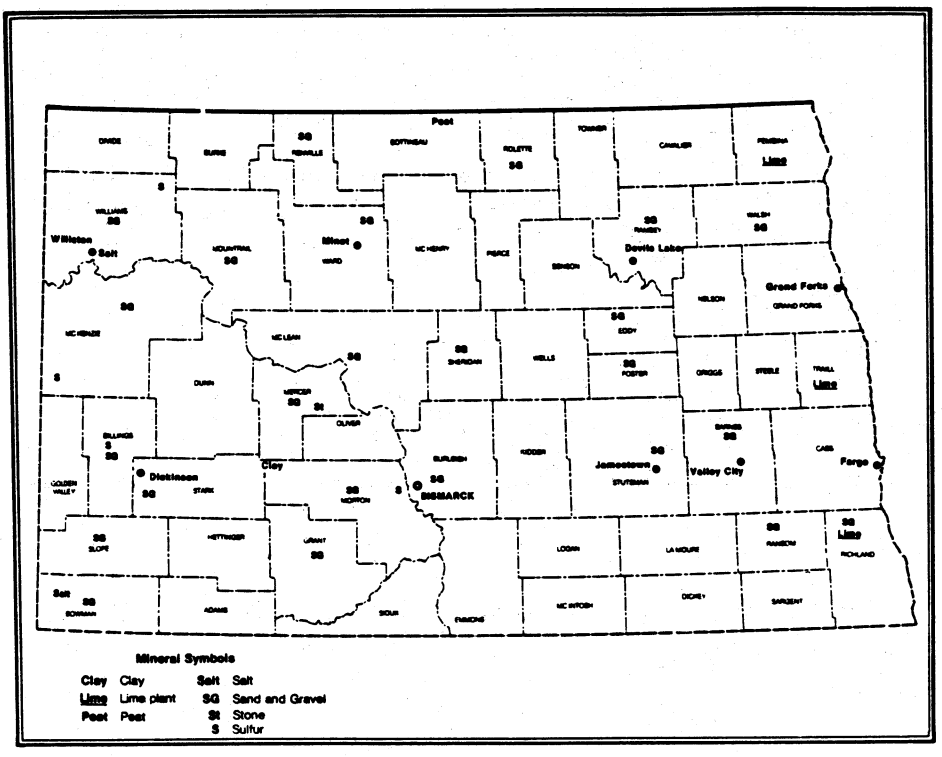

Figure 2.—Principal mineral producing localities in North Dakota.

Trends and Developments.—Controversy developed late in 1985 over the proposed sale of more than 1 million acres of mineral rights in North Dakota by the Farm Credit Services (FCS) of St. Paul, MN. The farm lending agency, financially strapped because of bad loans caused by the poor farm economy, began to seek bids on the mineral rights in an overall attempt to get a higher return on its assets to meet liabilities. Since the 1930's, the agency had acquired the mineral rights through land foreclosures, and when tracts of land were resold, it had retained a 50% interest in the mineral estate.

The North Dakota mineral rights were to be sold in a single block even though the State's Governor requested FCS to reconsider its proposal and to allow individual surface owners to submit bids for the mineral rights on their own land. When the Governor's request was rejected, the North Dakota Board of University and School Lands, along with other entities, submitted bids to FCS for the mineral rights, but all bids were refused.

In 1975, the North Dakota State Soil Conservation Committee was designated by the legislature to administer the Surface Mining Reports Law, which requires any person conducting surface mining operations for minerals other than coal to com-

ply with the reporting requirements of Chapter 38-16 (North Dakota Century Code). The law requires reports from any person conducting surface mining operations for minerals, other than coal, who, within 1 calendar year, removes 10,000 cubic yards or more of earthen material or products, including overburden, or affects one-half acre or more, in combined mining operations. Minerals included are cement rock, clays, gravel, limestone, manganese, molybdenum, peat, potash, pumicite, salt, sand, scoria, sodium sulfate, stone, zeolite, or other noncoal minerals. The Surface Mining Reports Law also requires the State Soil Conservation Committee to prepare and transmit to local soil conservation districts a report giving information about surface mining operations and reclamation activities conducted during the preceding calendar year. A summary of mining activities for the period 1983-85, based on data compiled under the Surface Mining Reports Law, is provided in table 4.

Table 4.—North Dakota: Noncoal surface mining activities

		1983	1984	1985
Number of mine operators		46	40	38
Number of active pits		128	153	107
Acres disturbed		442	462	370
Minerals mined:				
Clays	thousand cubic yards	41	133	44
Rock (cobbles)	do.	--	--	11
Sand and gravel	do.	2,752	3,330	2,974
Scoria	do.	93	104	83

Source: North Dakota State Soil Conservation Committee. 1983, 1984, and 1985 issues of Surface Mining Report for Minerals Other Than Coal.

Employment.—In 1985, average annual employment in both the fuel and nonfuel sectors of the minerals industry totaled 6,870—5,120 in petroleum and natural gas, 1,370 in coal, and 380 in nonfuel mineral production. Employment in the nonfuel mining industry ranged from 200 in March to 530 in July and August. The 1985 average of 380 was down 40 from the 1984 average. Petroleum and natural gas employment was down nearly 600 jobs as the sagging world oil price forced many domestic producers to curtail activity.

In Mercer County, construction employment fell by 2,000 jobs, and the demand for construction mineral commodities decreased significantly with the completion of the Great Plains coal gasification plant at Beulah.[4]

Exploration Activities.—Mineral exploration during 1985 was slow. The North Dakota Geological Survey (NDGS) issued seven permits for coal exploration, and all were for extensions of existing mines. One company expressed interest in gold-bearing gravels in the Souris River Basin in north-central North Dakota.[5]

Oil production in the State fell approximately 1 million barrels from the record high of 52.6 million barrels produced in 1984. The average number of oil rigs operating in North Dakota during 1985 was approximately 38, with a low of about 25 in March and April and a high of more than 50 in November. In June, about 40 drilling rigs were operating, compared with 55 rigs in June of 1984.

Legislation and Government Programs.—During the 1985 legislative session, House bill 1569 was enacted, requiring the reclamation of sand and gravel mines opened after July 1, 1985. Under the new law, a mine operator must negotiate a written agreement with the landowner to restore the affected acreage, as nearly as possible, to the original condition within 1 year after the surface mining has been completed unless the land is to be used for another purpose.

Other bills of interest to the North Dakota mineral industry, enacted during 1985, included the following:

House bill 1399 required seismic companies to plug drill holes and to notify the board of county commissioners when the hole is plugged.

House bill 1470 provided for an exemption to the coal severance tax for coal consumed for sugar refining or agricultural use.

House bill 1544 established a fund to provide oil and gas reservoir data compiled by the State Industrial Commission to government agencies and the general public.

House bill 1600 exempted minerals in the earth from property taxes until the miner-

als are mined and are subject to the coal severance tax or oil and gas gross production tax.

Senate bill 2254 allowed surface coal mining companies to mitigate adverse effects on significant cultural resource sites prior to permit approval, in accordance with plans approved by the superintendent of the State Historical Board.

Senate bill 2449 allowed a 5% coal severance tax reduction under certain circumstances.

House concurrent resolution 3024 authorized the Board of University and School Lands to exchange State coal mineral interests with Federal coal mineral interests.

Several attempts to provide incentives to the oil and gas industry met with defeat in the legislature because of the lack of a two-thirds majority approval. The petroleum industry advocated broader and more meaningful tax relief, whereas the Governor supported relief only for successful wildcats.

The NDGS, with offices on the University of North Dakota campus in Grand Forks, is the primary research agency in the State concerned with North Dakota's mineral resources. The NDGS, staffed by 12 geologists and engineers, maintained a core and well cutting library and also regulated coal exploratory drilling, subsurface mining, nuclear waste disposal, and geothermal resource exploration.

During 1985, work was ongoing to determine the geology, depositional environment, history, and subsurface stratigraphy distribution in the Williston Basin. Several studies on oil and gas reservoir characteristics and production were under way. Work on mapping the quality and quantity of North Dakota's ground water continued. Other programs were related to environmental concerns, paleontological studies, paleoclimatic investigations, and surface geology of the State. NDGS initiated a new map compilation project based on an atlas approach to the geology of North Dakota. The map sheets will show surface and subsurface geology, subsurface stratigraphy, mineral resources, and other specialized topics at a scale of 1:250,000 and will cover an area of 1° of latitude by 1° of longitude. Results of several research projects were published in 1985, including "Geology of Bottineau County," "Geology of McKenzie County," "Hydrology and Ground Water Resources of McKenzie County," and a new list of publications. The Core and Sample Library facility received 480 visitors, mostly industry geologists, who examined and studied 23,455 feet of Williston Basin core.

Several programs conducted by Federal agencies were related directly or indirectly to North Dakota's mineral industry. The U.S. Bureau of Mines is the Nation's principal scientific engineering agency involved in minerals data collection and analysis and in the research and development of improved, safe, and environmentally acceptable methods of mining and processing the minerals required to support the Nation's economy. During 1985, all North Dakota nonfuel mineral producers, except sand and gravel producers, were canvassed to develop baseline data on mineral production and value. This was part of an annual, nationwide program to track domestic mineral output and to identify trends in supply and demand and areas of potential research.

The Bureau's Intermountain Field Operations Center, Denver, CO, published "Preliminary Mining Feasibility Study, Area A, Lignite Reserves in Roseglen Tract, Fort Berthold Indian Reservation, North Dakota," in February.

The NDGS, under contract to the U.S. Bureau of Mines, produced a report titled "Types, Causes, and Effects of Instability Phenomena in Reclaimed Spoils at Two Surface Coal Mines in Western North Dakota." A second report consisting of appendices and containing data on survey marker movements during spoils settlement from 1977 through 1982 was also released.

The Bureau funded the Mining and Mineral Resources Research Institute at the University of North Dakota, Grand Forks, in fiscal year 1985. The funding was part of a program that provided funds for 31 institutes in mining States around the United States. The funds assisted the institute's operations and research and its efforts to encourage the training of engineers and scientists in mineral-related disciplines.

The U.S. Department of the Interior's Office of Surface Mining granted $430,000 to the Reclamation Division of North Dakota's Public Service Commission. The grant was to provide funding for 13 mine inspectors, equipment, supplies, and travel for a 12-month period beginning July 1, 1985.[6]

The U.S. Department of the Interior gave North Dakota $515,000 "as compensation for fiscal impacts caused by the presence of certain tax-exempt lands within its boundaries." The payments are in addition to revenues from the sale of minerals, oil and gas leases, and other materials and products derived from public lands that the Federal Government also shares with State governments.[7]

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Clays.—North Dakota's clay production was below that of 1984. Hebron Brick Co., the State's only commercial clay producer, mined common clay near Hebron in Morton County in the southwestern part of the State. Output, from two pits developed in the White River Formation, was used in the manufacture of brick and tile. The company's Hebron plant has an annual capacity of approximately 20 million brick.

The Benson County Highway Department also mined clay for road base and fill applications.

A second commercial clay producer, U.S. Noonlite Ltd., closed in 1984. The company, also in Morton County, had been expanding a local clay to produce a lightweight aggregate for use in concrete and concrete block manufacture.

Gem Stones.—Although there was no commercial gem mining reported in the State in 1985, both individuals and clubs collected gem and mineral specimens from several North Dakota locations.

Lime.—Quicklime was produced by two companies in the eastern part of the State for use in sugar refining. American Crystal Sugar Co. operated plants at Drayton, Pembina County, and Hillsboro, Traill County. Minn-Dak Farmers Coop. operated a plant at Wahpeton, Richland County. Production and value dropped about 6% in 1985. Limestone used in the manufacturing process was shipped in from out-of-State sources.

About 106,000 tons of quicklime and 4,000 tons of hydrated lime, all from domestic sources, were consumed in the State during the year.

Peat.—One firm, Peat Products Co., harvested reed-sedge peat from a bog in Bottineau County on the Canadian border. Sales of the material, marketed in both bulk and packaged form, increased 12% over the 1984 level.

Salt.—North Dakota's salt production was in the extreme western and southwestern part of the State by two firms that solution mined bedded salt of Permian and Mississippian age. Hardy Salt Co. produced evaporated salt from brines in Williams County, and Koch Exploration Co. produced brines in Bowman County. Production increased modestly during 1985. The salt was marketed for a variety of purposes that included food processing and water softening; it was also used as an oil-well-drilling mud component.

During 1985, Diamond Crystal Salt Co. of St. Clair, MI, purchased the Salt Div. of St. Louis-based Hardy Salt Co. for $9.5 million in cash while also assuming up to $2.4 million in liabilities. In addition to acquiring Hardy's evaporated salt plant at Williston, Diamond Crystal also acquired a similar Hardy plant in Manistee, MI, and distribution centers in Minnesota, Missouri, Ohio, Utah, and Wisconsin.

Sand and Gravel (Construction).—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Stone (Crushed).—Two companies processed scoria (baked shale from the burning lignite beds) in Mercer County for road surfacing material.

Sulfur (Recovered).—Elemental sulfur was produced during natural gas processing at five plants in Billings, McKenzie, and Williams Counties in the western part of the State and at a petroleum refinery in Morton County in the southern part of North Dakota. Sulfur sales, 109,000 metric tons valued at $6.1 million, were 3,000 tons less than 1984 sales. Total value increased $555,000.

In December, a natural gas processing plant near Tioga, which recovers sulfur, exploded, killing one worker. The facility was not expected to resume operations until mid-1986.[8]

Vermiculite (Exfoliated).—Robinson Insulation Co., of Minot, sold bagged exfoliated vermiculite for insulation applications. The material was shipped in from the company's Great Falls, MT, plant.

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[3]Editorial assistant, Bureau of Mines, Minneapolis, MN.

[4]Job Service North Dakota. North Dakota—1984 Versus 1985. North Dakota Labor Market Advisor, v. 2, No. 2, Feb. 1986, p. 1.

[5]Mining Engineering. Exploration 1985. V. 38, No. 5, May 1986, p. 330.

[6]Leader (Washburn, ND). PSC Receives Reclamation Grant for Regulation. June 26, 1985.

[7]U.S. Department of the Interior News Release. Local Governments To Receive Payments for Tax-Exempt Federal Lands. Sept. 23, 1985.

[8]The Bismarck Tribune. Tioga Plant Won't Reopen for 6 Months. Dec. 24, 1985.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Hebron Brick Co	Hebron, ND 58638	Pit and plant	Morton.
Lime:			
American Crystal Sugar Co	101 North 3d St. Moorhead, MN 56560	Shaft kilns at beet sugar refineries.	Pembina and Traill.
Minn-Dak Farmers Coop	Wahpeton, ND 58075	do	Richland.
Peat:			
Peat Products Co	821 4th St. Bismarck, ND 58501	Bog	Bottineau.
Salt:			
Hardy Salt Co	Drawer 449 St. Louis, MO 63166	Solids evaporated from brines.	Williams.
Koch Exploration Co	Box 2256 Wichita, KS 67201	Brines	Bowman.
Sand and gravel (construction, 1984):			
Badinger Sand & Gravel Co	Box 306 Dickinson, ND 58601	Pits and plants	Bowman, Dunn, Eddy, Golden Valley, Grant, Sioux, Slope.
Des Lacs Sand & Gravel Co	Box 66 Des Lacs, ND 58733	do	McLean, Mountrail, Rolette, Ward, Williams.
Earth Builders Inc	Box 838 Bismark, ND 58501	do	Adams, Bowman, Ward, Williams.
Fisher Sand & Gravel Co	Box 1034 Dickinson, ND 58601	do	Bowman, Hettinger, McKenzie, McLean, Mercer, Morton, Oliver, Stark.
Holen Construction Co	Box 126 McClusky, ND 58463	do	Billings, Kidder, McKenzie, Sheridan.
Lindteigen Construction Co. Inc	Turtle Lake, ND 58575	do	Foster, Griggs, McLean, Morton.
Northern Improvement Co	Box 1254 Bismarck, ND 58501	do	Burleigh and Morton.
Schriock Construction Inc	3009 South Broadway Minot, ND 58701	do	Golden Valley, Kidder, McKenzie, Mercer, Mountrail, Renville.
Stone (crushed):			
Helm Bros	Box 787 Mandan, ND 58554	Pit	Mercer.
North American Coal Corp	Box 299 Beulah, ND 58523	Pit	Do.
Sulfur (recovered):			
Chevron USA Inc	Box 1589 Tulsa, OK 74101	Plant	Billings.
Koch Hydrocarbon Co	Box 2256 Wichita, KS 67201	do	McKenzie.
Phillips Petroleum Co	14 B-1 Phillips Bldg. Bartlesville, OK 74004	Plants	Williams.
Western Gas Processors Ltd	10701 Melody Dr. Northglenn, CO 80234	Plant	Billings.

The Mineral Industry of Ohio

By L. J. Prosser, Jr.[1]

The value of nonfuel mineral production in Ohio in 1985 was about $607 million, the highest total since 1979. Nationally, the State ranked 13th in value of mineral production. The $54 million gain in value in 1985 resulted primarily from generally improved economic conditions and increased demand from the construction industry.

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

Mineral		1984		1985	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	101	$8,092	110	$10,412
Portland	do.	1,525	69,810	1,769	84,929
Clays	do.	1,960	10,473	2,114	10,581
Gem stones		NA	W	NA	10
Lime	thousand short tons	1,859	87,951	1,730	84,142
Peat	do.	13	345	16	413
Salt	do.	W	W	4,783	143,949
Sand and gravel:					
Construction	do.	31,748	104,709	e33,000	e109,000
Industrial	do.	1,506	20,829	1,312	21,945
Stone:					
Crushed	do.	e38,500	e139,000	38,310	136,544
Dimension	do.	e37	e3,454	53	3,661
Combined value of abrasives, gypsum, and value indicated by symbol W		XX	108,240	XX	1,541
Total		XX	552,903	XX	607,127

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

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

Table 2.—Nonfuel minerals produced in Ohio in 1984, by county[1]

County	Minerals produced in order of value
Allen	Sand and gravel.
Ashland	Sand and gravel, clays.
Ashtabula	Lime, sand and gravel.
Athens	Sand and gravel.
Auglaize	Sand and gravel, clays.
Belmont	Sand and gravel.
Butler	Do.
Carroll	Do.
Champaign	Sand and gravel, peat.
Clark	Sand and gravel.
Clermont	Do.
Columbiana	Sand and gravel, clays.
Coshocton	Do.
Cuyahoga	Salt, clays, peat.
Darke	Sand and gravel.
Erie	Lime, sand and gravel.
Fairfield	Sand and gravel.
Franklin	Sand and gravel, clays.
Gallia	Sand and gravel.
Geauga	Do.
Greene	Cement, sand and gravel, clays.
Hamilton	Sand and gravel.
Harrison	Clays.
Henry	Sand and gravel.
Hocking	Sand and gravel, clays.
Holmes	Clays, sand and gravel.
Huron	Sand and gravel.
Jackson	Clays.
Knox	Sand and gravel.
Lake	Salt, lime, sand and gravel.
Lawrence	Cement, clays, sand and gravel.
Licking	Sand and gravel, clays.
Logan	Sand and gravel, peat.
Lorain	Sand and gravel, abrasives.
Lucas	Cement, sand and gravel, clays.
Marion	Clays, sand and gravel.
Medina	Sand and gravel, clays.
Meigs	Sand and gravel.
Miami	Do.
Montgomery	Do.
Morgan	Do.
Morrow	Do.
Muskingum	Cement, sand and gravel, clays.
Ottawa	Lime, gypsum.
Paulding	Cement, clays.
Perry	Sand and gravel, clays.
Pickaway	Sand and gravel.
Pike	Do.
Portage	Do.
Preble	Do.
Putnam	Clays.
Richland	Sand and gravel, clays.
Ross	Sand and gravel.
Sandusky	Lime.
Scioto	Sand and gravel.
Shelby	Do.
Stark	Sand and gravel, cement, clays.
Summit	Salt, sand and gravel.
Trumbull	Sand and gravel.
Tuscarawas	Clays, sand and gravel.
Warren	Sand and gravel.
Washington	Do.
Wayne	Salt, sand and gravel.
Williams	Sand and gravel, peat.
Wyandot	Lime, sand and gravel, peat, clays.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Ohio business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	10,738	10,740	10,744
Total civilian labor force	do.	5,100	5,089	5,130
Unemployment	percent	12.2	9.4	8.9
Employment (nonagricultural):				
Mining total[1]	thousands	26.6	27.8	26.4
Coal mining	do.	11.1	11.7	10.9
Oil and gas extraction	do.	11.2	11.7	11.0
Manufacturing total	do.	1,066.0	1,127.0	1,123.1
Primary metal industries	do.	104.1	108.9	102.7
Stone, clay, and glass products	do.	52.1	52.5	50.4
Chemicals and allied products	do.	63.4	62.7	62.4
Petroleum and coal products[2]	do.	9.0	8.9	9.3
Construction	do.	130.8	144.8	154.1
Transportation and public utilities	do.	198.5	203.9	202.5
Wholesale and retail trade	do.	933.5	984.7	1,036.3
Finance, insurance, real estate	do.	207.8	211.5	218.3
Services	do.	873.3	905.2	953.3
Government and government enterprises	do.	656.1	655.2	664.7
Total[3]	do.	4,092.5	4,260.2	4,378.6
Personal income:				
Total	millions	$123,610	$134,439	$142,110
Per capita		$11,512	$12,517	$13,226
Hours and earnings:				
Total average weekly hours, production workers		41.4	42.3	42.0
Mining		43.1	43.9	43.7
Total average hourly earnings, production workers		$10.6	$11.0	$11.4
Mining		$10.6	$11.3	$11.6
Earnings by industry:				
Farm income	millions	$71	$979	$749
Nonfarm	do.	$88,544	$97,069	$103,297
Mining total	do.	$1,045	$1,179	$1,104
Nonmetallic minerals except fuels	do.	$98	$112	$117
Coal mining	do.	$464	$541	$518
Oil and gas extraction	do.	$484	$531	$472
Manufacturing total	do.	$30,149	$33,425	$35,068
Primary metal industries	do.	$3,588	$3,971	$3,893
Stone, clay, and glass products	do.	$1,402	$1,485	$1,529
Chemicals and allied products	do.	$2,013	$2,085	$2,194
Petroleum and coal products	do.	$414	$435	$480
Construction	do.	$4,259	$4,863	$5,058
Transportation and public utilities	do.	$5,985	$6,459	$6,578
Wholesale and retail trade	do.	$13,985	$15,148	$16,232
Finance, insurance, real estate	do.	$4,201	$4,399	$5,012
Services	do.	$16,923	$18,820	$20,625
Government and government enterprises	do.	$11,619	$12,459	$13,282
Construction activity:				
Number of private and public residential units authorized[4]		26,741	30,072	33,024
Value of nonresidential construction[4]	millions	$2,066.5	$2,135.8	$2,139.6
Value of State road contract awards	do.	$548.0	$590.3	$685.3
Shipments of portland and masonry cement to and within the State	thousand short tons	2,427	2,736	2,781
Nonfuel mineral production value:				
Total crude mineral value	millions	$479.1	$552.9	$607.1
Value per capita		$45	$51	$57

[p]Preliminary. [r]Revised.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U. S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

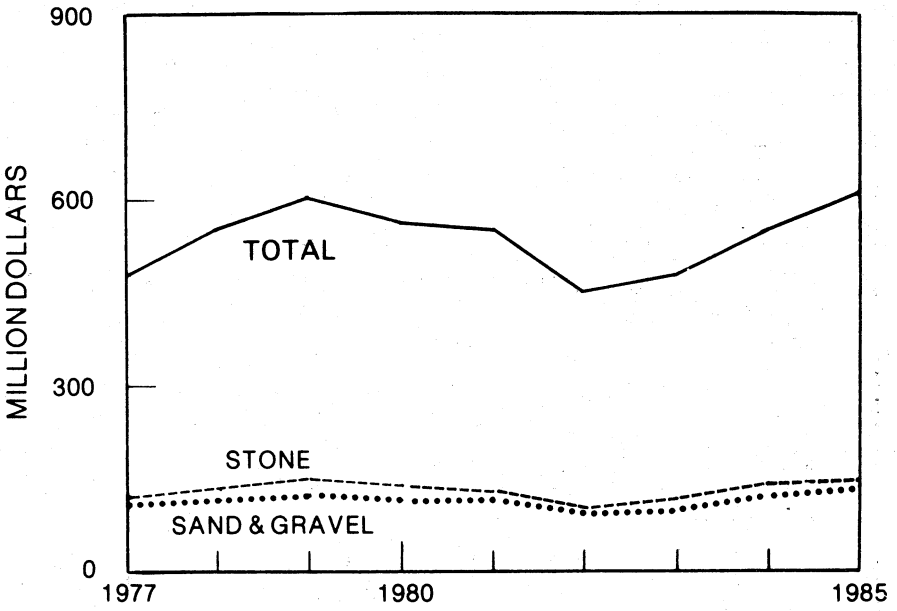

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Ohio.

Legislation and Government Programs.—In November, Ohio voters approved a $100 million referendum for research on clean coal technologies. The funds were expected to be awarded to individuals, businesses, or institutions for research and development to promote the use of Ohio coal. Coal producers in the State have been losing markets because of the higher sulfur content of the coal. Coalbeds in Illinois, Indiana, western Kentucky, and Ohio were among the highest in sulfur content and accounted for 20% of U.S. coal production. These same States also emitted about 6.7 million short tons of sulfur dioxide (SO_2) or 25% of the national total. The average sulfur content of Ohio's coalbeds was 3.0% based on analysis of about 4,700 samples.[2]

An estimated 10,000 to 30,000 jobs would be lost in high-sulfur coal mining States if utilities began purchasing or switching to lower sulfur coal. The employment losses were expected to be concentrated in the Midwest, especially Illinois and Ohio.[3]

The Ohio Division of Geological Survey (DGS) continued a core drilling program in northwestern Ohio. The objective of the drilling program was to evaluate the potential for sulfide mineralization and to investigate Precambrian basement geology. One drill hole penetrated the Precambrian basement at a depth of 2,870 feet providing the longest continuous core ever drilled in the State.[4] Geophysical logs were completed for the hole to obtain information on oil and gas.

Also during the year, a report on the sand and gravel resources of Ashtabula County was published. The report provides detailed information on the distribution of deposits in the county for use by explorationists and local land use planners.[5]

The DGS continued publication of a quarterly newsletter, "Ohio Geology." A complete description, including location by county of the State's limestone and dolomite deposits, was contained in the fall 1985 newsletter.[6]

Ohio State University's Mining and Mineral Resources and Research Institute received a $147,000 grant from the U.S. Bureau of Mines under Public Law 98-409. Ohio State was also an affiliate of the University of Missouri at Rolla, one of the five generic mineral technology centers in the United States with expertise in the area of pyrometallurgy.

The U.S. Forest Service completed a draft land and resource management plan and environmental impact statement for Wayne National Forest; these were expected to be released for comment in 1986.

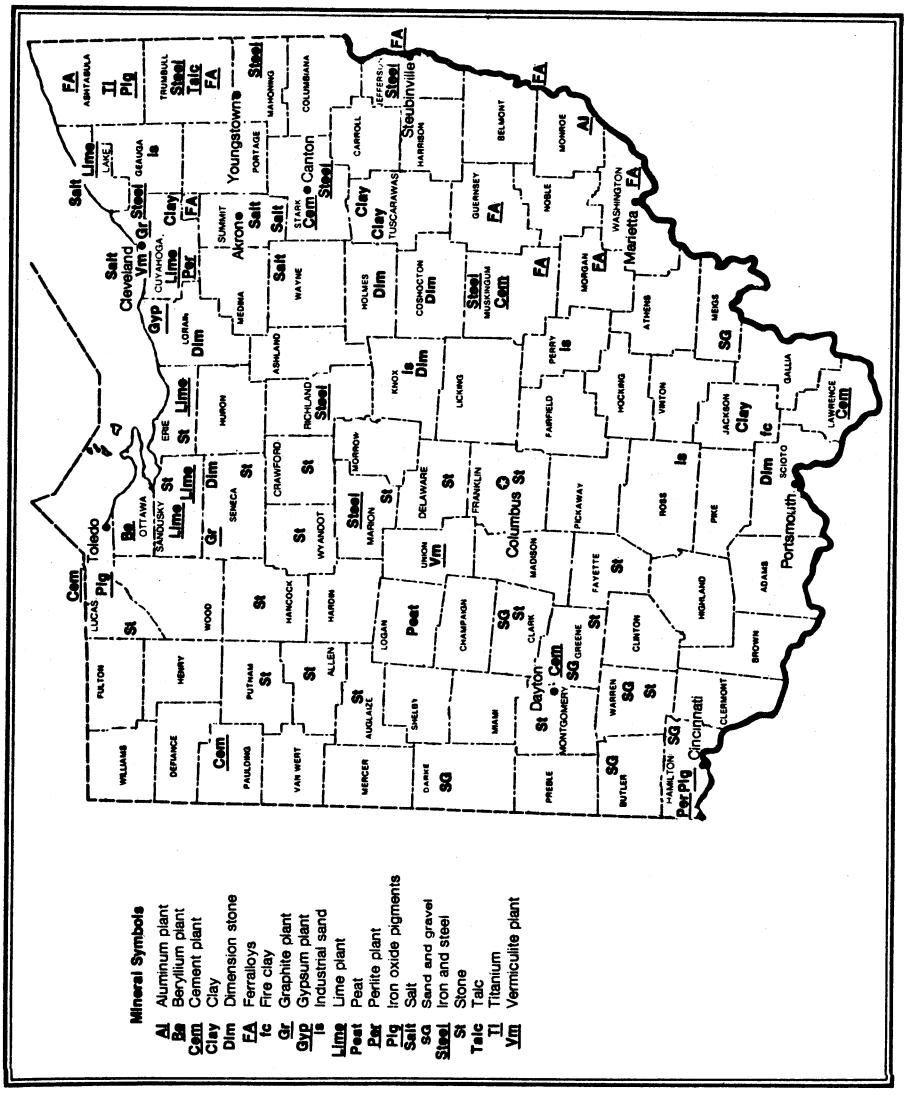

Figure 2.—Principal mineral producing localities in Ohio.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

In this section, nonfuel mineral commodities identified in table 1 along with some of the commodities processed or manufactured in Ohio are discussed. Processed commodities include graphite manufactures, iron oxide pigments (finished), iron and steel slag, sulfur (recovered), sulfuric acid, talc (ground), and vermiculite (exfoliated), and had a combined value of about $52 million. Cement and lime data are also presented in table 1.

Abrasives (Natural).—Cleveland Quarries Co. produced grindstones as a coproduct of its dimension sandstone quarrying operation in South Amherst, Lorain County. The 93% silica sandstone was selectively quarried and sold to grinding wheel manufacturers throughout the United States.

Cement.—Shipments of portland cement increased to nearly 1.8 million short tons, the highest level since 1979. Strong demand from the construction industry along with settlement of a strike at General Portland Inc.'s Paulding plant that shut down production for 6 months in 1984 resulted in an approximate 250,000-ton gain in output in 1985. Ohio's six cement plants operated at nearly 90% capacity in 1985, based on a reported annual capacity of almost 2 million tons; nationally, the utilization rate was about 77%. Masonry cement was also manufactured at four of the State's six plants.

Table 4.—Ohio: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1984	1985
Number of active plants	4	4
Production	103,021	113,369
Shipments from mills:		
Quantity	101,211	110,329
Value	$8,091,827	$10,411,783
Stocks at mills, Dec. 31	23,262	26,302

Table 5.—Ohio: Portland cement salient statistics

(Short tons unless otherwise specified)

	1984	1985
Number of active plants	6	6
Production	1,508,037	1,737,689
Shipments from mills:		
Quantity	1,525,326	1,769,119
Value	$69,809,563	$84,928,636
Stocks at mills, Dec. 31	244,717	213,287

Clays.—In 1985, Ohio produced about 2.1 million short tons of clays; about 90% was common clay, and 10%, fire clay. The State ranked sixth nationally in clay production. Since 1982, output of clay has increased about 663,000 tons. The 3 consecutive years of improved production paralleled upward trends in the State's construction industry. The State's 16 fire clay producers reported a decline in output of about 20% because of depressed conditions in the steel and related industries.

Gypsum.—Celotex Corp., a subsidiary of Jim Walter Corp., mined crude gypsum at an open pit mine in Ottawa County. Celotex also calcined gypsum at the same site for wallboard manufacture. National Gypsum Co. and USG Corp. also manufactured wallboard but obtained gypsum from out-of-State sources. Combined, the three companies calcined about 430,000 short tons of gypsum valued at about $10 million.

Lime.—Ohio again ranked first nationally in lime production despite a 7% decline in output. Reliant on the steel industry for a majority of their sales, Ohio's lime producers continued to lose sales in that market, particularly to steelmakers with basic oxygen furnaces (BOF).

Lime production in Ohio had dropped at a greater rate than that nationally when comparing the totals of 1979 and 1985. Both Ohio and U.S. steelmakers reported production decreases of approximately 35% since

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

Use	1984		1985	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, basic oxygen furnace	960,929	$46,366	869,438	$47,450
Steel, electric	47,886	2,266	W	W
Sewage treatment	19,169	862	43,194	2,304
Other[1]	830,816	38,457	817,077	34,388
Total	1,858,800	87,951	1,729,709	84,142

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

[1]Includes acid water neutralization; agriculture; calcium carbide; finishing lime; glass; ladle desulfurization (1984); magnesia from seawater or brine (1984); mason's lime (1984); magnesium; other chemical and industrial uses; paper and pulp; refractories; road stabilization; sand-lime brick (1984); steel, open-hearth; sugar refining; sulfur removal from stack gases (1984); and use indicated by symbol W.

1979; however, Ohio's lime production declined 50% while the U.S. total dropped by only 25%. Also, for the same period, Ohio lime sold for use in BOF steelmaking decreased by 55%; in the United States, by 42%.

Peat.—Peat was produced by seven companies in Ohio and sold primarily for agricultural and horticultural uses.

Salt.—Ohio ranked fourth and produced about 12% of the Nation's salt in 1985. Production increased significantly because of demand for rock salt used to melt ice and snow.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Estimated production of 33 million short tons was the highest output since 1980. Increased output resulted from demand from the construction industry.

Industrial.—Ohio's output of 1.3 million short tons of industrial sand and gravel ranked the State seventh nationally. In 1985, 7 companies at 10 sites produced industrial sand and gravel from crushed stone and conglomerate.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Production of 38 million short tons of crushed stone was about the same as that of 1984. About 35 million tons of crushed limestone, 3 million tons of crushed dolomite, and less than 100,000 tons of crushed sandstone and quartzite were produced at the State's 113 quarries. Leading counties in production, in descending order of tonnage, were Erie, Sandusky, Franklin, and Wyandot. The State's top 7 producing companies, as listed in table 8, accounted for more than 50% of the State's total output from 31 quarries. The average price per ton for crushed stone was $3.56 f.o.b. plant; about $0.50 per ton less than the U.S. average price.

Table 7.—Ohio: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	4,112	13,400
Riprap and jetty stone	646	2,633
Filter stone	356	996
Coarse aggregate, graded:		
Concrete aggregate, coarse	2,712	9,160
Bituminous aggregate, coarse	2,244	8,309
Bituminous surface-treatment aggregate	995	4,577
Railroad ballast	783	2,356
Fine aggregate (-3/8 inch):		
Stone sand, concrete	348	1,238
Stone sand, bituminous mix or seal	362	1,191
Screening, undesignated	200	554
Combined coarse and fine aggregates:		
Graded road base or subbase	4,280	15,670
Unpaved road surfacing	3,520	12,820
Crusher run or fill or waste	2,015	7,067
Other construction[2]	384	1,552
Agricultural:		
Agricultural limestone	1,189	4,958
Poultry grit and mineral food	5	22
Other agricultural	W	100
Chemical and metallurgical:		
Cement manufacture	2,062	6,895
Lime manufacture	620	2,092
Dead-burned dolomite manufacture	W	1,775
Flux stone	696	2,587
Sulfur oxide removal	32	W

See footnotes at end of table.

Table 7.—Ohio: Crushed stone[1] sold or used by producers in 1985, by use —Continued

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Special:		
Other fillers or extenders	184	1,710
Lightweight aggregate	75	223
Other miscellaneous[3]	742	2,799
Other unspecified[4]	9,749	31,860
Total	[5]38,310	136,544

W Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."
[1]Includes dolomite, limestone, quartzite, and sandstone.
[2]Includes terrazzo and exposed aggregate, fine aggregate, and stone used for other construction and maintenance purposes.
[3]Includes mine dusting or acid water treatment, asphalt fillers or extenders, whiting or whiting substitute, other unspecified uses, and uses indicated by symbol W.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data do not add to total shown because of independent rounding.

Dimension.—Output of dimension stone increased from 37,000 short tons (500,000 cubic feet) to 53,000 short tons (715,000 cubic feet). Most of the production was dimension sandstone from 13 of the State's 15 dimension stone operations; dimension limestone was quarried at two sites.

METALS

In this section, processed and manufactured metals are discussed. No metals are mined in Ohio.

Aluminum.—Nationally, Ohio ranked fifth in production of primary aluminum. The State's sole producer, Ormet Corp., manufactured aluminum sheet and plate at its Hannibal facilities. Alumina was produced at its Burnside, LA, refinery. The six-potline, 270,000-short-ton-per-year plant was operated at full capacity during the year.[7]

At yearend, Ormet closed the Burnside refinery and announced plans to purchase alumina on the spot market. The firm also contended that production costs must be reduced by $0.06 to $0.07 per pound for the company to remain competitive in the world marketplace. Late in the year, Ormet officials said the firm must cut about $35 million, one-tenth of its annual budget, from payroll, electricity, and purchasing of alumina. Ormet annually purchases 4.4 million megawatt hours of electricity from Ohio Power Co.'s Krammer plant in Marshall County, WV.[8] Ormet's 3-year contract with its 1,500 union employees, who earn about $23 per hour in wages and benefits, expires May 31, 1986.

Iron and Steel.—Ohio's iron and steel producers reported small declines in output, similar to those reported nationally. The State again ranked second in the United States in production of pig iron—9.3 million short tons—and steel, 14.1 million tons.

Despite the stagnant to depressed conditions in the U.S. steel industry, openings and expansions were reported in Ohio. During the year, production of special quality steel began by The Timken Co. at its $500 million Faircrest plant in Canton. The plant, with an annual capacity of 500,000 tons, was equipped with a 160-ton electric arc furnace and automated for high productivity. Demand for corrosion-resistant steel by the automobile and appliance industries resulted in three producers constructing new electrogalvanizing lines in Ohio; combined annual capacity of the three lines when completed was expected to be about 1.3 million tons.

The U.S. Department of Energy awarded a $2.6 million, 2-year contract to Armco Inc. and Westinghouse Electric Corp. for the joint development of a process to continuously cast thin steel strip. Technology to produce thinner steel strips or slags was expected to result in lower energy, labor, and equipment costs. As cast, the strip is to be no more than 0.125-inch thick and suitable for cold rolling to less than 0.03-inch. The joint Armco-Westinghouse research project will be carried out at Armco's Middletown, OH, works.

Ferroalloys.—Ohio ranked first nationally in ferroalloy shipments. The State's six plants produced about 325,000 short tons of

ferroalloys valued at $190 million and accounted for nearly 35% of the U.S. total output. Continued weak demand by the U.S. steel industry resulted in poor market conditions for ferroalloy producers. Ferroalloy shipments in Ohio declined by about 87,000 short tons compared with the 1984 total; the State's steel production dropped by about 1.4 million tons during the same period.

During the year, Ohio Ferro-Alloys Corp. closed its Powhatan Point silicon metal plant and decided to produce all its silicon metal at its Montgomery, AL, operation. In 1984, Ohio Ferro-Alloys closed its Philo ferrosilicon plant. Globe Metallurgical Inc. was reportedly considering ceasing production of ferrochromium at its Beverly plant.

Satra Concentrates Inc., Steubenville, processed ferrochrome slags purchased from Satralloy Inc., which shut down production in 1982. Satra expected to process about 175,000 tons of charge chrome slags and 1 million tons of low-carbon ferrochromium slags in the next 5 years to recover 1,400 tons of charge chrome and 4,000 tons of low-carbon ferrochromium.

Titanium.—The TIMET Div. of Titanium Metals Corp. of America (TMCA) and RMI Co., the Nation's two leading integrated producers of the metal, produced titanium mill products at their Ohio facilities. TIMET's sponge and ingot capacities were 14,000 short tons and 17,000 tons, respectively, whereas RMI's sponge and ingot capacities were 9,500 tons and 18,000 tons, respectively. Their combined ingot capacities represented 50% of the U.S. total.

RMI in Niles, built a $4 million welded-tube mill with an annual capacity of 1 million pounds. The expansion in tube products was aimed at marketing titanium mill products for nonaerospace applications such as heat exchangers, water desalination equipment, and chemical processing systems.

Negotiations that began in December 1984 for leveraged buyout of the TIMET Div. of TMCA by a TIMET management group were terminated in 1985. Financing for the deal apparently fell through partly because sales volume and profit projections were lower than originally anticipated by the prospective buyers.

[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2]Thomson, R. D., and F. H. York. The Reserve Base of U.S. Coals by Sulfur Content—The Eastern States. Bu-Mines IC 8680, 1975, 537 pp.

[3]Resources for the Future, 1984 Annual Report. Library of Congress Catalog Card No. 55.40198, pp. 28-29.

[4]Wickstrom, L. H., G. Botoman, and D. Smith. Report on a Continuously Cored Hole Drilled Into the Precambrian in Seneca County, Northwestern Ohio. OH Div. Geol. Surv., IC 51, 1985.

[5]Risser, M. L. Sand and Gravel Resources of Ashtabula County, Ohio. OH Div. Geol. Surv., RI 128, 1985.

[6]For more information contact the Ohio Department of Natural Resources, Division of Geological Survey, Fountain Square, Columbus, OH 43224; telephone: (614) 265-6605.

[7]American Metal Market. V. 93, No. 233, Dec. 12, 1985, p. 4.

[8]Jones, C. The Intelligencer (Wheeling, WV). P. 1.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives (natural):			
Cleveland Quarries Co.[1]	Quarry Rd. Amherst, OH 44001	Quarry and plant	Lorain.
Cement:			
General Portland Inc.[2]	Box 1019 Fort Wayne, IN 46801	Plant	Paulding.
SME Cement Inc	Box 1187 Uniontown, PA 15401	Plants	Lucas, Muskingum, Stark.
Southwestern Portland Cement Co.[2]	Box 191 Fairborn, OH 45324	Plant	Greene.
Clays:			
Common:			
Belden Brick Co	Box 910 Canton, OH 44701	Pits	Tuscarawas.
Hydraulic Press Brick Co	Box 7786 Independence, OH 44131	Pit	Cuyahoga.
Fire:			
Crescent Brick Co. Inc	50 Portsmouth Rd., Box 368 Oak Hill, OH 45656	Pits	Jackson.
Gypsum:			
Crude:			
Celotex Corp.[3]	320 South Wayne Ave. Cincinnati, OH 45215	Pit and plant	Ottawa.
Calcined:			
National Gypsum Co	1901 Henderson Dr. Lorain, OH 44052	Plant	Lorain.
USG Corp	Gypsum, OH 43433	do	Ottawa.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lime:			
Huron Lime Co	Box 451, 100 Meeker Huron, OH 44839	Quarry and plant	Erie.
Martin Marietta Corp	755 Lime Rd. Woodsville, OH 43469	____do ____	Sandusky.
Ohio Lime Co	128 East Main St. Woodsville, OH 43469	Quarries and plants.	Do.
LTV Steel Corp	Box 6778, Room 1629 Republic Bldg. Cleveland, OH 44101	Plant	Lake.
Peat:			
Sphagnum Moss Peat Farm	9797 Thompson Rd., Route 1 West Liberty, OH 43357	Bog	Champaign.
Weaver's Lawn & Garden Products	Box 333 Bowling Green, OH 43402	Bog	Logan.
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 Thiokol Inc., Morton Salt Div	Box 390 Painesville, OH 44077	Underground mine, wells, plant.	Lake and Wayne.
Sand and gravel:			
Construction:			
American Aggregates Corp	Drawer 160, Garst Ave. Greenville, OH 45331	Pits and plants (13 operations).	Butler, Champaign, Clark, Franklin, Greene, Hamilton, Montgomery, Warren.
Dravo Corp	5253 Wooster Rd. Cincinnati, OH 45226	Pits and plants (8 operations).	Butler, Hamilton, Meigs, Warren.
Industrial:			
Best Silica Sand Co	Box 87, 11830 Ravenna Rd. Chardon, OH 44024	Quarries and mill	Geauga.
Central Silica Co	806 Market St. Zanesville, OH 43701	____do ____	Knox and Perry.
Stone:			
Crushed:			
American Aggregates Corp	Drawer 160, Garst Ave. Greenville, OH 45331	Quarries and plants.	Clark, Darke, Delaware, Fayette, Franklin, Greene, Montgomery, Warren.
The France Stone Co.[1]	Box 1928, 1800 Toledo Trust Toledo, OH 43603	Quarries and plant	Lucas, Seneca, Wood.
Martin Marietta Refractories	755 Lime Rd. Woodville, OH 43469	Quarry and plant	Sandusky.
Maume Stone Co	Box 29A Maumee, OH 43537	Quarries and plant	Lucas, Ottawa, Paulding, Van Wert, Wood.
National Lime & Stone Co	First National Bank Bldg. Findlay, OH 45840	Quarries and plants.	Allen, Auglaize, Crawford, Delaware, Hancock, Marion, Putnam, Wyandot.
Sandusky Crushed Stone Co. Inc	Box 527 Sandusky, OH 44870	Quarry and plant	Erie.
Wagner Quarries Co	4203 Milan Rd. Sandusky, OH 44870	Quarries and plant	Do.
Dimension:			
Briar Hill Stone Co	Box 148, State Route 520 Glenmont, OH 44628	Quarries and plant.	Coshocton, Holmes, Knox.
Waller Bros. Stone Quarry Co	134 County Rd. McDermont, OH 45652	____do ____	Scioto.

[1]Also dimension stone.
[2]Also common clays.
[3]Also calcined gypsum.

The Mineral Industry of Oklahoma

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

By Lorraine B. Burgin[1]

The value of nonfuel minerals in Oklahoma rose to $252 million in 1985. Construction materials represented most of the output value with crushed stone, portland cement, construction sand and gravel, and gypsum the leading commodities, followed by industrial sand and gravel, iodine, lime, masonry cement, clays, and feldspar. Of the minerals surveyed, the value of production increased in feldspar, iodine, lime, construction and industrial sand and gravel, crushed and dimension stone, and tripoli; declines were posted for masonry and portland cement, clays, gypsum, pumice, and salt.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	49	$3,506	43	$2,854
Portland do	1,732	84,701	1,589	72,583
Clays do	979	2,498	997	2,338
Gem stones	NA	2	NA	2
Gypsum thousand short tons	1,549	13,485	1,595	12,548
Sand and gravel (construction) do	10,984	26,582	e12,600	e32,300
Stone:				
Crushed do	e25,500	e86,000	31,173	98,811
Dimension do	e12	e771	11	836
Combined value of feldspar, iodine, lime, pumice, salt, sand and gravel (industrial), and tripoli	XX	28,187	XX	29,335
Total	XX	245,732	XX	251,607

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

Table 2.—Nonfuel minerals produced in Oklahoma in 1984, by county[1]

County	Minerals produced in order of value
Beaver	Sand and gravel, pumice.
Blaine	Gypsum.
Bryan	Sand and gravel.
Caddo	Gypsum, sand and gravel.
Canadian	Sand and gravel, clays.
Carter	Sand and gravel.
Choctaw	Do.
Cleveland	Do.
Comanche	Gypsum.
Cotton	Sand and gravel.
Creek	Clays, sand and gravel.
Custer	Sand and gravel, clays.
Delaware	Sand and gravel.
Garfield	Do.
Garvin	Do.
Grady	Do.
Greer	Clays, sand and gravel.
Harmon	Salt.
Harper	Sand and gravel.
Jackson	Gypsum, sand and gravel.
Johnston	Sand and gravel.
Kay	Do.
Kingfisher	Sand and gravel, iodine.
Kiowa	Sand and gravel.
Lincoln	Do.
Logan	Do.
Love	Do.
McClain	Do.
McCurtain	Do.
Mayes	Cement, clays, sand and gravel.
Murray	Sand and gravel.
Muskogee	Feldspar, sand and gravel.
Oklahoma	Sand and gravel, clays.
Ottawa	Tripoli, sand and gravel.
Pawnee	Sand and gravel.
Payne	Do.
Pittsburg	Do.
Pontotoc	Cement, sand and gravel, clays.
Pottawatomie	Sand and gravel.
Pushmataha	Do.
Roger Mills	Do.
Rogers	Cement, clays.
Seminole	Clays, sand and gravel.
Sequoyah	Lime, sand and gravel.
Stephens	Sand and gravel.
Texas	Do.
Tillman	Do.
Tulsa	Do.
Wagoner	Do.
Washita	Do.
Woods	Do.
Woodward	Iodine, sand and gravel, gypsum.
Undistributed[2]	Stone, gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Oklahoma business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	3,311	3,310	3,301
Total civilian labor force	do.	1,552	1,556	1,573
Unemployment	percent	9.0	7.0	7.1
Employment (nonagricultural):				
Mining total[1]	thousands	77.7	72.0	66.3
Oil and gas extraction	do.	74.7	69.0	63.3
Manufacturing total	do.	166.2	175.0	172.4
Primary metal industries	do.	3.9	4.3	4.2
Stone, clay, and glass products	do.	10.9	11.1	11.0
Chemicals and allied products[1]	do.	3.5	3.5	3.1
Petroleum and coal products	do.	8.4	8.8	8.0
Construction	do.	52.4	52.3	46.7
Transportation and public utilities	do.	66.3	66.4	64.4
Wholesale and retail trade	do.	284.5	287.9	288.2
Finance, insurance, real estate	do.	62.8	64.2	64.0
Services	do.	215.7	221.2	225.7
Government and government enterprises	do.	245.2	241.4	252.4
Total[2]	do.	1,170.6	1,180.3	1,180.1
Personal income:				
Total	millions	$37,130	$39,142	$40,381
Per capita		$11,216	$11,827	$12,232
Hours and earnings:				
Total average weekly hours, production workers		40.5	41.6	41.3
Total average hourly earnings, production workers		$9.2	$9.6	$9.9
Earnings by industry:				
Farm income	millions	$479	$569	$570
Nonfarm	do.	$26,161	$27,469	$28,163
Mining total	do.	$2,623	$2,502	$2,336
Nonmetallic minerals	do.	$41	$43	$46
Oil and gas extraction	do.	$2,533	$2,399	$2,238
Manufacturing total	do.	$4,142	$4,591	$4,666
Primary metal industries	do.	$111	$123	$125
Stone, clay, and glass products	do.	$271	$282	$296
Chemicals and allied products	do.	$98	$105	$97
Petroleum and coal products	do.	$353	$390	$349
Construction	do.	$1,739	$1,909	$1,785
Transportation and public utilities	do.	$2,081	$2,143	$2,209
Wholesale and retail trade	do.	$4,512	$4,653	$4,714
Finance, insurance, real estate	do.	$1,403	$1,469	$1,549
Services	do.	$4,602	$4,999	$5,371
Government and government enterprises	do.	$4,944	$5,093	$5,422
Construction activity:				
Number of private and public residential units authorized[3]		40,926	22,004	10,670
Value of nonresidential construction[3]	millions	$785.9	$799.2	$986.2
Value of State road contract awards	do.	$195.4	$203.6	$208.6
Shipments of portland and masonry cement to and within the State	thousand short tons	1,824	1,811	1,369
Nonfuel mineral production value:				
Total crude mineral value	millions	$226.2	$245.7	$251.6
Value per capita		$68	$74	$76

[p]Preliminary. [r]Revised.
[1]Oklahoma Employment Security Commission.
[2]Data may not add to totals shown because of independent rounding.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

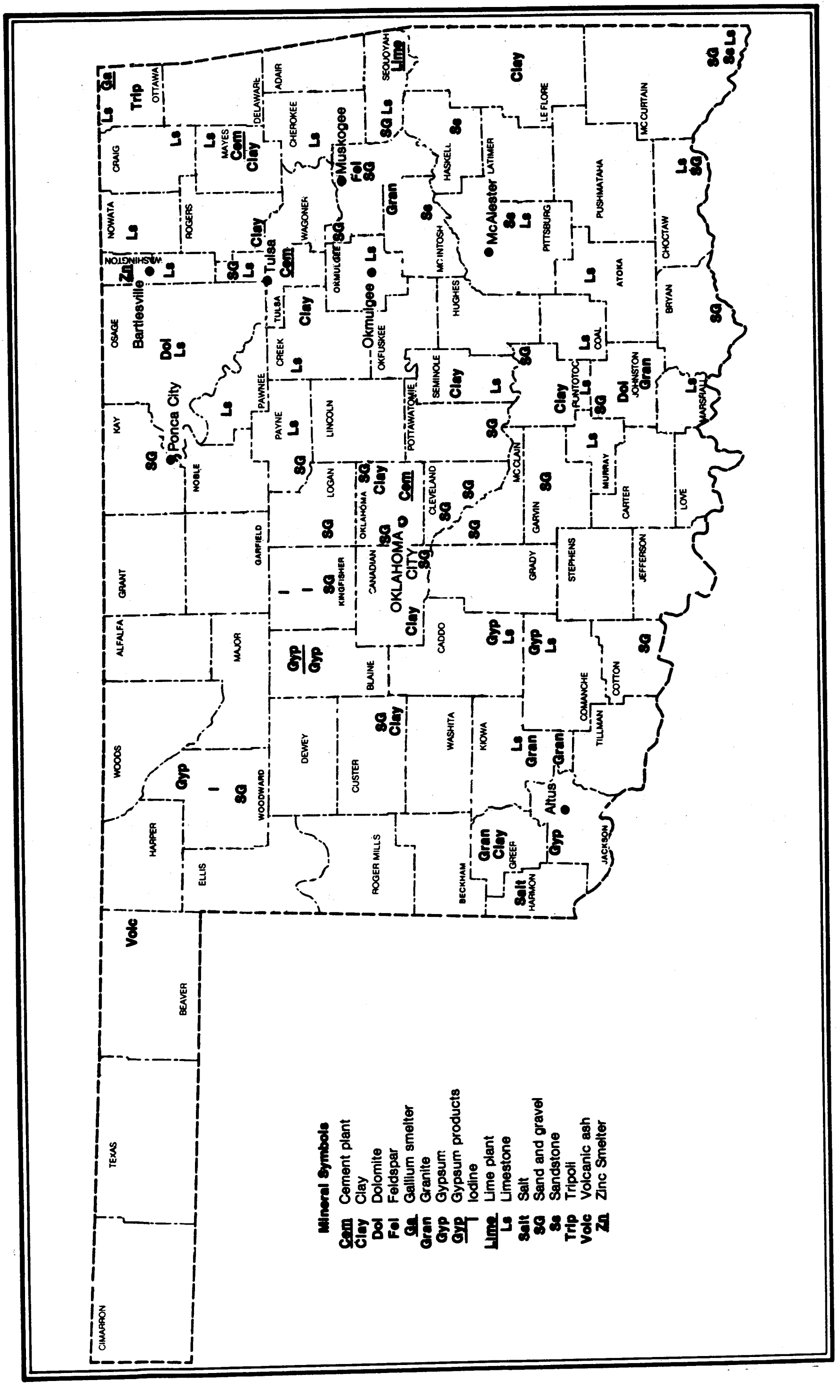

Figure 1.—Principal mineral producing localities in Oklahoma.

Trends and Developments.—The Center for Economic and Management Research at the University of Oklahoma reported that the State's economy weakened during the year. Although small gains were made in bank deposits and savings and loan association assets, losses of nearly 12% in crude oil output and 39% in the value of construction activity were of greater economic importance to the State. With the exception of a 1% increase in industrial building, all facets of construction declined. The dollar value of building permits for single-family construction fell more than 45%, compared with that of 1984; multifamily residential, 71%; commercial, more than 35%; institutional, 11%; and streets and highways, 15%, thus accounting, in part, for the drop in production of industrial minerals in the State. Representing the highest monthly average labor force on record for the State, the total labor force rose slightly to more than 1.5 million workers. The average monthly unemployment rate rose slightly to 7.1% from 7.0%.[2]

The number of mining employees, including those in oil and gas production, fell from 72,000 in 1984 to 66,300 in 1985. According to the Oklahoma Employment Security Commission, the oil and gas production industry employed 63,300 in 1985, compared with 69,000 in 1984, an 8% decline. Average employment in the coal mining industry fell from 1,400 workers in 1985 to 1,200 in 1984. On the other hand, employment in the industrial minerals segment of the mining industry rose from 1,600 workers in 1984 to 1,700 in 1985. The metal mining industry employed just a few workers in both years.[3]

Legislation and Government Programs.—On July 8, 1985, the Governor signed Senate bill 332, creating the Oklahoma Mining Commission, replacing the State Mining Board. Beginning January 1, 1986, the commission, consisting of 10 members, will oversee and set policy for the Department of Mines; designate a certain chief executive officer as Chief Mine Inspector; after examination by qualified Department of Mines personnel, issue certificates of competency for positions of mine superintendent, mine foreman, fire boss, shot-firer, certified surface blaster, hoisting engineer, and miner; and study ways to expand and create markets for Oklahoma coal and other minerals.

The Director of the U.S. Office of Surface Mining (OSM) authorized the Oklahoma Department of Mines to resume the enforcement of strip mine regulations in the State beginning January 1, 1986. Charging lax enforcement of Federal and State regulations, OSM had assumed responsibility for carrying out the State's reclamation and inspection laws in April 1984; however, the Department of Mines authority to review and issue mining permits continued uninterrupted. Under the agreement between OSM and the State, Oklahoma would start by monitoring the State's 225 inactive mines and, later, as permits and bonds were revised to correct any deficiencies, take responsibility for inspecting the State's approximately 25 active mines on a mine-by-mine basis. To assist in meeting OSM and State requirements, the 1984 Oklahoma Legislature nearly doubled the Department of Mines budget and number of employees to $2.2 million and 49 employees.

In October, the Governor declared an emergency for the coal mining industry when a New York insurance company was declared insolvent and left 11 coal and several noncoal mining companies without bonds required by OSM to ensure reclamation of strip mined lands. Alternate bonding arrangements were made for five active mines by November 26, leaving six inactive mines to find new insurance carriers, but without a deadline.

Because 95% of Oklahoma's potable water is underground, the U.S. Geological Survey (USGS) sponsored a conference in March to consider water use, abuse, availability quality, and water-information needs. At the meeting, USGS released "Oklahoma—A Summary of Activities of the U.S. Geological Survey Water Resources Division for 1985," which outlined federally funded projects such as a study of the geochemistry of the Tar Creek lead-zinc mine waters and contamination of the underlying Roubidoux aquifer, the effects of coal mining on ground water in eastern Oklahoma, and predictive models of ground water supply. The Oklahoma Water Resources Board, Oklahoma Geological Survey, Oklahoma Department of Health-State Environmental Laboratory Service, and the National Weather Service reported on their data and functions relating to water concerns.[4] A USGS publication provided Oklahoma hydrogeologic data.[5]

The Oklahoma Corporation Commission was asked by truckers and the Association of Oklahoma General Contractors to abolish its policy of prescribing exact rates—not maximums or minimums—for the intrastate hauling of sand and gravel and rock. The firms and their representatives re-

quested permission to file for individual rates that could be approved on a company-by-company basis and that would be more attuned to 1985 markets. The high rates set by the commission prevented haulers willing to ship under then current rates from obtaining customers.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Cement.—Cement producers in Oklahoma included Blue Circle Inc. in Rogers County, near Tulsa; Ideal Basic Industries Inc. at Ada, Pontotoc County; and Lone Star Industries Inc. at Pryor, Mayes County.

Sales of finished portland cement declined 8% in tonnage and 14% in value. The greater drop in value was partly attributed to the more than 17% fall in the average price per short ton in 1985. Shipments of gray finished portland cement, classified as general use and moderate heat type and the high-sulfate-resistance variety, declined in quantity and in value. Sales of the oil-well and high-early-strength gray portland cements increased in quantity. However, the value of the oil well variety dropped slightly. Finished portland cement was used principally by highway contractors, followed by ready-mixed concrete companies, concrete product manufacturers, and building material dealers. Compared with 1983 figures, finished portland cement use by highway contractors climbed 97% while its use for building materials declined nearly 77%. Masonry cement output and sales fell nearly 13% and, as prices declined about 9%, the value of those shipments fell about 18%.

Most cement was shipped from plant to terminal by rail, thence in bulk to consumers by truck; a small amount was barged from the terminal to consumers. Principal raw materials consumed included cement rock and limestone, clay and shale, gypsum, iron ore, and sandstone. Consumption of all fuels declined; natural gas was the chief fuel used in manufacturing cement, followed by electricity, and a small amount of coal.

Clays.—The nearly 42% gain in tonnage of face brick produced in 1985 contributed substantially to the increase in total clay output. The nearly 9% fall in the average price paid per short ton of clay brought a decline in the total value of production. Clay was mined for common brick by Commercial Brick Corp. at its Commercial pit near Wewoka in Seminole County. Face brick was produced by Acme Brick Co., a subsidiary of Justin Industries Inc., at its Edmond and Oklahoma City mines in Oklahoma County and at its Clinton pit in Custer County; by Mangum Brick Co. at its Mangum pit in Greer County; by Oklahoma Brick Corp., a subsidiary of Merry Companies, at its Canadian pit in Canadian County and its pit in Muskogee County; and by Sapulpa Building Brick Inc. at its Sapulpa pit in Creek County. Clay for portland cement was mined by Blue Circle at its Tulsa pit in Rogers County, by Ideal Basic at its Lawrence pit in Pontotoc County, and by Lone Star Industries at its Pryor plant in Mayes County. Clay for the production of lightweight aggregate for use in concrete block and structural concrete was obtained by Chandler Materials Co. at its Haydite pit near Choctaw in Oklahoma County. Pottery clay was mined by Frankoma Pottery Co. at its Sugar Loaf Hill pit and shaped at its Sapulpa plant west of Tulsa in Creek County. Clay used in lightweight aggregate for highway surfacing was mined in Washington County. Common clay and shale was used principally for face brick, portland cement, and common brick, followed by use in manufacturing concrete block and structural concrete and pottery.

Feldspar.—Oklahoma was one of six States reporting feldspar production. The quantity and value of output continued to gradually increase as markets improved. Arkhola Sand and Gravel Co. recovered feldspar from sands dredged from the bed of the Arkansas River near Muskogee. The acid-washed product was 25% feldspar and 75% quartz and was used by glass industries in the State.

Gypsum.—Nationally, Oklahoma ranked fourth in the production of gypsum. Although output increased slightly, the decline in the average price of crude gypsum from $8.71 per short ton in 1984 to $7.87 in 1985 contributed in part to the nearly 7% drop in the value of gypsum production.

Listed in descending order of tonnage, crude gypsum was open pit mined by United States Gypsum Co., a subsidiary of USG Corp., at Southard, Blaine County; by Republic Gypsum Co. at Duke, Jackson Coun-

ty; by Harrison Gypsum Co. Inc. near Cement, Caddo County; by Temple-Eastex Inc. near Fletcher, Comanche County; Lehigh Portland Cement Co. at Watonga, Blaine County; and Western Plains Materials Co. at McFaddin, Woodward County. Republic Gypsum and United States Gypsum calcined gypsum for wallboard at their facilities. Output of the calcined product continued to rise, modestly in quantity but substantially in value, as the average domestic price increased 19% to $23.20 per ton.

Anticipating increased demand for wallboard and other gypsum products, two companies in Oklahoma expanded their operations during the year. Temple-Eastex, a wholly owned subsidiary of Temple-Inland Inc., Diboll, TX, was constructing a 260,000-square-foot plant between Cyrl and Fletcher, on the Caddo-Comanche County line. With completion expected the second quarter of 1986, the facility could employ 100 workers for the production of 300 million feet per year of wallboard. The company had mined gypsum at a quarry in Fletcher since 1962. Republic Gypsum continued its program to add a second assembly line and double its wallboard capacity. With completion of the 85,000-square-foot addition, production was expected to rise for 340 million square feet of wallboard to 640 million. Another 75 workers will supplement the 210 already employed. Gypsum is trucked from the company's quarry 1 mile south of the facility.

Iodine.—Most of the iodine produced in the Nation was recovered from brines in Oklahoma. If Michigan facilities close as expected in 1986, Oklahoma would become the sole iodine producing State. Iodine output in the State declined 8% in quantity as domestic consumption decreased and imports continued to supply more than one-half of the demand. The nearly 5% gain in value of output was attributed, in part, to a price increase.

Woodward Iodine Corp., a subsidiary of Asahi Glass Co. Ltd. of Tokyo, Japan, and owner of Ise Chemical Industry Co. Ltd., the world's largest producer of iodine, recovered iodine from brines associated with natural gas. Approximately 8 miles northeast of Woodward, Woodward County, the facility, with a plant capacity of approximately 2 million pounds per year, was the largest crude iodine unit in the United States.

North American Brine Resources, a joint venture of Beard Oil Co. of Oklahoma City (40%) and two Japanese firms—Godoe USA Inc., a subsidiary of United Resources Industry Co. (50%), and Inorgchem Development Inc., a subsidiary of Mitsui & Co., (10%)—recovered iodine from oilfield waste brines at its miniplants in Dover and Hennessey in Kingfisher County.

Iodine was used for animal feed, catalytic, nutritional, pharmaceutical, and photographic uses, for which there was no substitute products. Other uses included inks and colorants, iodized salt, smog inhibitors, and lubricants.

Lime.—St. Clair Lime Co., marking its 50th year of operation, underground mined a high-calcium limestone for the production of lime at its Marble City plant in Sequoyah County. As a result of the completion of a facility expansion in 1984, the company's quicklime output increased about 10% in quantity and 11% in value in 1985. No hydrated lime production was reported.

Pumice.—Axtell Mining Corp. continued to mine and process volcanic ash at its operation near Gate, Beaver County, in northeastern Oklahoma. The Pleistocene age 40- to 70-foot-thick deposit consisted largely of volcanic glass shards, mixed with lesser amounts of clay, feldspar, mica, quartz, and diatom fossils. Although production more than doubled, its value slumped with a fall in price and a change in the use of the product. In 1984, the volcanic ash was used mostly in abrasives; in 1985, it was marketed principally for road construction and maintenance and lesser amounts for abrasive cleaning compounds.

Salt.—Acme Salt Co. at Erick, Harmon County, continued to recover crystal salt from brines evaporated in solar ponds. Commercial brines were pumped from shallow wells drilled into brine-filled solution cavities in the Permian Flowerpot shale. Salt output dropped sharply in tonnage and value.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel production was estimated to have increased in quantity and value despite overall declines in the State's construction industry. Among problems faced by the industry was the compliance with environmental regulations required by State, Federal, and local entities. As an example, the Murphy & Perkins Ready Mix Concrete Co.'s permit for a sand

operation along the North Canadian River was approved by the Yukon City Council after the company agreed to refrain from constructing permanent or temporary storage in the floodplain, maintain a 150-foot buffer zone at the edge of the mine area, obtain insurance for $10 million against flood damage caused by the operation, limit mining to 12 acres per year and production to 20 years, appear yearly for a renewal hearing, and refrain from removing vegetation from the buffer zone.

Industrial.—Industrial sand production continued to decline, although its value inched upward. Pennsylvania Glass Sand Corp., with its Oklahoma plant and works near Mill Creek in Johnston County, and Arkhola Sand and Gravel Co., with its operation near Muskogee, Muskogee County, were the two producers in the State. The sand was used mainly for ground fiberglass, containers, flat glass, specialty glass, and foundry mold and core. Other important applications included roofing granules, hydraulic fracturing for stimulating hydrocarbon producing formations, chemicals, scouring cleansers, porcelain pottery, blasting, and refractory purposes.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—After falling to a low in 1983, crushed stone output rose 31% in tonnage and nearly 28% in value by 1985. The average unit value of crushed stone produced in 1985 fell to $3.17, from $3.22 produced in 1983. Crushed stone was quarried in 34 counties; in descending order of tonnage, more than 75% came from Murray, Comanche, Tulsa, Rogers, Mayes, Kiowa, Johnston, Choctaw, Seminole, Creek, Atoka, and Wagoner. Nearly 93% of the output was limestone and dolomite; some granite was quarried in Johnston County, and sandstone, in McIntosh County. During the year, 49 companies produced crushed stone at 70 quarries in the State.

Leading uses of limestone included cement manufacture, dense road base, concrete aggregate, fill, surface treatment of roads, fine aggregate, and bituminous aggregate. Granite was used for railroad ballast, construction and maintenance, stone sand for bituminous mix, riprap and jetty stone, and fill. Sandstone was also used for dense road base. In descending order of tonnage, the major producers included Dolese Bros. Co.; Standard Industries, a division of APAC-Oklahoma Inc.; Boorhem-Fields Inc.; McNabb Coal Co. Inc.; The Quapaw Co.; Lone Star Industries; Meridian Aggregates Co., a subsidiary of Burlington Northern Railroad; Tulsa Rock Co., a subsidiary of The McMichael Co. of Koppers Co. Inc.; Anchor Stone Co.; Sooner Rock & Sand Co., a subsidiary of Hallet Construction Co.; Blue Circle; Bellco Materials Inc.; and Ideal Basic.

Table 4.—Oklahoma: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	19	63
Riprap and jetty stone	115	476
Filter stone	124	524
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,809	7,283
Bituminous aggregate, coarse	309	1,246
Bituminous surface-treatment aggregate	672	2,384
Fine aggregate (-3/8 inch):		
Stone sand, bituminous mix or seal	330	488
Other fine aggregate	514	889
Combined coarse and fine aggregates:		
Graded road base or subbase	2,220	4,872
Unpaved road surfacing	239	1,097
Crusher run or fill or waste	1,268	4,017
Other construction[2]	1,099	3,139
Agricultural: Agricultural limestone	85	287
Chemical and metallurgical: Cement manufacture	2,625	3,970
Special:		
Other miscellaneous[3]	28	69
Other unspecified[4]	19,716	68,008
Total[5]	31,173	98,811

[1]Includes dolomite, granite, limestone, sandstone, and miscellaneous stone.
[2]Includes stone used for railroad ballast, stone sand (concrete), and stone used for other construction and maintenance purposes.
[3]Includes other uses not specified.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Dimension.—Although tonnage of dimension stone declined, its value of output rose 13% over that of 1983 and about 8% compared with the estimated 1984 figures. This was attributed, in part, to an increase in the average value of $74.19 in 1983 to $76.97 in 1985. Sixty-two percent of the output was granite used principally for monumental stone; 36% was sandstone used for irregular stone, billiard tables, flagging, and rough stone; and the remainder for limestone used as irregular shaped stone. Granite producers included Bodie L. Anderson Quarries Inc. in Johnston County, The Georgia Granite Co. in Greer County, Roosevelt Granite Co. in Kiowa County, and Willis Granite Co. Inc. in Greer County. Sandstone was quarried by Barbee Stone in Haskell County, Wilson Miller in LeFlore County, and TDM Quarry Co. in Pittsburg County. Pontotoc Stone Co. quarried limestone in Johnston County.

Sulfuric Acid.—Sulfuric acid production, recovered in smelting and refining zinc concentrate, increased about 11% in output and about 45% in value.

Tripoli.—Of the three States producing tripoli in 1985, Oklahoma continued to rank second. Tripoli is a naturally occurring microcrystalline, finely particulated, friable form of silica leached from a siliceous limestone or calcareous chert. The American Tripoli Co. mined tripoli in east-central Ottawa County, northeastern Oklahoma, and processed the material at Seneca, MO, for use as an abrasive in polished and buffing compounds. Tripoli output decreased 8% while its value increased almost 4%.

Vermiculite (Exfoliated).—W. R. Grace & Co. produced exfoliated vermiculite at its plant in Oklahoma City from raw material shipped in from out of State. Production and sales of the material declined, but dollar value of the product increased slightly as the use of the exfoliated vermiculite for horticultural applications rose; other uses included concrete aggregates, loose-fill insulation, block insulation, and plaster aggregates.

METALS

Gallium and Germanium.—Eagle-Picher Industries Inc., Electro-optics Materials Department, recovered and refined gallium and germanium from concentrates and scrap material at the company's plant in Quapaw.

Iron and Steel.—Gate City Steel Co., a service center and fabricator, expanded its Tulsa plant 19,800 square feet, bringing the facility up to 367,800 square feet. Construction costing $670,000 for the expansion and equipment began in February. Additional space in the plant was to be used for plate rolling and seam welding of cylinders for the pressure vessel and shell and tube heat exchanger industries.

Oklahoma Steel Processing Co. opened a plant in Oklahoma City for the manufacture of reinforcing steel bars for concrete. Initially, 25 people were employed.

Zinc and Lead.—St. Joe Minerals Corp., a subsidiary of Fluor Corp., acquired the National Zinc Co. zinc refinery at Bartlesville in August 1984. Operating at near capacity in 1985, St. Joe Resources Co. obtained feed for the 55,000-short-ton-per-year refinery from St. Joe Minerals lead-zinc mines in Missouri, from ASARCO Incorporated in a tolling arrangement, and by purchasing concentrate from other sources. The 38% increase in the 109,000 tons of zinc metal produced by St. Joe Minerals in 1985 was largely attributed to the company's Bartlesville acquisition.

Acidic waters from abandoned lead-zinc mines in the Picher Field of the Tri-State (Kansas, Missouri, and Oklahoma) mining district continued to discharge into the Tar Creek drainage system, threatening contamination of potable water supplies in the Roubidoux aquifer. Tar Creek, a southward flowing tributary of the Neosho River, drains 54 square miles in southeastern Kansas and northeastern Oklahoma.

In 1981, a 40-square-mile area near Picher, Ottawa County, was declared a hazardous water site and eligible for Superfund assistance under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. An agreement was made in 1984 for Oklahoma to contribute $346,000 of the estimated $3.97 million required to clean up the contaminated area; the cleanup program started in November. Clearing and plugging of almost 50 abandoned wells through which the contaminated acid mine water could migrate downward into the Roubidoux aquifer had been completed by June 30, 1985. However, further investigation by the Oklahoma Water Resources Board staff during the year revealed another 17 wells that would require action and, although the Environmental Protection Agency (EPA) approved clearing and plugging the additional wells, full funding for the project was postponed when Congress delayed reauthorizing the Superfund legis-

lation. Another part of the cleanup program was the construction of diversion structures to decrease surface water inflow into the mines. Planned and designed in 1985, this project was scheduled to start after anticipated EPA approval in early 1986.

[1]State Mineral Officer, Bureau of Mines, Denver, CO.

[2]Dikeman, N. J., Jr. Business Highlights. OK Bus. Bull., v. 54, No. 3, Mar. 1986, pp. 1-2, 5. (Center for Economic & Business Management Research, University of Oklahoma).

[3]U.S. Department of Labor. Employment and Earnings. V. 33, No. 5, May 1986, p. 127.

[4]Cooper, C. Oklahoma's Water-Information Needs Discussed at Recent OKC Conference. OK Geol. Notes, OK Geol. Surv., v. 45, No. 3, June 1985, pp. 100-101.

[5]Hauth, L. D. Overview of Hydrologic-Data Collection by the U.S. Geological Survey in Oklahoma. OK Geol. Notes, OK Geol. Surv., v. 45, No. 4, Aug. 1985, pp. 149-159.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Blue Circle Inc., a subsidiary of Blue Circle Industries Ltd.[1 2]	One Parkway Center 1850 Parkway Place Suite 1000 Marietta, GA 30067	Quarry and plant	Rogers.
Ideal Basic Industries Inc., Ideal Cement Co.[1 2]	Box 8789 Denver, CO 80201	----do----	Pontotoc.
Lone Star Industries Inc.[1 2]	Box 12449 Dallas, TX 75225	----do----	Mayes.
Clays:			
Acme Brick Co., a subsidiary of Justin Industries Inc.	Box 24012 Oklahoma City, OK 73124	Pits and plants	Custer and Oklahoma.
Chandler Materials Co	5805 East 15th St. Tulsa, OK 74102	----do----	Oklahoma and Rogers.
Commercial Brick Corp	Box 1382 Wewoka, OK 74884	Pit and plant	Seminole.
Frankoma Pottery Co	Box 789 Sapulpa, OK 74006	----do----	Creek.
Mangum Brick Co	Box 296 Mangum, OK 73554	----do----	Greer.
Oklahoma Brick Corp., a subsidiary of Merry Companies.	Box 75368 4300 NW. 10th St. Oklahoma City, OK 73127	----do----	Canadian.
Feldspar:			
Arkhola Sand and Gravel Co., a division of APAC-Arkansas Inc., a subsidiary of Ashland Oil Co.[2 3]	Box 1401 Muskogee, OK 74401	Dredge and plant	Muskogee.
Gallium and germanium:			
Eagle-Picher Industries Inc	Box 737 Quapaw, OK 74363	Refinery	Ottawa.
Gypsum:			
Harrison Gypsum Co. Inc	Box 336 Lindsay, OK 73052	Quarry	Caddo.
Lehigh Portland Cement Co	Box 1882 Allentown, PA 18105	----do----	Blaine.
Republic Gypsum Co	Drawer C Duke, OK 73532	Quarry and plant	Jackson.
Temple-Eastex Inc	Box 101 Fletcher, OK 73541	Quarry	Comanche.
United States Gypsum Co., a subsidiary of USG Corp.	Box 187 Southard, OK 73770	Quarry and plant	Blaine.
Western Plains Materials Co	Box 979 Weatherford, OK 73096	Quarry	Woodward.
Iodine:			
North American Brine Resources	c/o Beard Oil Co. 2000 Classen Center Bldg. Oklahoma City, OK 73106	Oilfield brines and plant.	Kingfisher.
Woodward Iodine Corp., a subsidiary of Asahi Glass Co. Ltd.	Box 1245 Woodward, OK 73801	Brine field and plant.	Woodward.
Lime:			
St. Clair Lime Co	Box 569 Sallisaw, OK 74955	Mine and plant	Sequoyah.
Pumice (volcanic ash):			
Axtell Mining Corp	Box 92 Gate, OK 73844	Open pit	Beaver.
Salt:			
Acme Salt Co	Box 420 Erick, OK 73645	Solar evaporation	Harmon.
Sand and gravel:			
Construction:			
Boorhem-Fields Inc	Box 1177 Paris, TX 75460	Pit and plant	Choctaw.
The Dolese Co	Box 677 Oklahoma City, OK 73101	Pits and plants	Canadian, Kingfisher, Logan, Oklahoma.
E & A Materials Inc	Box 365 Wichita Falls, TX 76307	Pit and plant	Cotton.

See footnotes at end of table.

Table 5.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Construction —Continued			
Lemon Haskel Construction Co. of General Materials Co. Inc.	Box 24044 Oklahoma City, OK 73124	Pits and plant	Cleveland.
McMichael Concrete Co., a subsidiary of Koppers Co. Inc.[2]	Box 3878 Tulsa, OK 74102	Pit and plant	Tulsa.
Murphy & Perkins Ready Mix Concrete Co.	Box 82099 Oklahoma City, OK 73108	do	Oklahoma.
Shoffner Sand of Oklahoma Inc	Box 863 Edmond, OK 73083	Pits and plant	Do.
Industrial:			
Mid-Continent Glass Sand Co	Box 248 Roff, OK 74865	Pit and plant	Pontotoc.
Pennsylvania Glass Sand Corp., Oklahoma Works.	Box 187 Berkeley Springs, WV 25411	do	Johnston.
Stone:			
Crushed:			
Amis Materials Co	Box 168 Stringtown, OK 74569	Quarry	Atoka.
Anchor Stone Co., a subsidiary of Anchor Industries.	3300 North Mingo Valley Expressway Tulsa, OK 74116	do	Tulsa.
Bellco Materials Inc	Box 466 Nowata, OK 74048	Quarries	Nowata, Rogers, Washington.
Dolese Bros. Co	Box 677 20 NW. 13th St. Oklahoma City, OK 73101	do	Atoka, Caddo, Carter, Comanche, Kiowa, Murray, Pittsburg, Seminole.
Material Producers Inc	Box 577 Norman, OK 73070	Quarry	Murray.
McNabb Coal Co. Inc	Drawer C Catoosa, OK 74015	Quarries	Rogers and Wagoner.
Meridian Aggregates Co., a subsidiary of Burlington Northern Railroad.	Box 86 Mill Creek, OK 74856	Quarry	Johnston.
The Quapaw Co	Box 72 Drumright, OK 74030	Quarries	Creek and Pawnee.
Sooner Rock & Sand Co., a subsidiary of Hallet Construction Co.	Box 1549 Norman, OK 73070	Quarry	Murray.
Standard Industries, a division of APAC-Oklahoma Inc.	Box 580670 Tulsa, OK 74158	Quarries	Cherokee, Kay, Mayes, Tulsa.
Tulsa Rock Co., a subsidiary of The McMichael Co. of Koppers Co. Inc.	Box 3878 Tulsa, OK 74102	Quarry	Rogers.
Dimension:			
Bodie L. Anderson Quarries Inc	Box 106 Mill Creek, OK 74856	do	Johnston.
Wilson Miller	Route 1 Hackett, AR 72937	do	LeFlore.
Pontotoc Stone Co	1434 NW. 30th St. Oklahoma City, OK 73118	do	Johnston.
Roosevelt Granite Co	Box 307 Snyder, OK 73566	Quarries and plant	Kiowa.
TDM Quarry Co	Route 5, Box 72 McAlester, OK 74501	Quarry	Pittsburg.
Tripoli:			
American Tripoli Co	Box 489 Seneca, MO 64865	Mines	Ottawa.
Zinc:			
St. Joe Resources Co., National Zinc Div., a subsidiary of Fluor Corp.	Box 579 Bartlesville, OK 74005	Refinery	Washington.

[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 Leon E. Esparza[1] and Mark Ferns[2]

Oregon's nonfuel mineral production value rose in 1985 to $130 million, an increase of about 8.2% from the $120 million recorded in 1984. Industrial minerals accounted for nearly all of the nonfuel mineral value reported for the year. Stone was the leading commodity in terms of value, followed by construction sand and gravel, cement, and lime; these commodities accounted for about 95% of the total value. Oregon ranked 36th in the Nation in the total value of its nonfuel mineral production for 1985, and was 33d in value for industrial minerals.

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

Mineral		1984		1985	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	189	$288	188	$285
Gem stones		NA	400	NA	350
Nickel (content of ores and concentrates)	short tons	14,540	W	6,127	W
Sand and gravel (construction)	thousand short tons	12,776	37,117	e12,500	e36,800
Stone (crushed)	do.	e12,500	e37,500	15,336	54,244
Talc (soapstone)	do.	(2)	66	(2)	30
Combined value of cement, diatomite, gold, lime, pumice, silver (1984), stone (dimension, 1985), and values indicated by symbol W		XX	45,031	XX	38,587
Total		XX	120,402	XX	130,296

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

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

[2]Less than 1/2 unit.

Table 2.—Nonfuel minerals produced in Oregon in 1984, by county[1]

County	Minerals produced in order of value
Baker	Cement, sand and gravel (construction), clays.
Benton	Sand and gravel (construction).
Clackamas	Do.
Clatsop	Do.
Columbia	Do.
Coos	Do.
Crook	Do.
Curry	Do.
Deschutes	Pumice.
Douglas	Nickel, sand and gravel (construction).
Grant	Sand and gravel (construction).
Jackson	Sand and gravel (construction), talc.
Josephine	Sand and gravel (construction), gold, silver.
Klamath	Clays.
Lake	Diatomite, sand and gravel (construction).
Lane	Sand and gravel (construction).
Lincoln	Do.
Linn	Sand and gravel (construction), gold.
Malheur	Lime, sand and gravel (construction).
Marion	Sand and gravel (construction).
Morrow	Do.
Multnomah	Lime, sand and gravel (construction), clays.
Polk	Sand and gravel (construction).
Tillamook	Do.
Umatilla	Do.
Wallowa	Do.
Wasco	Do.
Washington	Do.
Yamhill	Do.
Undistributed[2]	Stone (crushed), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Oregon business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	2,660	2,676	2,687
Total civilian labor force	do	1,341	1,335	1,327
Unemployment	percent	10.8	9.4	8.8
Employment (nonagricultural):				
Mining total	thousands	1.6	1.6	1.6
Metal mining[1]	do	.1	.1	.1
Manufacturing total	do	188.8	201.1	199.9
Primary metal industries	do	7.5	9.1	8.8
Stone, clay, and glass products	do	3.0	2.7	3.0
Chemicals and allied products	do	2.2	2.0	1.9
Petroleum and coal products	do	.5	.5	.4
Construction	do	27.0	30.2	32.1
Transportation and public utilities	do	55.4	57.1	58.0
Wholesale and retail trade	do	242.6	253.0	258.8
Finance, insurance, real estate	do	64.5	65.4	66.9
Services	do	194.6	204.5	214.5
Government and government enterprises	do	192.3	194.1	197.1
Total[2]	do	966.7	1,006.9	1,029.0
Personal income:				
Total	millions	$29,856	$32,147	$33,921
Per capita		$11,224	$12,011	$12,622
Hours and earnings:				
Total average weekly hours, production workers		38.9	39.2	38.7
Total average hourly earnings, production workers		$10.3	$10.4	$10.5

See footnotes at end of table.

Table 3.—Indicators of Oregon business activity —Continued

		1983[r]	1984	1985[p]
Earnings by industry:				
Farm income	millions	$480	$600	$570
Nonfarm	do	$20,341	$22,090	$23,381
Mining total	do	$76	$87	$83
Metal mining	do	$3	$2	$1
Nonmetallic minerals except fuels	do	$27	$25	$28
Coal mining	do	$11	W	W
Oil and gas extraction	do	$35	W	W
Manufacturing total	do	$4,778	$5,264	$5,350
Primary metal industries	do	$254	$304	$302
Stone, clay, and glass products	do	$80	$78	$82
Chemicals and allied products	do	$57	$59	$62
Petroleum and coal products	do	$17	$16	$12
Construction	do	$990	$1,136	$1,230
Transportation and public utilities	do	$1,692	$1,824	$1,871
Wholesale and retail trade	do	$3,871	$4,154	$4,334
Finance, insurance, real estate	do	$1,096	$1,130	$1,266
Services	do	$4,050	$4,545	$4,980
Government and government enterprises	do	$3,566	$3,742	$4,055
Construction activity:				
Number of private and public residential units authorized[3]		8,694	8,055	11,297
Value of nonresidential construction[3]	millions	$439.0	$539.6	$582.6
Value of State road contract awards	do	$226.8	$217.1	$255.9
Shipments of portland and masonry cement to and within the State	thousand short tons	554	609	709
Nonfuel mineral production value:				
Total crude mineral value	millions	$110.9	$120.4	$130.3
Value per capita		$42	$45	$48

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2]Data may not add to totals shown because of independent rounding.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

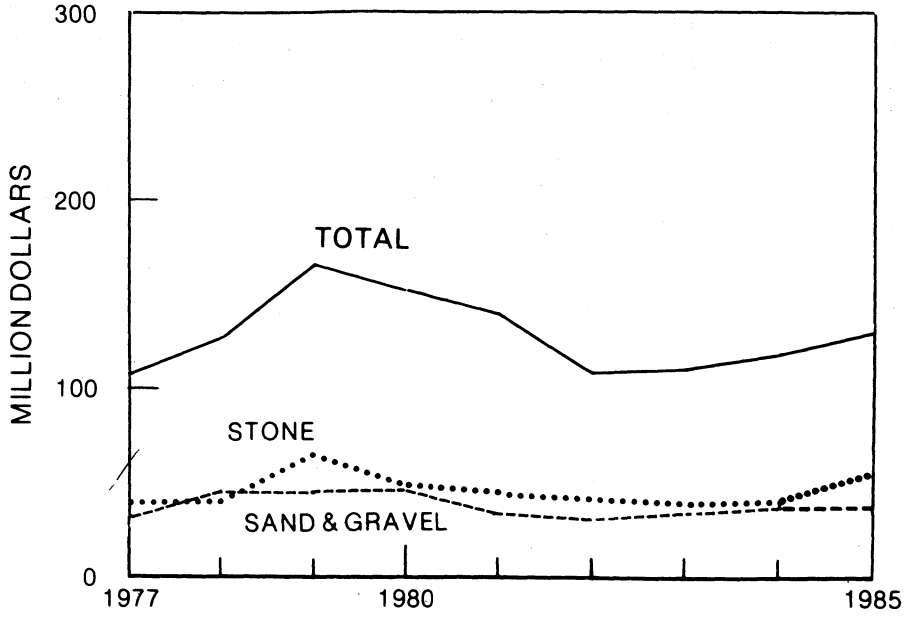

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Oregon.

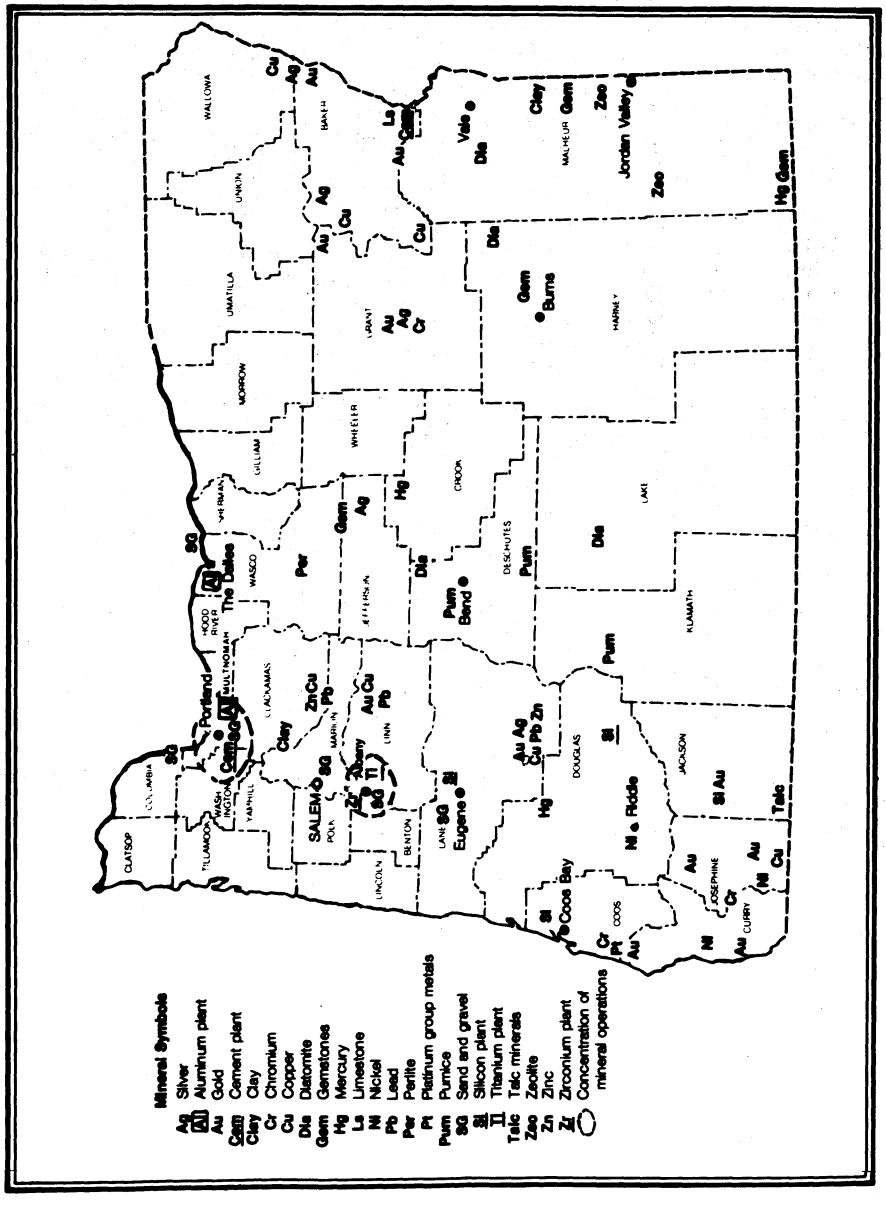

Figure 2.—Principal mineral producing localities in Oregon.

Trends and Developments.—In June, the M. A. Hanna Co. shut down its integrated nickel mine and smelter complex, near Riddle, to begin a $13 million renovation. The project involved installation of equipment for a new wet-screening process that the company hopes will make it more competitive in a climate of what has been consistently depressed nickel prices. The operation is the only domestic integrated mine-smelter nickel producer. Aluminum companies curtailed production again this year. Northwest Aluminum Co. of Portland began negotiations with Martin Marietta Aluminum Inc. for operation of the Martin Marietta smelter in The Dalles. At yearend, negotiations hinged on finding solutions to such problems as (1) high regional power costs, (2) labor costs, (3) low metal prices, and (4) firming up plans to toll process aluminum. Bonneville Power Administration (BPA), under a proposed variable rate plan, may be able to help find at least a partial solution to the high regional power costs that affect these negotiations and the Northwest aluminum producers in general.

Albany Titanium Inc. (ALTi) was awarded a contract by the U.S. Department of Defense to begin research into the production of low-density titanium powders. Research will focus on the use of ALTi's ALTi-Oxy process, which produces titanium from ilmenite via zinc and aluminum reduction. Use of these powders could allow enhanced performance of superalloys used in advanced aerospace and jet engine applications.

Teledyne Wah Chang Albany (TWCA) released and defended results of its study claiming that a radium-bearing sludge was not sufficiently radioactive to fall under the jurisdiction of Oregon State law. The sludge was previously produced as a byproduct of the zirconium refining process.

Under the guidance of the Gorda Ridge Technical Task Force, Federal and State teams continued to search for submarine polymetallic sulfide deposits along the Gorda Ridge off the Oregon coast, within the Nation's 200-mile Exclusive Economic Zone. A National Oceanic and Atmospheric Administration research ship, the *Surveyor,* looked for indicators of high concentrations of copper, lead, manganese, nickel, and zinc. During the expedition, manganese-laden water samples and thermal anomalies were discovered about 135 miles west of Cape Blanco, indicating that Gorda Ridge is the site of active hydrothermal venting and may be an indication of massive sulfide deposits.

Research on the Juan de Fuca Ridge, meanwhile, focused on an area about 200 miles west of Newport, where active vents and massive sulfide deposits were discovered in 1984.

Exploration Activities.—Most metallic mineral exploration projects in 1985 were for gold and silver. Exploration was concentrated in the northeastern and southwestern parts of the State, where most of Oregon's past productive precious metals mines have been found. There also has been continued exploration in southeastern Oregon by several major companies for epithermal gold deposits.

Seneca Exploration and Litho-Logic Resources mapped and sampled a massive sulfide zone at the Fall Creek copper deposit in Josephine County. Amselco Minerals Inc. drilled the area around the Goff Mine, also in Josephine County. The deposit is in siliceous tuffs and contains massive sulfides capped by barite. The Gold Note strata-bound sulfide deposit, on the Josephine-Jackson County line, was drilled by Boise Cascade Corp. The Turner-Albright polymetallic sulfide deposit in southwestern Josephine County was surveyed using pulse-electromagnetic geophysics by Ray Rock Mines Inc.

Silver King Mines Inc. placed a crew at the Iron Dyke Mine in Baker County with the expressed intent of mining out a 20,000-ton ore body, which reportedly averages 0.3 troy ounce per short ton of gold and 3% copper.

Rio Algom Corp., under an agreement with Capri Resources Ltd. of Vancouver, British Columbia, Canada, drilled for lode gold deposits at the Sunday Hill Mine in the Mormon Basin District in southern Baker County. Sunshine Mining Co. sampled accessible underground workings at the Flagstaff Mine in the Virtue Flat District, Baker County.

American Copper & Nickel Co. Inc., a subsidiary of Inco Ltd., continued exploration in the Susanville District, Grant County, on its Susanville property and Bull of the Woods claims, and completed a surface drilling program on its claims in the Cable Cove District, Baker County. In the Cable Cove District, Shell Mining Co. and Manville Products Corp., under a joint venture agreement, explored for precious metals

in an area previously evaluated for copper and molybdenum. Manville also drilled its Grouse Spring prospect in southern Baker County. Manville had a joint venture agreement with Tenneco Minerals Co. to explore for gold at its Red Butte property, Malheur County. Manville collected surface samples and mapped its Castle Rock property, also in Malheur County. Evaluation of gold occurrences at Quartz Mountain, Lake County, by The Anaconda Minerals Co. and Exploration Ventures Co. joint venture, continued.

Tenneco reported its Tucker Hill deposit in Lake County has at least 20 million tons of vesicular-to-granular perlite and perlite breccia amenable to open pit mining. Bulk sample test results made by Tenneco indicated the perlite was suitable for use in horticulture, loose-fill insulation, insulation board, and acoustical tile. Supreme Perlite Co. continued to evaluate its perlite discovery at Dooley Mountain, Baker County.

Anaconda conducted assessment drilling on its Harney zeolite property in Lake County, which reportedly may be one of the world's largest known clinoptilolite deposits. Anaconda reports the deposit may contain 1 billion short tons of 90% clinoptilolite rock, associated with a 215-foot-thick ash flow tuff. Anaconda also continued drilling its Rome zeolite property in Malheur County, for which it reports a resource of 30 million short tons of 60% mordenite.

Teague Mineral Products Co. continued exploration for zeolite and bentonite deposits in Malheur and Harney Counties. Cascade Sulfur Co. conducted surveys of a hydrothermally altered zone in dacitic volcanic rocks in the Foster Creek area of Douglas County. The purpose of the surveys was to test various applications for the bentonite clays (montmorillonite) and pyrophyllite collected from the altered zone.

Legislation and Government Programs.—BPA proposed a variable power rate program, tied to the price of aluminum, for the Northwest aluminum industry. BPA also agreed to extend for 5 years the agreement with M. A. Hanna to reduce offpeak power use rates at its nickel smelter in Douglas County. Smelters in the Northwest purchase about one-third of all power generated by BPA. The variable rates would be in place for 10 years and would be adjusted annually to account for inflation or changes in BPA's general rates. There also would be an adjustment midway through the period, based on aluminum price trends. The rates would apply only to smelters and not to aluminum fabricating facilities.

The U.S. Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) announced plans to transfer 3.6 million acres presently under BLM jurisdiction to the USFS. These lands are mostly west of the Cascade Mountains. In return, the USFS would transfer about 300,000 acres in southeastern Oregon to the BLM.

The BLM also was involved in a debate with environmental and mining groups, cattle ranchers, and recreationists concerning the Oregon wilderness draft environmental impact statement. The BLM recommended about 950,000 acres in 41 study areas be designated wilderness. Under consideration originally was about 2.3 million acres of BLM-managed land in 77 wilderness study areas.

The BLM proposed the Eight Dollar Mountain area in Josephine County as an "Area of Critical Environmental Concern." The area encompasses 1,200 acres underlain by nickel laterite that contains chromium (Cr_2O_3) and cobalt at grades of about 1% and 0.035%, respectively.

The USFS and BLM released results of a study indicating that a 34-mile stretch of the North Umpqua River in southwestern Oregon was eligible for protection under the National Wild and Scenic Rivers system. The study was the first step in a process that could result in Federal protection of the river from damming, diversion, dredging, or channeling. The study was authorized by Senate bill S-416 and signed by the President as Public Law 98-494, October 19, 1984. The law also provided additional protection for Steamboat Creek, a North Umpqua tributary, and added Oregon's Illinois and Owyhee Rivers to the National Wild and Scenic Rivers system.

Legislation was introduced to expand by about 300,000 acres the wilderness areas in the Hells Canyon National Recreation Area along the Snake River. This would bring the total area under Federal protection to about 515,000 acres; the area spans parts of Idaho, Oregon, and Washington.

The U.S. Department of the Interior, through the Gorda Ridge Technical Task Force, continued mineral resource assessment studies of Gorda Ridge, situated about 135 miles off the coast of southern Oregon. The objective of the Gorda Ridge studies was to analyze the economic and environmental impacts of leasing. The scope of the program in 1985 involved water column,

heat flow, and seismic studies; sampling; and undersea photography. In May, plumes of metal-rich seawater were discovered over the Gorda Ridge. In late 1985, massive sulfide samples were collected from the Escanaba Trough area of Gorda Ridge, in water depths of about 11,000 feet. These discoveries indicate that the area may be the site of active hydrothermal venting and may have associated polymetallic sulfide mineral deposits. The Oregon Department of Geology and Mineral Industries (DOGAMI) continued its involvement in the Gorda Ridge studies and acts as co-chair of the Gorda Ridge Technical Task Force.

DOGAMI's mineral investigations were being reoriented from metallic commodities to industrial commodities, including bentonite, limestone, and talc; all are known to occur in relatively large quantities in the State. The State's Mined Land Reclamation Program focused on permitting and regulating 600 sites in various stages of producing gravel, sand, stone, other industrial minerals, and metallics (mostly placer gold).

Curry County officials, including the county commissioner and members of the Planning Commission, proposed that a new national park be created. The park would include the junction of the Rogue and Illinois Rivers and USFS-controlled land between the Wild Rogue and Kalmiopsis Wilderness Areas. The Rogue River is one of the most popular rafting rivers in the Northwest, and the Illinois is considered one of the technically most challenging rivers to float. The county officials' expressed intent for the proposal was to stimulate the economy of southwestern Oregon by increasing tourism. Officials from neighboring counties were concerned about the effect such a park would have on the local mining and timber industries.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

The 1985 value of industrial mineral production in Oregon increased almost 11% over that recorded in 1984. The change was due mostly to increased production of diatomite, lime, and crushed stone.

Cement.—Cement production in the State declined from that reported in 1984. Ash Grove Cement West Inc. operated its limestone quarry and cement plant near Durkee, Baker County, throughout the year.

Portland cement produced in 1985 was used as follows: 73% by ready-mixed concrete companies, 13% by highway contractors, 7% by concrete product manufacturers, and 7% by building material dealers and others. The uses or customers for portland cement did not change from 1984 to 1985. Raw materials used to produce cement were clays, gypsum, iron oxide, limestone, and shale.

Clays and Zeolite.—Teague continued to produce bentonitic clay and zeolite from pits near Adrian in eastern Malheur County. The company also had a processing facility near Adrian. The clay was marketed as a water sealant and/or drilling mud. Zeolite was sold for soil conditioner and as a waste absorbent.

The Oregon Sun Ranch and Central Oregon Bentonite clay pits on Camp Creek, Lake County, were active producers. Both companies produced clay-bearing materials that were used mostly as cat litter.

Value and quantity of clay and shale produced in Oregon decreased slightly from that reported in 1984.

Diatomite.—Eagle-Picher Industries Inc. continued construction of its Celatom project, which includes a mine and processing plant in Malheur and Harney Counties, respectively. The minesite is near Drewsey, and the plant is 7 miles west of Vale. The project will cost between $8 and $13 million and was being partially funded by an Industrial Revenue Bond and Urban Development Action Grant. Production rates at the mine were anticipated to reach 140,000 cubic yards of diatomite per year. The company controls about 3,700 acres of property along the Harney-Malheur County line, on private, State, and Federal lands. Mine life is anticipated to be 15 to 20 years. The Celatom project should employ about 40 people by the time full production is realized. The refined product will be used for filters in beverage manufacture and pharmaceuticals.

Oil-Dri Production Co. continued to produce diatomite from its open pit and processing plant in Christmas Valley, Lake

County. The product was used for cat litter, oil absorbent, and anticaking additive in animal feeds, and an absorbent for hazardous wastes.

Lime.—Lime production in Oregon for 1985 increased 7% in value over that reported in 1984. Amalgamated Sugar Co. in Malheur County and Ash Grove Cement in Multnomah County continued quicklime production throughout the year. A comparatively small amount of hydrated lime was produced by Ash Grove Cement. All of Amalgamated Sugar's production and part of Ash Grove Cement's was used to process sugar.

Pumice.—Oregon retained its rank as first in the Nation for pumice production in 1985. The value was down about 5% from that reported in 1984. Production remained about the same as that of 1984. Pumice was produced by Cascade Pumice Co. and Central Oregon Pumice Co. from their respective operations in Deschutes County, near Bend. Primary uses were for concrete aggregate (52%), decorative building block (38%), road construction and maintenance (5%), and landscaping and roofing (5%).

Sand and Gravel (Construction).—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Production of crushed stone increased nearly 23% and about 45% in quantity and value, respectively, from that reported in 1984. The major use for crushed stone was in road base and unpaved road surfacing. These uses consumed nearly 43% of the crushed stone produced during 1985. About 88% of the crushed stone produced was transported by truck. The USFS produced 25% of the total crushed stone for use in maintenance of roads on USFS administered lands.

Table 4.—Oregon: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	117	216
Riprap and jetty stone	287	983
Filter stone	129	418
Coarse aggregate, graded:		
Concrete aggregate, coarse	30	103
Bituminous aggregate, coarse	103	354
Bituminous surface-treatment aggregate	813	3,378
Railroad ballast	377	1,431
Fine aggregate (-3/8 inch):		
Stone sand, concrete	4	19
Stone sand, bituminous mix or seal	53	169
Screening, undesignated	3	4
Combined coarse and fine aggregates:		
Graded road base or subbase	5,386	22,314
Unpaved road surfacing	1,196	3,893
Crusher run or fill or waste	899	3,436
Other construction materials[2]	76	200
Special:		
Other miscellaneous[3]	830	1,814
Other unspecified[4]	5,034	15,513
Total[5]	15,336	54,244

[1]Includes limestone, granite, sandstone, traprock, volcanic cinder and scoria, and miscellaneous stone.
[2]Includes stone used in terrazzo and exposed aggregate and stone used for other construction and maintenance purposes.
[3]Includes stone used for cement manufacture, chemical stone, and other uses not specified.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Bristol Silica and Limestone Co. continued to produce metallurgical-grade silica rock for Dow Corning Chemical Co. at Bristol's mine in Jackson County. The company also sells silica for use as poultry grit, and fine-grained silica for use as a filtration medium.

Talc (Soapstone).—Steatite of Southern Oregon Inc. produced block soapstone for art carving and other specialty uses in 1985. Its value decreased nearly 55% from that reported in 1984.

METALS

Aluminum.—Aluminum production in Oregon declined both in quantity and value compared with that reported in 1984. The decrease was attributed to worldwide aluminum oversupply and the resultant lower aluminum prices. Oregon's aluminum smelters were operating at 40% of capacity near yearend. Also affecting the industry were escalating electrical power costs, which had increased 800% during the previous 5 years. The BPA, the region's largest producer of hydroelectrical energy, began discussions with the aluminum producers to seek an equitable solution to all involved. One proposal offered by BPA would link electricity rates to the worldwide market price of aluminum. The proposal would establish a rate of 22 mills per kilowatt hour for aluminum ingot prices of $0.61 to $0.72 per pound. If aluminum prices dropped below $0.61, the rate would decrease 1 mill per kilowatt hour for each 1-cent-per-pound drop. Aluminum price increases above $0.72 per pound would result in a power rate increase of 0.5 mill per kilowatt hour for each 0.5-cent-per-pound increase in price. At yearend, rates were 22.8 mills per kilowatt hour, and the Metals Week average daily price quotation for December 1985 was 49.976 cents per pound.

Reynolds Metals Co. laid off 155 employees at Troutdale and shut down 1 potline because of large company aluminum inventories. The reductions brought the operating rate down to about 42% of capacity or 55,000 short tons of metal per year, where it remained at yearend.

Northwest Aluminum of Portland won exclusive rights to negotiate a lease-purchase of Martin Marietta's idle aluminum smelter at The Dalles. The plant has a rated capacity of 82,000 metric tons per year and was closed in late December 1984. Closure meant lost jobs for 450 people.

Columbium, Tantalum, Zirconium.—TWCA again was listed among eight major domestic processors and/or producers of columbium and tantalum in 1985. The company has facilities to produce columbium and tantalum metal, columbium pentoxide, and ferrocolumbium, and employs 1,300 people at its Albany plant.

Copper, Gold, Lead, and Silver.—A number of gold placers were active in Baker and Grant Counties in northeastern Oregon, and Douglas, Jackson, and Josephine Counties in southwestern Oregon. Most of the operations were small, and only a few produced more than 50 troy ounces of gold in 1985.

The larger producing placer mines in eastern Oregon were on Pine Creek near Hereford, on Clarks Creek and on the Upper Burnt River in Baker County, and on Boulder Creek near Granite in Grant County. Numerous small operations continued in Josephine County, including a number on Josephine Creek and its tributaries in the Galice area and on Coffee Creek in Douglas County. Proposed rules for the Wild and Scenic Illinois River Management Plan would end the use of small dredges on the Wild and Scenic stem of the Illinois River, where a number of operations have been active in past years at various sites between the U.S. National Forest boundary and the mouth of Biggs Creek.

Lode gold, silver, and base metal production was mainly from small, intermittent operations at the Thomason Mine in Baker County; the Elk Heaven, Pyx, and Tempest Mines in Grant County; and the Greenback and Fall Creek gold mines in Josephine County.

Nickel.—M. A. Hanna began a $13 million renovation in June of its nickel operation at Riddle, in Douglas County. Mining and smelting ceased for 4 months to install the new equipment, which the company hopes will restore profitability by allowing them to concentrate low-grade ores for more economic smelting. The Riddle operation is the Nation's only integrated nickel mine and smelter. The renovation involves installation of equipment for a new wet-screening process. The process will increase grades of ore shipped to the smelter from about 1% to at least 2% by washing the higher grade, soft, fine material off the relatively unweathered host rock. Ore will be wet crushed, then pumped into a 300-foot-diameter thickener tank. The ore will then be transported, as a slurry from the tank, down Nickel Mountain through a 10-inch-diameter pipe to the plant, a distance of about 13,000 feet. At the plant, the slurry will be funneled into five large centrifuges for dewatering; the water will then be recir-

culated. The dewatered material will be blended with other dry fine ore before being fed into a furnace for smelting.

Titanium.—ALTi continued a pilot program to produce titanium sponge and powder from ilmenite, using the continuous flow process (ALTi-Oxy process), which was patented by Occidental Petroleum Corp. in 1983. ALTi received a license from Occidental for the process and capital from the private sector to fund production. The new process may enable ALTi to produce new titanium alloys that currently cannot be produced by conventional methods. ALTi also announced plans to construct a manufacturing plant to increase production. The plant probably will be built in Alabama, Florida, Mississippi, or Texas. The company indicated the Southern States are a better source for the ilmenite sand concentrate used in the production process, and Oregon's strict regulations make disposing of the saltwater byproduct prohibitively expensive.

Oregon Metallurgical Corp. (OREMET) celebrated its 30th year in business. In September, Armco Inc.'s 80% stock ownership of OREMET was purchased by Owens-Corning Fiberglas Corp. of Toledo, OH. OREMET operates an integrated production plant in Albany, OR, that produces titanium sponge, ingots, mill products, and castings for aerospace and industrial applications. In 1985, OREMET expanded its magnesium recycle facility to provide the corporation with an optimum balance in its total sponge manufacturing operation.

[1]State Mineral Officer, Bureau of Mines, Spokane, WA.
[2]Geologist, Oregon Department of Geology and Mineral Industries, Baker, OR.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Reynolds Metals Co	5100 NE. Sundial Rd. Troutdale, OR 97060	Smelter	Multnomah.
Cement:			
Ash Grove Cement West Inc.[1]	5550 SW. Macadam Ave. Suite 300 Portland, OR 97201	Plants and quarries.	Baker.
Diatomite:			
Eagle-Picher Industries Inc	Graham Blvd. Vale, OR 97918	Surface mine and plant.	Harney and Malheur.
Oil-Dri Production Co	Box 191 Christmas Valley, OR 97638	do	Lake.
Lime:			
Amalgamated Sugar Co	Box 1766 Nyssa, OR 97913	Plant	Malheur.
Ash Grove Cement Co	8900 Indian Creek Parkway Suite 600 Overland Park, KS 66225	do	Multnomah.
Nickel:			
M. A. Hanna Co	Box 85 Riddle, OR 97469	Surface mine and smelter.	Douglas.
Perlite (expanded):			
Supreme Perlite Co	4600 North Suttle Rd. Portland, OR 97217	Plant	Multnomah.
Pumice:			
Cascade Pumice Co	Box 1087 Bend, OR 97701	Pit	Deschutes.
Central Oregon Pumice Co	5 NW. Greenwood Ave. Bend, OR 97701	Pit	Do.
Stone:			
Baker Rock Crushing Inc	21880 SW. Farmington Rd. Beaverton, OR 97005	Quarry	Washington.
Karban Rock Inc	3707 24th Ave. Forest Grove, OR 97116	do	Do.
Rogers Construction Co	Box 730 Umatilla, OR 97882	do	Umatilla.
Springfield Quarry Rock Products	Box 692 Springfield, OR 97477	do	Lane.
Talc (soapstone):			
Steatite of Southern Oregon Inc	2891 Elk Lane Grants Pass, OR 97526	Surface mine and mill.	Jackson and Josephine.
Titanium:			
Oregon Metallurgical Corp	Box 580 Albany, OR 97321	Smelter	Linn.
Zeolite:			
Teague Mineral Products Co.[2]	Box 35-C, Route 2 Adrian, OR 97901	Surface mine and plant.	Malheur.
Zirconium:			
Teledyne Wah Chang Albany[3]	1600 NE. Old Salem Rd. Albany, OR 97321	do	Do.

[1]Also clays, pumicite, and crushed stone.
[2]Also bentonite.
[3]Also columbium, hafnium, tantalum, and vanadium.

The Mineral Industry of Pennsylvania

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

By L. J. Prosser, Jr.,[1] and Robert C. Smith[2]

The value of Pennsylvania's nonfuel mineral production of about $804 million was the highest in the State's history. Nationally, Pennsylvania ranked eighth in value of nonfuel mineral production accounting for about 3.5% of the U.S. total. The increase in value of $96 million over that of 1984 was also the largest among the 50 States in 1985. However, the record-high value reflected, primarily, continuing higher prices for mineral commodities produced in Pennsylvania rather than significant gains in mineral output.

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

Mineral	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
Cement:				
Masonry thousand short tons	298	$20,849	303	$20,970
Portland do	5,735	281,590	5,535	288,036
Clays[2] do	963	4,050	1,142	5,293
Gem stones	NA	5	NA	5
Lime thousand short tons	1,620	90,182	1,492	85,269
Peat do	24	693	21	602
Sand and gravel:				
Construction do	14,472	64,285	e17,000	e74,000
Industrial do	W	W	693	9,846
Stone:				
Crushed do	e56,200	e228,000	64,765	310,859
Dimension do	e44	e6,001	51	8,214
Combined value of clays (kaolin), mica (scrap), and value indicated by symbol W	XX	12,701	XX	1,380
Total	XX	708,356	XX	804,474

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

Table 2.—Nonfuel minerals produced in Pennsylvania in 1984, by county[1]

County	Minerals produced in order of value
Adams	Lime, clays, mica.
Allegheny	Cement, sand and gravel, clays.
Armstrong	Sand and gravel, clays.
Beaver	Do.
Berks	Cement, clays.
Blair	Sand and gravel.
Bradford	Do.
Bucks	Sand and gravel, clays.
Butler	Lime, cement, sand and gravel.
Cameron	Sand and gravel.
Carbon	Do.
Centre	Lime.
Chester	Lime, clays.
Clinton	Clays.
Columbia	Sand and gravel.
Crawford	Do.
Cumberland	Do.
Dauphin	Do.
Erie	Sand and gravel, peat.
Forest	Sand and gravel.
Franklin	Do.
Fulton	Do.
Huntingdon	Do.
Jefferson	Clays, sand and gravel.
Lackawanna	Peat, sand and gravel.
Lancaster	Clays.
Lawrence	Cement, sand and gravel, clays, peat.
Lebanon	Lime.
Lehigh	Cement.
Luzerne	Sand and gravel, peat.
Lycoming	Sand and gravel.
Mercer	Do.
Mifflin	Lime, sand and gravel.
Monroe	Sand and gravel, clays, peat.
Montgomery	Lime.
Northampton	Cement, sand and gravel.
Northumberland	Sand and gravel, clays.
Pike	Sand and gravel.
Schuylkill	Do.
Susquehanna	Do.
Tioga	Do.
Union	Clays.
Venango	Sand and gravel.
Warren	Do.
Wayne	Do.
Westmoreland	Do.
Wyoming	Do.
York	Lime, cement, sand and gravel, clays.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Trends and Developments.—Increased prices for mineral commodities coupled with demand for industrial minerals by the construction industry escalated Pennsylvania's value of nonfuel mineral production to a record high of $804 million. Cement, lime, construction sand and gravel, and crushed stone accounted for about $780 million or 97% of the total value.

The previous State record for the value of nonfuel mineral production was $722 million in 1979. Since 1979, the unit prices of Pennsylvania's four leading commodities in total value had increased or remained above that of the national average. The average price per short ton of crushed stone (f.o.b. quarry) in the United States in 1979 was $2.98; in Pennsylvania, $3.14 or 5% above the national average. By 1985, crushed stone prices in Pennsylvania were $4.80 per ton, which was $0.75 or nearly 20% above the U.S. average. An even greater change occurred in cement prices over the last 6 years. In 1979, portland cement sold in Pennsylvania for about $40 per short ton (mill value) compared with $46 per ton nationally. Gradually, since 1979, Pennsylvania cement prices rose to $52.04 surpassing the national average by $0.63 in 1985. Whereas the average U.S. price for cement increased 12% since 1979, Pennsylvania's price was 30% higher. Lime prices in Pennsylvania ranged from 6% to 11% above the national average for the past 6 years. Of the 17 States producing more than 200,000 short tons of lime in 1985, Pennsylvania's average price of $57.15 per short ton was third highest. In 1979, the unit value per short ton of construction sand and gravel in Pennsylvania was $3.15, second highest among the 50 States and 40% above the national average. In 1985, a ton of construction sand and gravel in Pennsylvania cost $4.35, highest in the Nation and 43% above the U.S. average.

The recent history of mineral prices in Pennsylvania is related to changes in the domestic and international marketplace along with the indigenous conditions in the State's mining industry. The State's cement industry used the wet process at 5 of its 11 plants. Nationally, about 38% of production was exclusively from wet-process plants. Average fuel consumption for kiln-firing in wet-process plants was 33% higher than for dry-process operations. Also in 1985, cement imports increased to nearly 14.5 million tons, the highest level in U.S. history. Traditionally, Pennsylvania's steel industry consumed more than 50% of the State's lime production. That percentage of consumption remained about the same in 1985. The State's steel production has declined by about 25% since the late 1970's. The decline in Pennsylvania's steel, cement, and lime manufacturing also reduced the output of crushed stone, particularly limestone. As the population continued to move from cities to suburbs, the land available for mining aggregate declined because of local zoning and other regulations. In addition, environmental concerns and stipulations increased the time and cost for aggregate producers in opening or expanding mining operations. These conditions were similar nationwide, but particularly affected Pennsylvania sand and gravel production because of inherent limited resources.

Table 3.—Indicators of Pennsylvania business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	11,891	11,887	11,853
Total civilian labor force	do.	5,506	5,479	5,519
Unemployment	percent	11.8	9.1	8.0
Employment (nonagricultural):				
Mining total[1]	thousands	39.0	38.6	36.3
Nonmetallic minerals except fuels	do.	3.9	4.0	4.6
Coal mining	do.	30.1	29.1	26.0
Oil and gas extraction[2]	do.	4.9	5.4	5.6
Manufacturing total	do.	1,095.8	1,121.9	1,089.5
Primary metal industries	do.	120.4	117.9	104.5
Stone, clay, and glass products	do.	48.7	49.0	47.9
Chemicals and allied products	do.	58.1	59.2	59.8
Petroleum and coal products	do.	14.8	13.0	12.6
Construction	do.	165.7	175.8	189.5
Transportation and public utilities	do.	239.7	244.2	239.4
Wholesale and retail trade	do.	994.1	1,033.1	1,069.0
Finance, insurance, real estate	do.	243.0	253.5	262.4
Services	do.	1,073.2	1,114.9	1,170.8
Government and government enterprises	do.	673.7	672.9	679.3
Total[3]	do.	4,524.3	4,654.8	4,736.3
Personal income:				
Total	millions	$141,508	$151,020	$159,276
Per capita		$11,901	$12,704	$13,437
Hours and earnings:				
Total average weekly hours, production workers		39.2	40.2	39.9
Mining (nonmetallic minerals, except fuels)		43.4	44.6	45.0
Total average hourly earnings, production workers		$8.9	$9.3	$9.6
Mining (nonmetallic minerals, except fuels)		$9.0	$9.3	$9.7
Earnings by industry:				
Farm income	millions	$496	$978	$850
Nonfarm	do.	$97,190	$104,751	$110,885
Mining total	do.	$1,571	$1,792	$1,710
Metal mining	do.	$6	W	W
Nonmetallic minerals except fuels	do.	$97	$102	$127
Manufacturing total	do.	$27,181	$29,086	$29,625
Primary metal industries	do.	$4,037	$4,116	$3,787
Stone, clay, and glass products	do.	$1,280	$1,342	$1,382
Chemicals and allied products	do.	$1,885	$1,991	$2,157
Petroleum and coal products	do.	$732	$692	$705
Construction	do.	$5,556	$6,080	$6,442
Transportation and public utilities	do.	$7,251	$7,749	$7,973
Wholesale and retail trade	do.	$15,312	$16,296	$17,258
Finance, insurance, real estate	do.	$5,269	$5,653	$6,543
Services	do.	$21,456	$23,790	$26,165
Government and government enterprises	do.	$13,234	$13,951	$14,792
Construction activity:				
Number of private and public residential units authorized[4]		33,508	39,546	43,566
Value of nonresidential construction[4]	millions	$1,744.3	$2,013.0	$2,115.4
Value of State road contract awards	do.	$298.0	$941.0	$1,252.0
Shipments of portland and masonry cement to and within the State	thousand short tons	2,417	2,686	3,025
Nonfuel mineral production value:				
Total crude mineral value	millions	$635.1	$708.4	$804.5
Value per capita		$53	$60	$68

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]Data may not add to totals shown because of independent rounding.
[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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.—Unresolved for the second year was a proposal by the U.S. Department of Transportation to sell the federally owned Consolidated Railroad Corp. (Conrail) to private interests. About 15,000 Pennsylvanians are employed by Conrail, nearly 40% of the company's work force. Also, about 28% (4,014 miles) of the railroad system is in the State. The State's steel, coal, and other mineral producers heavily dependent on rail transportation were concerned that the sale could result in abandonment of some routes and reduce competition in the East affecting freight rates.

The Pennsylvania Bureau of Topographic and Geologic Survey's mineral resource program published a directory of nonfuel mineral producers that included the geologic formation and rock type of each operation.[3] Also completed during the year was a geologic map illustrating the 19 basic rock types in the State.[4] This map simplified the 1980 Geologic Map of Pennsylvania (Map 1), which detailed geologic age relationships.

Future studies anticipated by the Penn-

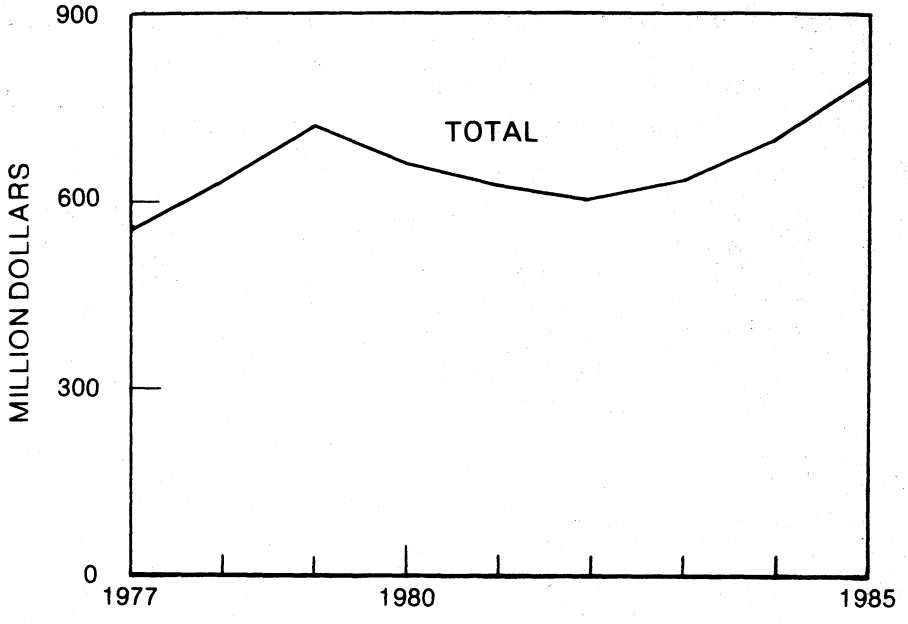

Figure 1.—Total value of nonfuel mineral production in Pennsylvania.

sylvania Geological Survey (PGS) included a followup investigation of high-purity silica in the Blue Ridge physiographic province, description and characterization of the uranium mineralization in the Reading Prong, and chemical analyses of thick Ordovician Age carbonates in central Pennsylvania. A compilation of early Mesozoic copper-gold occurrences was planned in support of the U.S. Geological Survey's studies of mineralization associated with early Mesozoic diabase.

The cooperative clay-shale testing program between the U.S. Bureau of Mines and PGS has tested more than 900 sources for the purpose of identifying new ceramic resources in the State. Although this program was to end in 1986, information and sample briquets were available for inspection at the PGS headquarters in Harrisburg.

Federal programs included research at the U.S. Bureau of Mines Pittsburgh Research Center. Among the projects at the center in 1985 was one to develop an artificial intelligence system with the capability to recommend solutions when hazardous conditions occur in a mine. Subsidence profiles for northern Appalachia were designed using a computer model along with actual observation. This work was expected to be expanded for use in other regions of the country.[5]

In October, the State received a $41.5 million grant for its reclamation and coal mine regulatory program from the Office of Surface Mining (OSM), U.S. Department of the Interior. The funding will be used to reclaim 84 sites, including the Cherry Land limestone mines in Armstrong County and the Oakhurst clay mine in Cambria County. The mine reclamation funds came from fees paid by coal mine operators nationwide and were administered by OSM for reclamation of mines abandoned before 1977.

The State needed an additional $97 million to reclaim strip mines covering 15,000 acres abandoned since 1977, according to Pennsylvania's Department of Environmental Resources (DER). Although State and Federal laws require strip mine operators to reclaim the land, poor coal markets, enforcement problems, and operators failing to reclaim land in the last 8 years resulted in the acres of unreclaimed land. In 1985, the DER reclaimed 460 acres, a tenfold increase since 1980.

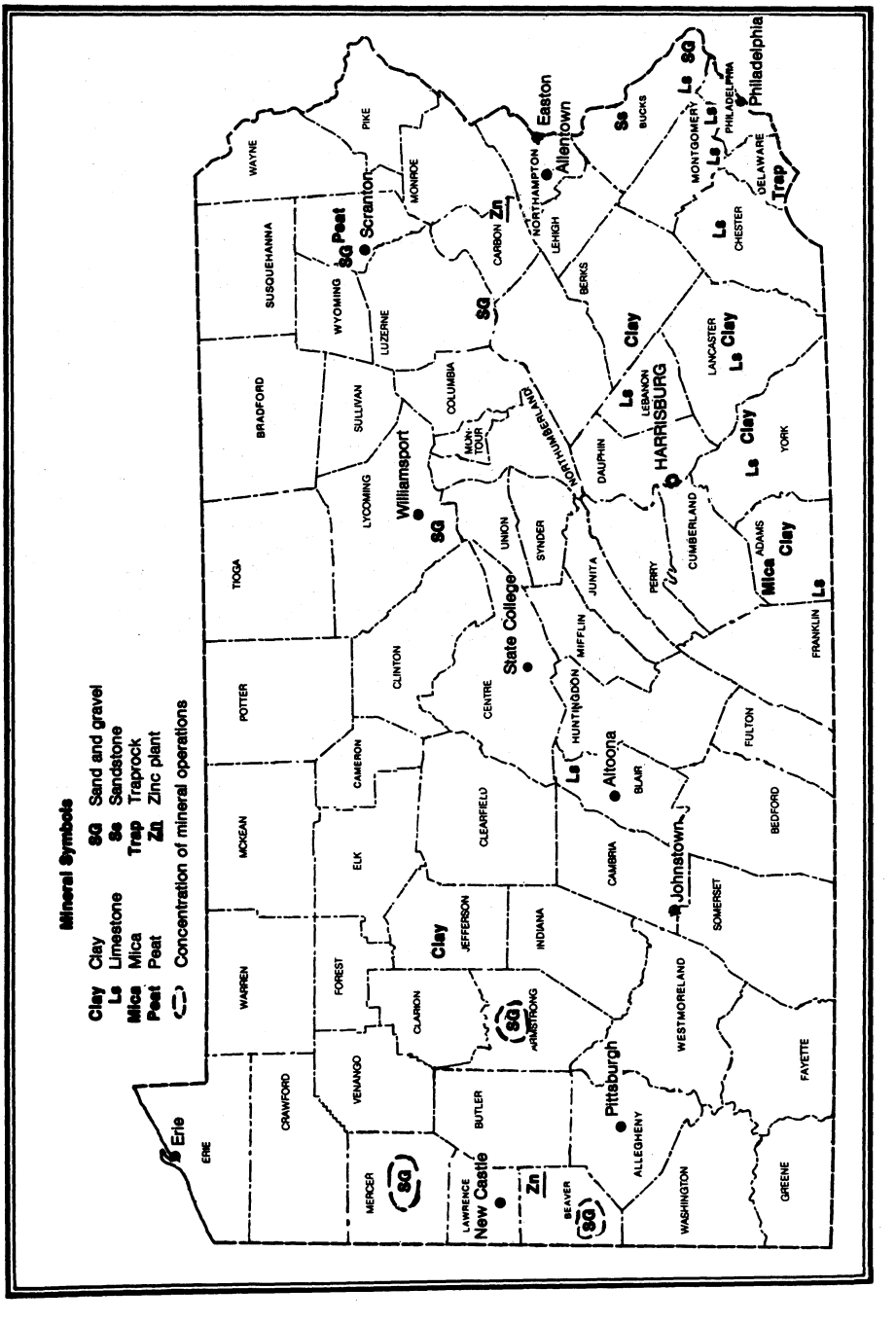

Figure 2.—Principal mineral producing localities in Pennsylvania.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

In this section, nonfuel mineral commodities that were mined in Pennsylvania in 1985 are discussed. Quantity and value data for these commodities are given in table 1.

Pennsylvania also manufactured or processed graphite, gypsum, perlite, pyrophyllite, slag, sulfur, sulfuric acid, and vermiculite. Combined value of these processed minerals was about $95 million.

Cement.—In Pennsylvania, cement data are divided into two districts: eastern Pennsylvania, which is all counties east of the eastern boundaries of Potter, Clinton, Centre, Huntingdon, and Franklin Counties; and western Pennsylvania, which is all other counties in the State. In 1985, the State's nine eastern plants produced 4.3 million short tons of portland cement utilizing about 85% of capacity. Pennsylvania's four western plants produced about 1.3 million tons of portland cement utilizing about 52% of capacity.

Construction of two new cement import terminals was expected to increase competition for cement producers in eastern Pennsylvania. Late in 1985, Norwegian and Italian interests purchased a site in Philadelphia and began constructing a dry bulk-loading facility. The facility was expected to be equipped by mid-1986 for the import of cement and export of coal. A second terminal was under construction in Chester. The two terminals were expected to have a combined capacity of 500,000 tons or about 10% of the total capacity of cement plants in eastern Pennsylvania.

Also during the year, Allentown Cement Co. Inc., an independent producer, purchased the Evansville cement plant and quarry of National Gypsum Co. The sale also included cement terminals in Bowie, MD, and Jersey City, NJ.

Fuller International Inc., Bethlehem, signed a $26 million contract with Fecto Cement Ltd. According to the agreement, a 2,000-ton-per-day cement plant is scheduled for completion in 1987 at a site about 10 miles north of Islamabad, Pakistan.

Clays.—Output of clay and shale increased for the second consecutive year. The nearly 20% gain in output primarily resulted from demand for brick from the construction industry.

Table 4.—Pennsylvania: Clays sold or used by producers, by use[1]

(Short tons)

Use	1984	1985
Common brick	4,000	10,000
Face brick	761,237	772,491
Firebrick, blocks and shapes	15,524	139,204
Flue linings	24,220	44,348
Mortar and cement, refractory	38,812	38,926
Portland and other cements	85,107	93,080
Tile: Drain, quarry, structural	31,120	31,295
Other[2]	2,935	12,873
Total	962,955	1,142,217

[1]Excludes kaolin.
[2]Includes paint, lightweight aggregates, highway surfacing, and structural concrete.

Gem Stones.—Rockhounds and mineral dealers collected mineral specimens and semiprecious gem stones in Pennsylvania valued at an estimated $5,000.

Lime.—Pennsylvania was one of six States that produced more than 1 million short tons of lime. The State ranked fourth nationally in total output despite a 128,000-ton or 8% decline in production in 1985 compared with that of 1984. The lower output in 1985 reflected decreases in coal and steel production. One small tonnage producer, Honey Creek Lime Co., Reedsville, Mifflin County, was shut down for the year.

Table 5.—Pennsylvania: Lime sold and used by producers, by use

Use	1984		1985	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, basic oxygen furnace	545,086	$27,674	545,453	$29,454
Steel, electric	222,673	10,960	194,462	10,495
Sewage treatment	180,399	9,827	143,342	8,807
Acid water neutralization (mine and plant)	97,379	5,827	46,428	2,464
Water purification	89,830	5,169	72,543	4,323
Paper and pulp	30,259	1,482	30,844	1,543
Agriculture	20,245	1,381	W	W
Other[1]	433,832	27,862	458,907	28,183
Total	1,619,703	90,182	1,491,979	85,269

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes alkalies, animal and human food, briquetting (1984), desiccant (1984), explosives (1984), fiberglass (1984), glass, oil well drilling, other ore concentration, manganese, mason's lime, other chemical and industrial uses, other metallurgy, paint, petroleum refining, refractories, sand lime brick, soil stabilization, sugar refining, sulfur removal from stack gases, steel (open-hearth), tanning, wire drawing, and data indicated by symbol W.

Mica.—Gross Mineral Corp. mined mica (sericite) near Fairfield, Adams County. The mica was trucked to a plant in Aspers for processing and used as a filler and extender primarily by the automotive industry.

Peat.—In a ruling by the State's Attorney General in 1984, peat was considered "not a mineral." With that ruling, regulation of peat mining became the responsibility of the Bureau of Dams and Waterway Management (BDWM) because peat bogs are typically associated with wetland areas. This change in authority increased procedures and regulations regarding permitting, mining, and reclamation of peat bogs. In 1985, the BDWM continued to work with peat producers to lessen the impact of the change in regulations.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel production increased for the second consecutive year. Both the housing and highway construction industries reported gains in 1985 as measured in the number of housing units started and the value of State road contracts. Construction sand and gravel prices in Pennsylvania also remained high at $4.35 per short ton, $1.30 above the U.S. average price and the highest in the Nation.

During the year, Pittsburgh Sand & Gravel Co. began operating a 350-ton-per-hour dredge and processing plant near the Pike Island Dam along the Ohio River. The new dredge was equipped with a unique diffuser that minimized turbidity and distributed waste water particulates over the river bottom.[6] Pittsburgh Sand & Gravel's market area included eastern Ohio, western Pennsylvania, and the West Virginia Panhandle.

Industrial.—Pennsylvania's leading industrial sand producer, Pennsylvania Glass Sand Corp., was sold to United States Borax & Chemical Corp., a subsidiary of The Rio Tinto Zinc Corp. PLC of the United Kingdom. The firm mined industrial sand in Huntingdon County primarily for use in manufacture of glass containers.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Crushed stone output increased 15% in 1985 and was the highest total reported in 6 years. About 70% of the stone produced was limestone. Also mined were dolomite, granite, sandstone, and traprock.

Table 6.—Pennsylvania: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	953	3,731
Riprap and jetty stone	537	2,156
Filter stone	145	680
Coarse aggregate, graded:		
Concrete aggregate, coarse	4,346	17,748
Bituminous aggregate, coarse	4,553	19,199
Bituminous surface-treatment aggregate	2,377	11,329
Other graded coarse aggregate	376	1,568
Fine aggregate (-3/8 inch):		
Stone sand, concrete	824	4,197
Stone sand, bituminous mix or seal	1,329	5,353
Screening, undesignated	621	2,264
Combined coarse and fine aggregates:		
Graded road base or subbase	12,573	51,484
Unpaved road surfacing	1,779	8,770
Terrazzo and exposed aggregate	1,873	7,805
Other construction[2]	2,945	11,347
Agricultural: Agricultural limestone	1,219	10,480
Chemical and metallurgical:		
Cement manufacture	6,571	25,420
Lime manufacture	1,533	8,422
Flux stone	1,810	11,137
Special:		
Other fillers or extenders	377	6,435
Other miscellaneous[3]	4,419	35,586
Other unspecified[4]	13,602	65,749
Total[5]	64,765	310,859

[1]Includes dolomite, granite, limestone, sandstone, slate, traprock, and miscellaneous stone.
[2]Includes stone used in terrazzo and exposed aggregate, combined coarse and fine aggregates, building products, and stone used for other construction and maintenance purposes.
[3]Includes stone used in dead-burned dolomite manufacture, mine dusting or acid water treatment, poultry grit and mineral food, whiting or whiting substitute, glass manufacture, paper manufacture, porcelain, roofing granules, and other uses not listed.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Dimension.—In 1985, 51,000 short tons (617,820 cubic feet) of dimension stone was produced in Pennsylvania. Types of stone quarried in descending order of production were sandstone, slate, and block granite (diabase). Demand remained strong for the State's slate and flagstone products. During the year, a summary of Pennsylvania's slate industry was published.[7]

Table 7.—Pennsylvania: Dimension stone[1] sold or used by producers in 1985, by use

	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Irregular-shaped stone	16,488	211	$667
Dressed stone:			
Monumental	8,220	98	1,678
Structural and sanitary	4,434	49	2,129
Flagging	6,151	69	549
Flooring slate	1,526	17	419
Roofing slate	4,135	45	2,138
Billiard table tops	1,379	16	174
Other[2]	8,935	112	460
Total	51,268	[3]618	8,214

[1]Includes granite, sandstone, slate, and miscellaneous stone.
[2]Includes ashlars and partially squared pieces and a small amount of rough blocks for building and construction.
[3]Data do not add to total shown because of independent rounding.

METALS

Metals discussed in this section were processed from materials received from both foreign and domestic sources. Pennsylvania's last metal mine was closed in 1983. Production and value data for these metals, which are not included in table 1, are given if available.

Beryllium.—The Cabot Wrought Products Div. of Cabot Corp. produced beryllium-copper and other beryllium alloys at its Reading, PA, plant. In October 1985, Cabot announced that it would sell most of its alloys and metals facilities, including its beryllium-copper alloy sector, as part of a restructuring program. The divestiture reportedly would include beryllium-copper alloy facilities at Reading.[8]

Iron and Steel.—Pennsylvania ranked third of 10 States in pig iron shipments in 1985. Shipments declined by about 1.1 million short tons to a total of 6.5 million tons compared with the 1984 total. Correspondingly, the value of shipments declined from $1.6 billion in 1984 to $1.4 billion in 1985.

Steel production also decreased in Pennsylvania in 1985 to about 12 million tons from 14.4 million tons in 1984. Pennsylvania accounted for about 13% of U.S. steel production in 1985.

The decline in the State's iron and steel industry was reflected in plant closings during the year. Wheeling-Pittsburgh Steel Corp. (W-P), with about $500 million in long-term debts, filed for chapter 11 bankruptcy protection in April. In July, union workers began a 98-day strike that was finally settled with a new contract that reduced employment costs by about 16%. W-P, the Nation's seventh largest steel producer, employed about 8,200 workers at plants in Pennsylvania, Ohio, and West Virginia.

In Pennsylvania, W-P permanently closed its hot-strip mill and seamless tube operations in Allenport. Remaining in operation were a tandem mill, pickle line, temper mill, and annealing facility employing about 425 of an early 1980's work force of 2,000. At W-P's other Pennsylvania operation in Monessen, the last operating blast furnace was shut down at yearend to reduce inventory. W-P also announced that a feasibility study on replacing the blast furnace with an electric arc furnace (EAF) would be completed by mid-1986. LTV Steel Co. shut down or idled facilities at Alliquippa, Beaver Falls, and Pittsburgh, reducing employment from about 22,000 in 1979 to about 2,400 at yearend 1985. Armco Inc. also closed a tubular goods plant at Ambridge. That closing resulted in an employment loss of about 1,500. The continuing decline in Pennsylvania's steel industry from a 30-million-ton-per-year scale in 1970 to 12 million in 1985 paralleled the demise of integrated steel producers in the Northeast.

In addition to foreign competition, integrated producers faced domestic competition from minimills. Minimills usually have less than 1 million tons of annual capacity and employ mostly nonunion workers. Employee wages and benefits at minimills were about $16 per hour versus $22 to $23 for unionized workers.[9]

Minimills also typically use EAF that remelt steel scrap. In contrast, integrated plants in the Northeast, predominantly equipped with basic oxygen and open-hearth furnaces, required higher quantities of the raw materials used in steelmaking.

The local economic impact of plant closings and cutbacks was exemplified by Bethlehem Steel's request for a reduction in property taxes for its Northampton County operations. Bethlehem Steel requested the assessed value of its properties be dropped from $32 million to $18 million thereby lowering its tax obligation from $3.5 million to $1.9 million. In 1985, the $3.5 million paid by Bethlehem Steel was distributed to the county, $575,000; the city of Bethlehem, $970,000; the Bethlehem area school district, $1.65 million; and the Saucon Valley school district, $280,000. A decision on the reassessment was expected in 1986. In other activity, Bethlehem Steel sold its Grace Mine as part of a 4,100-acre tract in Berks County to a development firm for about $3.7 million. Iron ore was produced at the mine for use in the company's steelmaking operations until it was closed in 1977.

Late in the year, United States Steel Corp. (USS), the Nation's leading steelmaker, signed a $3.7 billion agreement to purchase Texas Oil & Gas Corp. If the agreement is approved by shareholders, steel would account for about 33% of USS' total business.

USS' facilities in Pennsylvania had an annual production capacity of about 6.5 million tons of steel. Both the Monongahela Valley (Mon Valley) and Fairless Hills operations primarily produced sheet steel but neither was equipped with continuous casters. Continuous casting forms molten steel directly into a semifinished product elimi-

nating several steps in the traditional steelmaking process. Nationally, the percent of raw steel continuously cast increased from 39.6% in 1984 to 42.3% in 1985 and has doubled since 1980. Operations without continuous casting capability are considered less likely to survive strong competition in the international marketplace.

Ferroalloys.—Output of ferroalloys remained about the same in 1985, but the average price per ton dropped 22%. Continued weak demand from the steel industry and competition from imports combined to drop the average price of ferroalloys in Pennsylvania 75% below that of 1980.

About 240,000 short tons of potential domestic high-carbon ferromanganese (H-C FeMn) capacity was eliminated with the demolition of Bethlehem Steel Corp.'s "L" blast furnace in Johnstown. Elkem Metals Co., headquartered in Pittsburgh, completed the second year of a General Services Administration (GSA) contract to convert manganese ore to H-C FeMn. Elkem also received funding for 1986, and by the end of that year, a total of about 195,000 tons of manganese ore will be converted to about 105,000 tons of H-C FeMn. Federal funding through GSA totaled nearly $45 million for the 3 years.

Titanium.—In 1985, the ALTA Group began production of high-purity titanium primarily for use in the electronics industry at a plant in Evans City. ALTA used a molten salt bath electrolytic plating process developed by the U.S. Bureau of Mines.[10] High-purity titanium was produced in crystal, powder, or mill product form and used in electronic, prosthetic, or corrosion-resistant applications.

Zinc.—St. Joe Minerals Co., a subsidiary of Fluor Corp., operated a 100,000-short-ton-per-year-capacity zinc refinery in Monaca. Zinc concentrates were shipped from St. Joe's Balmat and Pierrepont Mines in New York. Workers went on strike in July when the labor contract expired, and the work stoppage continued at yearend. Production continued at the mines with supervisory and nonunion personnel but at a reduced rate. St. Joe also produced zinc oxide and dust.

The New Jersey Zinc Co. Inc. (NJZI), a subsidiary of Horsehead Industries Inc. (HII), produced zinc oxide at its refinery in Palmerton. NJZI processed ore from its Sterling, NJ, mine, slab zinc, and waste and scrap materials to produce both American- and French-process zinc oxide. Horsehead Resource Development Co. (HRD), a sister company of NJZI and also a subsidiary of HII, used Waelz kiln and sintering facilities at the Palmerton plant to produce crude zinc oxide from steelmaking EAF dusts. HRD processed about 54,000 tons of EAF dust, which contained about 20% or higher zinc content and planned to double that tonnage in 1986. The crude zinc oxide products, which generally contained about 55% zinc, 6% lead, and some cadmium, were further processed into marketable metal and zinc oxide.

EAF steelmaking dusts, listed as hazardous waste by the Environmental Protection Agency (EPA) mainly because of leachable lead, cadmium, and chromium, cost the steel industry as much as $200 per ton to dispose. About 450,000 tons of EAF dust, all containing zinc, were generated in the United States in 1985; about 75% of the tonnage was disposed at hazardous waste landfills. About 15% was processed to primarily recover zinc, mostly by HRD at Palmerton. By August 1988, a ban on disposing EAF dust at hazardous waste landfills was scheduled by the EPA. The HRD recovery process was being used for studies on environmentally safe disposal methods for EAF dust.

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[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2]Economic geologist, Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources, Harrisburg, PA.

[3]Berkheiser, S. W., Jr., H. Barnes, and R. C. Smith. Directory of the Nonfuel-Mineral Producers in Pennsylvania. PA Geol. Surv., IC 54, 4th ed., 1985, 165 pp.

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[6]Robertson, J. L. Homemade Dredge Mines Ohio River. Rock Prod., v. 88, No. 11, Nov. 1985, pp. 32-36.

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[8]Crissafulli, T. Cabot Undertakes Major Revamping. Am. Met. Mark., v. 93, No. 201, Oct. 17, 1985, pp. 1, 11.

[9]Bowman, L. Minimills Keeping Big Steel on the Run. The Pittsburgh Press (PA), Oct. 16, 1986, p. C14.

[10]Rogers, T. ALTA's Pure Titanium Used on Electronic Chips. Am. Met. Mark., v. 93, No. 141, July 24, 1985, p. 6.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Coplay Cement Co	Drawer 32 Nazareth, PA 18064	Plant and quarries.	Lehigh and Northampton.
General Portland Inc	5160 Main St. Whitehall, PA 18052	Plant	Lehigh.
Hercules Cement Co	Center St. Stockertown, PA 18083	Plant and quarry.	Northampton.
Lone Star Industries Inc	Wood & Prospect St. Box 270 Nazareth, PA 18064	Plant	Northampton.
Clays and shale:			
Glen-Gery Corp	Box 1542 Reading, PA 19603	Pits and plant	Adams, Berks, York.
Hanley Brick Inc	Box 376 Bradford, PA 16701	Pit	Jefferson.
McAvoy Vitrified Brick Co	Phoenixville, PA 19460	Pit	Chester.
Medusa Corp	Box 5668 Cleveland, OH 44101	Pit	Lawrence.
W. R. Turner Clay Co	Box 104, R.D. 3 Philipsburg, PA 16866	Pit	Clearfield.
Watsontown Brick Co	Box 68 Watsontown, PA 17777	Pit	Northumberland.
Lime:			
Bethlehem Steel Corp.[1]	Martin Tower Bethlehem, PA 18016	Plants and quarries.	Adams and Lebanon.
Mercer Lime & Stone Co	525 William Penn Pl. Pittsburgh, PA 15219	Plant	Butler.
Warner Co	Yellow Springs Rd. Devault, PA 19432	Plant, mine, quarries.	Centre and Chester.
Peat:			
Gouldsboro Wayne Peat Co	Box 68 Gouldsboro, PA 18424	Bog	Lackawanna.
Lake Benton Peat Moss	622 South Blakely St. Dunmore, PA 18512	Bog	Do.
Sand and gravel:			
Construction:			
Davison Sand & Gravel Co	3d Ave. and 4th St. New Kensington, PA 15068	Dredge and pits.	Armstrong and Westmoreland.
Dravo Corp	4800 Grand Ave. Pittsburgh, PA 15222	Dredge, pit, plant.	Allegheny and Beaver.
Glacial Sand & Gravel Co	Box 1022 Kittanning, PA 16201	do	Armstrong.
Stabler Co. Inc.[1]	Box 3188 Wescoville, PA 18106	Pits and plants.	Bradford and Northampton.
Warner Co	699 Bristol Pike Morrisville, PA 19067	Pit and plant	Bucks.
Industrial:			
McCrady Inc	Box 11566 Pittsburgh, PA 15238	Quarries and plant.	Allegheny.
United States Borax & Chemical Corp	Box 187 Berkeley Springs, WV 25411	do	Huntingdon.
Stone:			
Crushed:			
The General Crushed Stone Co., a subsidiary of Koppers Co. Inc.	Box 231 Easton, PA 18042	do	Berks, Bucks, Chester, Clinton, Columbia, Dauphin, Delaware, Lancaster, Montour, Tioga, York.
New Enterprise Stone & Lime Co. Inc	R.D. 3 New Enterprise, PA 16664	do	Adams, Bedford, Blair, Cumberland, Franklin, Huntingdon, Lancaster, Somerset.
Dimension:			
A. Dally & Sons Inc	Railroad Ave., Box 27 Pen Argyl, PA 18072	Quarries and mills.	Northampton.
Delaware Quarries	Route 22 Lumberville, PA 18933	Quarry	Bucks.
Pennsylvania Granite Corp	Box 510 St. Peters, PA 19470	do	Chester.

[1]Also stone.

The Mineral Industry of Puerto Rico, Caribbean and Pacific Island Possessions, and Trust Territory of the Pacific Islands

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

By Doss H. White, Jr.,[1] and Ivette E. Torres[2]

PUERTO RICO

In 1985, the value of extractive mineral production was reported to be $101.9 million according to sales and/or value data reported to the Bureau of Mines, U.S. Department of the Interior, by the island's mineral producers. The value figure is approximately $18.6 million below that reported for 1984 and reflects a decrease in the use of mineral commodities during the latter part of the year. Sales of all major mineral commodities produced on the island fell below the 1984 levels.

Table 1.—Nonfuel mineral production in Puerto Rico[1]

Mineral		1984		1985	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement (portland)	thousand short tons	997	$87,568	962	$72,602
Clays	do.	128	266	118	264
Lime	do.	35	4,531	23	3,249
Sand and gravel (industrial)	do.	43	W	--	--
Stone:					
Crushed	do.	e5,813	e27,675	5,493	25,799
Dimension	do.	e35	e455	--	--
Total[2]		XX	120,495	XX	101,914

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

Table 2.—Nonfuel minerals produced in Puerto Rico in 1984, by district[1]

District	Minerals produced in order of value
Mayaguez	Sand and gravel.
Ponce	Cement, lime, clays.
San Juan	Cement, clays.
Undistributed[2]	Stone (crushed and dimension).

[1]No production of nonfuel mineral commodities was reported for districts not listed.
[2]Data not available by district for minerals listed.

Table 3.—Indicators of Puerto Rico business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population[1]	thousands	3,265	3,269	3,282
Total civilian labor force[1]	do	942	958	969
Unemployment[1]	percent	23.4	20.7	21.8
Employment (nonagricultural):				
Mining total	thousands	.7	.7	.7
Manufacturing total	do	143.7	150.3	148.2
Stone, clay, and glass products	do	3.7	3.8	3.9
Chemicals and allied products	do	15.9	16.4	16.9
Construction	do	22.8	27.5	25.1
Transportation and public utilities	do	15.4	15.5	14.6
Wholesale and retail trade	do	108.3	116.4	119.9
Finance, insurance, real estate	do	28.2	29.3	30.2
Services	do	86.5	91.3	94.0
Government and government enterprises	do	240.1	253.2	255.4
Total[2]	do	645.9	684.3	688.1
Hours and earnings:				
Total average weekly hours, production workers		38.7	38.7	38.4
Total average hourly earnings, production workers		$4.8	$5.0	$5.2
Construction activity:				
Shipments of portland cement (by destination)	thousand short tons	920	1,000	962
Nonfuel mineral production value:				
Total crude mineral value	millions	$113.3	$120.5	$101.9
Value per capita		$35	$37	$31

[p]Preliminary. [r]Revised.
[1]Division of Local Area Unemployment Statistics, Bureau of Labor Statistics, Bureau of the Census, U.S. Department of Commerce.
[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.—The output of Puerto Rico's mineral producers is used primarily by the construction industry—crushed stone for aggregate and cement manufacture, dimension stone for riprap and building applications, clays for brick and tile and cement manufacture, and cement for concrete. Historically, the value of these four mineral commodities has accounted for over 95% of the value of extractive mineral production, illustrating the dependency of mineral sales on the health of the construction industry.

In 1985, the value of construction permits rose from $31.7 million in January to $50.5 million in March. However, the value of permits dropped sharply in April as the island's economic growth flattened and remained essentially flat for the remainder of the year. Although increased construction activity by the military and transportation sector helped to buoy mineral commodity sales, inadequate sewage treatment facilities created a crisis of major proportions for the construction and construction minerals industries.

A ban by the U.S. Environmental Protection Agency (EPA) on wastewater hookups at 89 of the 106 treatment plants under the Puerto Rico Aqueducts and Sewer Authority paralyzed more than $100 million in private and public sector construction. The ban was projected to affect an additional $300 million of stalled or canceled construc-

tion projects in 1986. The Commonwealth notified the EPA that it will establish financial mechanisms through the Government Development Bank of Puerto Rico to provide adequate financing for necessary improvements to the island's wastewater treatment facilities.

Legislation and Government Programs.—The Puerto Rican Geological Survey, a division of the Department of Natural Resources, carried out an extensive geological mapping and geochemical sampling program in the Barranquitas area in the center of the island. Exploration activity was also conducted in Cerro La Avispa in Cayey and in Cerro La Tiza in Comerío. Several target sites for exploration drilling were identified. Work was under way on the drilling of three 160-meter holes, and the Puerto Rican Government allocated an initial $135,000 for the exploratory drilling.

The U.S. Geological Survey and the British Institute of Oceanographic Sciences began reconnaissance mapping of nearly 30,000 square miles of the sea floor off Puerto Rico and the U.S. Virgin Islands. The project is part of a U.S. Department of the Interior program to map and assess the nonliving resources in the Exclusive Economic Zone declared by the President in 1983. The 3-billion-acre Exclusive Economic Zone gives the United States jurisdiction over seabed resources within 200 nautical miles of the coast of the United States and its trust territories and possessions.

REVIEW BY NONFUEL MINERAL COMMODITIES

Industrial Minerals.—Puerto Rico's extractive mineral industry, in descending order of sales, consists of stone, clays, salt, and sand. In 1985, according to data obtained from the U.S. Department of Labor, Mine Safety and Health Administration (MSHA), 49 crushed stone operations were active and 31 companies were extracting sand. MSHA figures do not include clay producers. U.S. Bureau of Mines production and value data on table 1 include stone and clays produced for cement manufacture. Past canvasses of the island's sand and salt producers have been too incomplete to supply meaningful data.

Two companies produced cement, and one company produced synthetic graphite electrodes using petroleum pitch and tar as a raw material. One oil refinery recovered sulfur as a byproduct.

Table 4.—Puerto Rico: Portland cement salient statistics

(Short tons unless otherwise specified)

	1984	1985
Number of active plants	2	2
Production	998,565	964,214
Shipments from mills:		
Quantity	996,839	962,225
Value	$87,567,743	$72,601,674
Stocks at mills, Dec. 31	33,276	35,265

A summary of the crushed stone industry in Puerto Rico in 1985, abstracted from MSHA records, is as follows:

Stone type	Number of quarries
Limestone	39
Stone, undifferentiated	6
Traprock	3
Marble[1]	1

[1]Used in terrazzo floor manufacture.

Table 5.—Puerto Rico: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	2	10
Riprap and jetty stone	153	833
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,148	5,294
Bituminous aggregate, coarse	166	728
Bituminous surface-treatment aggregate	32	173
Fine aggregate (-3/8 inch):		
Stone sand, concrete	457	2,795
Stone sand, bituminous mix or seal	150	721
Screening, undesignated	8	37
Combined coarse and fine aggregates:		
Graded road base or subbase	146	605
Terrazzo and exposed aggregate	13	117
Other construction[2]	61	230
Agricultural: Poultry grit and mineral food	7	36
Chemical and metallurgical: Cement manufacture	1,124	5,089
Special: Other unspecified[3]	2,027	9,131
Total	[4]5,493	25,799

[1]Includes limestone, granite, marble, sandstone, traprock, and other stone.
[2]Includes stone used for filter stone, stone used for other construction and maintenance purposes, and other uses not listed.
[3]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[4]Data do not add to total shown because of independent rounding.

CARIBBEAN ISLAND POSSESSIONS

The Virgin Islands was the only Caribbean Island possession with mineral production. Extractive output was limited to crushed stone and sand. During the year, Martin Marietta Corp. closed its St. Croix aluminum refinery. Sulfur was recovered at the Hess refinery.

PACIFIC ISLAND POSSESSIONS AND TRUST TERRITORY OF THE PACIFIC ISLANDS

Stone is the only mineral commodity known to be produced in the two geographic areas, and output is apparently limited to Guam and American Samoa.

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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]

In 1985, the value of nonfuel mineral production in Rhode Island was $12.2 million.

Trends and Developments.—The State's mining industry again benefited from improved demand from the construction industry. Housing starts, one measure of this improvement, increased from 2,683 in 1982 to 5,375 in 1985. For that same period, the combined output of crushed stone and construction sand and gravel increased from nearly 1.3 to about 2.3 million short tons.

Until 1982, construction sand and gravel was the State's leading mineral commodity in quantity produced and value of production. Beginning in 1983, crushed stone became Rhode Island's leading value commodity, and production increased to an average of 1 million tons per year in 1984 and 1985. Sand and gravel output began to decline in 1980 and, although stabilizing at about 1 to 1.5 million tons from 1981 to 1985, was significantly lower than past production levels of 2.9 to 3.5 million tons from 1975 to 1979. These production trends are indicative of a dwindling supply of quality gravel and resultant increases in crushed stone as a substitute aggregate material.

Table 1.—Value of nonfuel mineral production in Rhode Island, by county[1]

(Thousands)

County[2]	1984	1985	Minerals produced in 1985 in order of value
Kent	$2,075	--	
Newport	--	W	Stone (crushed).
Providence	2,566	W	
Washington	641	--	
Undistributed[3]	486	$576	
Sand and gravel:			
Construction	XX	e4,600	
Industrial	W	W	
Stone:			
Crushed	e5,800	4,016	
Dimension	W	--	
Total	11,568	12,192	

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

[1]County distribution for crushed stone (1984) and construction sand and gravel (1985) is not available; total State values are shown separately under "Sand and gravel" or "Stone."

[2]Bristol County is not shown because no nonfuel mineral production was reported.

[3]Includes gem stones, other stone (1985), and values indicated by symbol W.

[4]Excludes other stone; included with "Undistributed."

Table 2.—Indicators of Rhode Island business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	956	962	968
Total civilian labor force	do.	475	490	500
Unemployment	percent	8.3	5.3	4.9
Employment (nonagricultural):				
Mining total	thousands	0.1	0.2	0.1
Nonmetallic minerals except fuels[1]	do.	.1	--	.1
Oil and gas extraction[1]	do.	(2)	--	(2)
Manufacturing total	do.	116.2	121.7	119.5
Primary metal industries	do.	6.0	6.2	5.9
Stone, clay, and glass products	do.	2.0	1.9	1.7
Chemicals and allied products	do.	3.0	3.1	3.1
Petroleum and coal products[1]	do.	.1	.1	.2
Construction	do.	11.6	13.3	14.9
Transportation and public utilities	do.	13.3	13.5	13.8
Wholesale and retail trade	do.	83.5	88.6	93.2
Finance, insurance, real estate	do.	21.5	22.7	23.4
Services	do.	93.2	99.0	103.3
Government and government enterprises	do.	56.9	57.4	57.6
Total	do.	396.3	416.4	425.8
Personal income:				
Total	millions	$11,557	$12,642	$13,365
Per capita		$12,088	$13,145	$13,906
Hours and earnings:				
Total average weekly hours, production workers		39.0	40.9	40.2
Total average hourly earnings, production workers		$6.9	$7.3	$7.6
Earnings by industry:				
Farm income	millions	$35	$33	$34
Nonfarm	do.	$7,642	$8,442	$9,087
Mining total	do.	$18	$25	$22
Nonmetallic minerals except fuels	do.	$2	$2	$3
Oil and gas extraction	do.	$17	$22	$19
Manufacturing total	do.	$2,267	$2,503	$2,566
Primary metal industries	do.	$152	$178	$167
Stone, clay, and glass products	do.	$51	$52	$51
Chemicals and allied products	do.	$76	$85	$86
Petroleum and coal products	do.	$4	$5	$8
Construction	do.	$359	$433	$489
Transportation and public utilities	do.	$353	$370	$394
Wholesale and retail trade	do.	$1,183	$1,297	$1,437
Finance, insurance, real estate	do.	$457	$492	$565
Services	do.	$1,694	$1,921	$2,105
Government and government enterprises	do.	$1,260	$1,357	$1,456
Construction activity:				
Number of private and public residential units authorized[3]		3,856	4,236	5,408
Value of nonresidential construction[3]	millions	$95.7	$131.1	$154.2
Value of State road contract awards	do.	$63.9	$152.2	$128.5
Shipments of portland and masonry cement to and within the State[4]	thousand short tons	150	202	169
Nonfuel mineral production value:				
Total crude mineral value	millions	$7.9	$11.6	$12.2
Value per capita		$8	$12	$13

[p]Preliminary. [r]Revised.
[1]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2]Less than 50 employees.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.
[4]Has no cement-producing plants.

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

The price of aggregate has also increased in Rhode Island. In 1985, the average unit price per short ton (f.o.b. plant) for crushed stone in Rhode Island was $6.18; in New England, $5.01; and in the United States, $4.05. For construction sand and gravel, the average unit price per ton was $3.83 in Rhode Island, $3.08 in New England, and $3.05 in the United States. This trend of rising prices was identified in the 1977 Minerals Yearbook for Rhode Island:

"The urbanized character of Rhode Island has intensified pressure upon sand and gravel producers to locate deposits that are both economically viable to mine and culturally acceptable. The result was a continued upward trend in prices for mineral products used in construction."[2]

Legislation and Government Programs.—As is typical of New England, no

statewide laws or regulations exist for the mining of aggregate. Some cities and towns have enabling acts to regulate mining activity, in others regulations are nonexistent.

In 1985, Rhode Island appointed a State geologist. Through this position, the State was anticipating development of a program of surficial and bedrock mapping jointly supported by the U.S. Geological Survey and the State. The maps could be used by sand and gravel operators to find new deposits and assist State, city, and town planners in determining sites for residential and commercial development.[3]

Because of the increasing price and dwindling supply of aggregate, interest was developing in offshore mining of sand and gravel. Rhode Island was 1 of 18 coastal States sharing a $604,469 grant from the U.S. Department of the Interior's Minerals Management Service to study actual or potential offshore areas where commercial deposits of minerals may exist.

Exploration in Rhode Island was limited to individual entrepreneurs and small companies. The focus was on field mapping and geochemical analyses aimed at possible molybdenum, tin, and tungsten mineralization related to Paleozoic alkalic plutonism. Ground magnetic and gravity surveys were also carried out, seeking magnetite enrichment at fault and shear zones. Remote sensing techniques were used to explore the relationship between lineaments and available ground water supplies in the State.[4]

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Rhode Island's mineral production paralleled the demand for aggregate from the construction industry. The value of contract construction awards increased for the third consecutive year, more than tripling since 1982.

Type of construction activity	Value of contract awards (millions)		
	1983	1984	1985
Residential	$209.1	$237.8	$366.5
Nonresidential	200.4	195.6	255.2
Public works and utilities	104.1	111.2	159.7
Total	513.6	544.6	781.4

Source: Rhode Island Department of Economic Development.

The combined output of construction sand and gravel and crushed stone showed a similar upward trend from 1983 to 1985.

Commodity	Quantity (thousand short tons)		
	1983	1984	1985
Sand and gravel (construction)	e1,000	1,483	e1,200
Stone (crushed)	971	e1,000	1,135
Total	1,971	2,483	2,335

eEstimated.

Sand and Gravel.—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Traditionally, all of the State's output is from three of the States five counties—Kent, Providence, and Washington.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

For the second consecutive year, crushed stone output totaled 1 million short tons or more. One of the State's limestone producers, Conklin Limestone Co., Lincoln, estimated that its quarry reserves would be depleted within 10 to 15 years. Conklin has operated the quarry since 1946, mining nearly 1.5 million tons of limestone.[5]

[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2]Barton, W. R., and C. A. Maine. The Mineral Industry of Rhode Island. Ch. in BuMines Minerals Yearbook, 1977, v. 2, p. 528.

[3]Murphy, T. URI Department Chief Appointed State First Official Geologist. Providence J., Aug. 5, 1985, p. 1.

[4]Mining Engineering. V. 38, No. 5, May 1986, p. 330.

[5]Toother, N. L. Conklin Limestone Co., Lincoln, Has But 10-15 More Years of Life. Providence J., Apr. 8, 1986, p. 3.

Table 3.—Principal producers

Commodity and company	Address	Type of activity	County
Sand and gravel:			
A. Cardi Construction Co. Inc	451 Arnold Rd. Coventry, RI 02816	Pits and plant	Kent.
Holliston Sand Co.[1]	Box 393 Slatersville, RI 02876	Pit and plant	Providence.
Richmond Sand & Gravel Co	Pole 175, Farnum Pike Smithfield, RI 02917	Pit	Washington.
River Sand & Gravel Co. Inc	101 Ferris St. Pawtucket, RI 02861	Pit and plant	Kent.
South County Sand & Gravel Co. Inc.	North Rd. Peace Dale, RI 02878	do	Washington.
Stone:			
Forte Bros. Inc	14 Whipple St. Berkley, RI 02864	Quarry	Providence.
J. H. Lynch & Sons Inc.[2]	825 Mendon Rd. Cumberland, RI 02864	do	Do.
Tilcon Inc	875 Phoenix Ave. Cranston, RI 02920	do	Do.

[1]Also industrial sand.
[2]Also sand and gravel.

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 Arthur H. Maybin[2]

South Carolina's extractive nonfuel mineral production during 1985 increased slightly over the 1984 value. This was the third consecutive year that the value of nonfuel mineral production increased, and mineral production in 1985 exceeded the record high established in 1984. The State ranked 19th in industrial mineral production and 26th in nonfuel mineral production nationally.

Nationally, South Carolina's kaolin production was second in tonnage and value, behind that of Georgia, and vermiculite production and sales were second, behind that of Montana. The State ranked in the top 10 in ferroalloys, fuller's earth, and masonry cement output. During the year, the first commercial gold mine since the early 1940's began production, and the fourth vermiculite producer in South Carolina came on-stream.

Table 1.—Nonfuel mineral production in South Carolina[1]

Mineral		1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
Cement, portland	thousand short tons	2,319	$103,891	2,207	$104,705
Clays[2]	do.	1,834	36,809	1,896	37,695
Gem stones		NA	10	NA	10
Manganiferous ore	thousand short tons	20	W	20	W
Peat	do.	5	W	W	173
Sand and gravel:					
Construction	do.	5,845	17,097	e4,900	e14,000
Industrial	do.	882	14,889	794	14,092
Stone:					
Crushed	do.	e17,900	e72,500	17,079	72,520
Dimension	do.	e16	e1,092	8	541
Combined value of cement (masonry), clays (fuller's earth), gold (1985), mica (scrap), silver (1985), vermiculite, and values indicated by symbol W		XX	29,562	XX	32,193
Total		XX	275,850	XX	275,929

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

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

[2]Excludes fuller's earth; value included with "Combined value" figure.

Table 2.—Nonfuel minerals produced in South Carolina in 1984, by county[1]

County	Minerals produced in order of value
Abbeville	Sand and gravel.
Aiken	Clays, sand and gravel.
Anderson	Sand and gravel.
Bamberg	Do.
Charleston	Do.
Cherokee	Sand and gravel, clays, manganese.
Chester	Sand and gravel.
Chesterfield	Sand and gravel, clays.
Colleton	Peat, sand and gravel.
Dorchester	Cement, sand and gravel, clays.
Edgefield	Clays.
Florence	Sand and gravel.
Greenville	Do.
Greenwood	Clays.
Horry	Do.
Jasper	Sand and gravel.
Kershaw	Sand and gravel, clays.
Lancaster	Sand and gravel, mica (scrap), clays.
Laurens	Vermiculite.
Lee	Sand and gravel.
Lexington	Sand and gravel, clays.
Marion	Clays.
Marlboro	Sand and gravel, clays.
Orangeburg	Cement, clays, sand and gravel.
Richland	Clays, sand and gravel.
Saluda	Clays, manganese.
Spartanburg	Sand and gravel.
Sumter	Clays, sand and gravel.
York	Sand and gravel.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

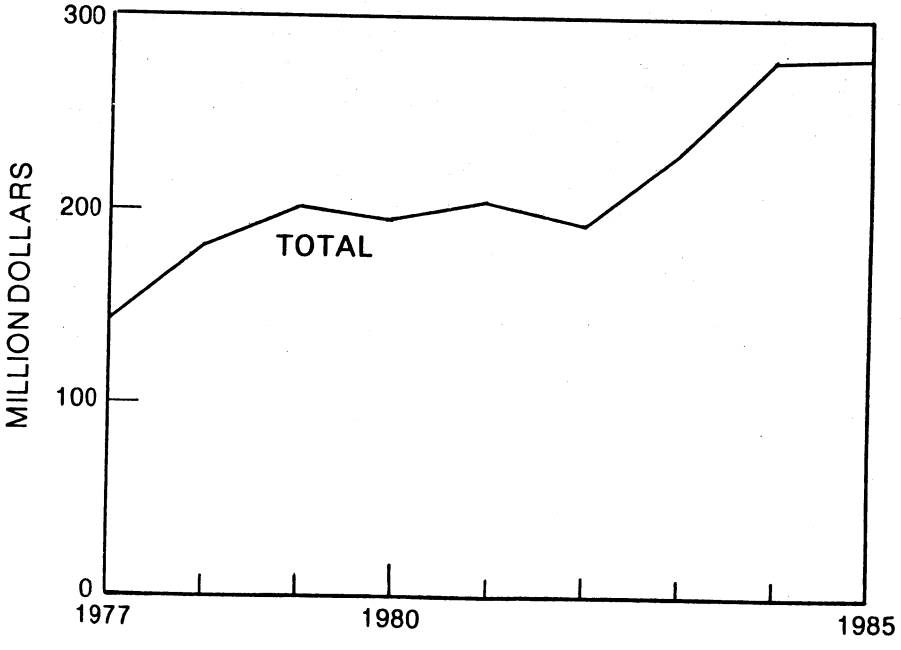

Figure 1.—Total value of nonfuel mineral production in South Carolina.

Table 3.—Indicators of South Carolina business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	3,258	3,302	3,347
Total civilian labor force	do.	1,470	1,481	1,563
Unemployment	percent	10.0	7.1	6.8
Employment (nonagricultural):				
Mining total	thousands	1.7	1.8	1.8
Manufacturing total	do.	362.4	377.6	365.1
Primary metal industries	do.	6.4	7.5	8.1
Stone, clay, and glass products	do.	10.2	10.7	10.7
Chemicals and allied products	do.	32.5	32.8	32.4
Petroleum and coal products[1]	do.	.4	.4	.4
Construction	do.	70.3	80.8	83.9
Transportation and public utilities	do.	54.0	55.3	56.4
Wholesale and retail trade	do.	239.4	261.2	278.9
Finance, insurance, real estate	do.	50.9	54.4	57.1
Services	do.	180.0	194.2	210.2
Government and government enterprises	do.	230.3	237.3	245.8
Total[2]	do.	1,189.0	1,262.5	1,299.1
Personal income:				
Total	millions	$30,259	$33,406	$35,434
Per capita		$9,288	$10,118	$10,586
Hours and earnings:				
Total average weekly hours, production workers		40.6	40.8	40.4
Total average hourly earnings, production workers		$7.0	$7.3	$7.6
Earnings by industry:				
Farm income	millions	$61	$292	$151
Nonfarm	do.	$22,378	$24,790	$26,411
Mining total	do.	$65	$77	$73
Manufacturing total	do.	$6,927	$7,586	$7,725
Primary metal industries	do.	$169	$217	$232
Stone, clay, and glass products	do.	$234	$259	$264
Chemicals and allied products	do.	$951	$1,010	$1,077
Petroleum and coal products	do.	$15	$15	$13
Construction	do.	$1,490	$1,776	$1,862
Transportation and public utilities	do.	$1,491	$1,626	$1,694
Wholesale and retail trade	do.	$3,243	$3,630	$3,947
Finance, insurance, real estate	do.	$955	$1,054	$1,206
Services	do.	$3,240	$3,722	$4,137
Government and government enterprises	do.	$4,857	$5,203	$5,643
Construction activity:				
Number of private and public residential units authorized[3]		30,197	36,081	32,815
Value of nonresidential construction[3]	millions	$571.2	$668.1	$892.4
Value of State road contract awards	do.	$122.0	$178.6	$224.0
Shipments of portland and masonry cement to and within the State	thousand short tons	964	1,100	1,138
Nonfuel mineral production value:				
Total crude mineral value	millions	$230.6	$275.9	$275.9
Value per capita		$71	$84	$82

[p]Preliminary. [r]Revised.
[1]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2]Data may not add to totals shown because of independent rounding.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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.—Highlighting the year was the beginning of production of two new mineral operations. Piedmont Mining Co. began gold production at the old Haile gold mine near Kershaw, and Carolina Vermiculite Co. Inc. began mining and processing vermiculite at a plant near Woodruff.

In retrospect, the year was not without its problems. Three South Carolina metal companies petitioned Santee Cooper, a State-operated utility, for lower electric rates or extended credit. Macalloy Inc., a ferroalloy producer in Charleston, and one of the State's three steel producers, Georgetown Steel Corp., Georgetown, were both given a discount in rates to preserve jobs. Alumax Inc., Mount Holly, the State's only aluminum smelter, was granted a 1-year reduction of about 3 mils per kilowatt hour, and the company has requested an additional reduction of 6 mils. Company officials noted that the smelter could cut production or close unless power costs can be lowered by 20%.

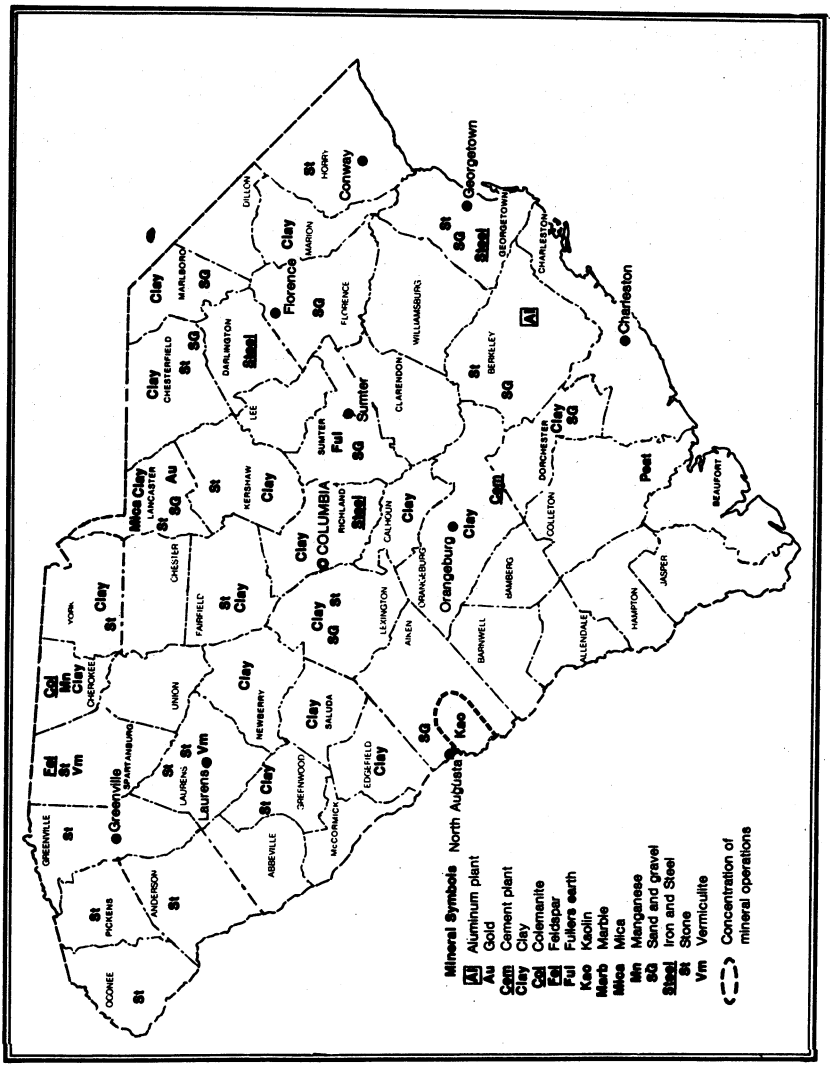

Figure 2.—Principal mineral producing localities in South Carolina.

Legislation and Government Programs.—The South Carolina General Assembly passed House bill 2407, which amended the State Mining Act section concerning the publication of notice of a mining permit application. The revised section of the act requires that 10 persons must request a hearing before one is scheduled.

Geologists with the U.S. Geological Survey (USGS) continued work on the geologic mapping of the Barnwell 1° sheet, which covers portions of South Carolina and Georgia. The USGS published "Distribution of Beryllium in Heavy-Mineral-Concentrate Samples From the Charlotte 1° by 2° Quadrangle (North Carolina and South Carolina)" as of 84-0843-G and "Distribution of Barium in Heavy-Mineral-Concentrate Samples From the Charlotte 1° by 2° Quadrangle, North Carolina and South Carolina" as of 84-0843-N. Also released was Bulletin 1569, "Cassiterite Occurrences in the Shelby Area, North and South Carolina."

The South Carolina Geological Survey (SCGS) continued work on mapping the State's geology and provided aid to several companies interested in the State's mineral potential. The SCGS published its journal "South Carolina Geology." Eight open file reports were released. These reports included geologic maps of four quadrangles within the Atlantic Coastal Plain; three gravity maps (scale 1:24,000) within the Piedmont; a South Carolina base overlay (scale 1:500,000) showing distribution of six selected rare-earth elements in stream sediments; a South Carolina mines inventory showing active and inactive mines and/or prospects (scale 1:250,000, eight maps); and a geologic map showing metamorphic rock units in a portion of the Inner Piedmont. Other projects included radiometric age dating of selected units in South Carolina.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Cement.—South Carolina maintained its position as one of the leading cement producing States in the Southeast.

Three companies produced portland Types I and II, and Giant Portland & Masonry Cement Co. and Santee Portland Cement Corp. produced masonry cement. Raw material was obtained from Canada and the Caribbean area.

During the year, Giant relocated its corporate office from Columbia to Harleyville. The plant is on a 2,000-acre site approximately 6 miles from the community of Holly Hill.

Table 4.—South Carolina: Cement industry in 1985

Company	Location	Process	Number of kilns	Annual clinker capacity (thousand short tons)	Primary fuel
Giant Portland & Masonry Cement Co	Harleyville	Wet	4	770	Coal.
Gifford-Hill & Co. Inc	do	Dry	1	550	Do.
Santee Portland Cement Corp	Holly Hill	Wet	2	1,060	Do.

Clays.—The State's clay industry, excluding fuller's earth value, which is proprietary information, accounted for nearly 14% of the value of mineral sales during 1985. The industry, composed of 20 companies operating 38 mines in an 18-county area, produced, in descending order of value, kaolin, common clay and shale, and fuller's earth.

Kaolin.—Kaolin was produced by 10 companies from 19 surface mines in 5 southwestern counties. Production increased approximately 90,000 short tons over that reported in 1984.

Kaolin was recovered using wheel scrapers and draglines for stripping and a variety of equipment for mining. Both truck and pipeline methods were used to move the raw clay to the plant. Air-float and water-washed methods were used in the beneficiation phase to produce a processed kaolin for a variety of markets.

A mined-out kaolin pit owned by J. M. Huber Corp. was used as a sanitary landfill from 1976 to 1985. Beginning in March, several shallow wells were drilled into the fill material to recover methane. A portion of the methane will be used by Huber to fuel a nearby kaolin processing plant.

Table 5.—South Carolina: Kaolin industry in 1985

County	Number	
	Companies	Mines
Aiken	5	8
Calhoun	1	1
Chesterfield	1	1
Richland	2	7
Saluda	1	2

Table 6.—South Carolina: Kaolin sold or used by producers, by kind and use

(Short tons)

Kind and use	1984	1985
Air-float:[1]		
Adhesives	16,751	14,528
Animal feed and pet waste absorbent	6,844	5,333
Ceramics[2]	5,843	13,542
Fertilizers, pesticides and related products	19,300	33,855
Fiberglass	82,149	67,095
Paint	365	364
Paper coating and filling	1,488	1,843
Plastics	12,351	13,051
Rubber	204,627	188,945
Refractories[3]	9,318	30,052
Other uses[4]	108,514	85,495
Exports[5]	62,658	50,227
Total	530,208	504,330
Unprocessed: Face brick and other uses	246,359	362,482
Grand total	776,567	866,812

[1]Includes water-washed.
[2]Includes floor and wall tile, pottery, and roofing granules.
[3]Includes refractory calcines and grogs; refractory mortar and cement; high-alumina refractories; and firebrick, blocks, and shapes.
[4]Includes animal oil, catalysts (oil-refining), chemical manufacturing, ink, medical, sewer pipe, and unknown uses.
[5]Includes ceramics, adhesives, paper filling, pesticides and related products, and rubber.

Common Clay.—Common clay and shale was mined by 14 companies from 21 pits in 14 counties. The clay and shale was used in the manufacture of brick, cement, pipe, and tile. Several of the brick companies used sawdust to fuel the kilns, reducing fuel costs substantially.

Table 7.—South Carolina: Common clay industry in 1985

Area	Number		Production	
	Companies	Mines	Quantity (thousand short tons)	Value (thousands)
Eastern[1]	3	5	208	$470
Northern and Central[2]	8	10	296	802
Coastal Plain[3]	6	6	526	1,114
Total	17	21	[4]1,029	2,386

[1]Edgefield, Greenwood, and Saluda Counties.
[2]Cherokee, Fairfield, Kershaw, Lexington, Richland, and York Counties.
[3]Dorchester, Horry, Marion, Marlboro, and Orangeburg Counties.
[4]Data do not add to total shown because of independent rounding.

Fuller's Earth.—One firm, GSX Services of South Carolina, mined and processed fuller's earth for the production of industrial and animal waste absorbents. The mine and plantsite in Sumter County are leased from SCA Services Inc., which used the mined portion of the pit as a chemical waste storage repository.

Colemanite.—Fiberglass companies in South and North Carolina imported various calcium borate minerals, including colemanite from Turkey, for use in fiberglass manufacture. The raw ore, off-loaded at the Port of Charleston, was shipped by rail to Kings Creek in the northern part of the State where Industrial Minerals Inc. operated a custom grinding facility.

Feldspar.—Spartan Minerals Corp. ground a feldspar-silica concentrate recovered during lithium ore beneficiation by Lithium Corp. of America (Lithcoa) at Cherryville, NC. The grinding facility at Pacolet produced a product used by the glass and whiteware industries and as a filler in some industrial applications.

Graphite (Synthetic).—Union Carbide Corp. produced graphite fiber at a plant in Greenville. Much of the output from the 1-million-pound-per-year-capacity facility is used in the manufacture of graphite-epoxy composites.

The Airco Carbon Div. of BOC Inc. produced graphite electrodes at a new plant in Ridgeville. The division shifted much of the production from a Pennsylvania plant to the Ridgeville facility.

Mica.—Spartan Minerals dry ground a mica concentrate at its plant at Pacolet for joint compound manufacture. The concentrate was recovered at the Lithcoa lithium beneficiation plant at Cherryville, NC.

Mineral Mining Corp. operated an open pit mine in a massive sericite schist near Kershaw in Lancaster County in the northern part of the State. The schist was dry ground to produce a product used principally in the joint cement and electronics industries.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

The estimate for the State's construction sand and gravel production in 1985 was 945,000 short tons less than in 1984.

Industrial.—Six companies operating six pits reported industrial sand output during 1985. Three operations were in Lexington County, two in Kershaw, and one in Cherokee.

The three leading markets for the State's industrial sand output were (1) fiberglass, (2) containers, and (3) blasting.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Crushed stone production was reported by 15 companies operating 27 quarries in 19 counties.

Dimension.—Four companies operated four granite quarries in Fairfield, Kershaw, and Lancaster Counties. Output consisted of rough block and monumental stone.

Table 8.—South Carolina: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch): Riprap and jetty stone	336	1,839
Coarse aggregate, graded:		
Concrete aggregate, coarse	2,664	14,226
Bituminous aggregate, coarse	2,176	10,256
Bituminous surface-treatment aggregate	755	3,720
Railroad ballast	682	3,118
Fine aggregate (-3/8 inch): Screening, undesignated	700	2,255
Combined coarse and fine aggregates:		
Crusher run or fill or waste	1,264	5,161
Other construction[2]	4,209	19,692
Chemical and metallurgical: Cement manufacture	3,171	6,642
Special:		
Other miscellaneous[3]	115	805
Other unspecified[4]	1,007	4,806
Total	17,079	72,520

[1]Includes granite, limestone, and marl.
[2]Includes stone used in agricultural limestone, macadam, graded road base or subbase, unpaved road surfacing, filter stone, stone sand (concrete), stone sand (bituminous mix or seal), and unspecified uses.
[3]Includes stone used for lime manufacture and sulfur oxide removal.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.

Vermiculite.—South Carolina was one of three States with vermiculite production. During 1985, 4 companies had 29 mines under permit.

Sales were for lightweight aggregate applications, loose fill insulation, and horticultural applications.

Carolina Vermiculite began production in July in a plant near Woodruff. Plant capacity was being raised from 4 to 9 short tons per hour. Ore was trucked from several mines in the area to a central stockpile where it was slurried into the plant for screening. Rod mills, agglomerating tables, and flotation cells were used in processing the crude ore. The company is owned by Strong Systems Inc. of Pine Bluff, AR, a major vermiculite expander, and 20% to 30% of the Woodruff plant output will be used by the parent company with the remainder sold on the open market.[3]

METALS

Aluminum.—Alumax operated the State's only aluminum smelter in Berkeley County. The 181,000-metric-ton facility used alumina that was imported from Australia through the Port of Charleston. The plant has two potlines and produced billets, ingots, and slabs.

In a cost-cutting program initiated in October, the company reduced pay and benefits for employees by 10% and replaced approximately 100 employees in entry-level positions with temporary help. The wage and benefit cut followed a $14 million reduction in rates by the smelter's power supplier, Santee Cooper. At yearend, the smelter and power company finalized an agreement that will tie future power rates to the market price of aluminum ingot. This was the first time that an aluminum price-power cost linkage was instituted in the United States.[4] Despite the reduction in benefits and power costs, the company cut production to 165,000 metric tons per year in November citing "high costs" as the reason.[5]

Copper.—AT&T Nassau Metals Corp. operated a copper recycling facility at Gaston. Plant facilities included a scrap handling and upgrading section, a three-story secondary smelter, an electrolytic refinery, and a continuous cast copper wire rod plant.

Ferroalloys.—Macalloy operated the only significant domestic 50% to 55% charge chrome ferroalloy plant in Charleston. During the year, the U.S. General Services Administration exercised an option in a previous contract with Macalloy to convert 92,000 short tons of chromite ore into ferrochromium. The contract was valued at $19.3 million. The conversion program was designed to reduce the quantity of ore needing conversion to ferroalloy form during a national emergency and to help maintain an adequate level of domestic ferroalloy furnace and processing capacity.

Germanium.—Pirelli Cable Corp. of Union, NJ, announced plans for the construction of a new fiber-optic cable manufacturing facility near Lexington. Optical fibers use a germanium compound as a major constituent of the high-index optical core cable. The plant was expected to begin operations in early 1986. This installation would be the third Pirelli plant producing fiber-optic cables in North America; the other two are in Wallingsford, CT, and in Surrey, British Columbia, Canada.

Gold.—The year marked a rebirth of gold production from the Haile gold mine near Kershaw where gold was first produced in the 1820's. Piedmont Mining began operating a heap leach gold operation in January, and the first gold recovery took place in April. Gold-bearing ore was mined by surface methods and milled after mixing with a dilute solution of sodium cyanide and portland cement. After agglomeration, the ore was transported to a leach pad where windrows of ore were built by a radial stacker and then sprayed with dilute sodium cyanide. The resulting gold-bearing leachate was recovered downslope in ponds. The leachate was pumped through charcoal, which was washed with a hot caustic solution to strip the gold from the charcoal. An electroplating process deposited the gold from solution onto steel wool, which was heated to recover the gold that was then shipped to New England for refining.

Iron and Steel.—The State's steel industry is composed of 3 companies operating 10 electric furnaces.

In August, the Government of Kuwait increased its stock holdings in Georgetown Industries Inc., the parent company of Georgetown Steel Corp., from 53% to 91%. In 1984, Georgetown Steel restarted its direct-reduction-iron (DRI) facility. The Georgetown DRI plant has operated at about 30% of capacity since resuming production. Low scrap prices and the expense of shipping from the Georgetown area have hindered sales.

Manganiferous Ore.—Three companies in Cherokee County mined manganiferous

zones in the Battleground Schist. The material was ground, bagged, and sold to South and North Carolina brick manufacturers for use in brick coloring.

Platinum.—Engelhard Corp. began construction of a custom catalyst plant near Seneca. Palladium, platinum, rhodium, and ruthenium will be used in catalyst production. The new $25 million facility will replace the company's Newark, NJ, plant.

Zircon.—M & T Chemicals Inc. operated a zircon grinding plant at Andrews. Zircon concentrate, a byproduct of titanium mineral beneficiation, was imported from Australia and Florida. Ground zircon from the Georgetown County facility had application in the foundry, wall tile, whiteware, and ceramics industries.

[1]State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.
[2]Chief, Economic Geology Div., South Carolina Geological Survey, Columbia, SC.
[3]Industrial Minerals (London). World of Minerals: USA. No. 219, Dec. 1985, p. 13.
[4]Metals Week. Aluminum. Dec. 23, 1985, p. 6.
[5]———. Elsewhere in Aluminum. Nov. 11, 1985, p. 7.

Table 9.—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	Chesterfield and Marlboro.
Richtex Corp.[1]	Box 3307 Columbia, SC 29230	do	Lexington and Richland.
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:			
SCA Services Inc	Route 1, Box 255 Pinewood, SC 29125	Mine and plant	Sumter.
Kaolin:			
Cyprus Industrial Minerals Co	Box 3299 Englewood, CO 80155	do	Aiken.
W. R. Grace & Co., a subsidary of National Kaolin Products Co.	Box 2768 Aiken, SC 29802	do	Do.
J. M. Huber Corp	Route 4 Huber Macon, GA 31298	do	Do.
Richtex Corp	Box 3307 Columbia, SC 29230	Mines and plant	Lexington and Richland.
Colemanite:			
Industrial Minerals Inc	Box 459 York, SC 29745	Plant	York.
Feldspar:			
Spartan Minerals Corp., a subsidiary 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 (1984):			
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.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Granite:			
Crushed and broken:			
Lone Star Industries Inc	Box 420 Norfolk, VA 23501	Quarries 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.
Dimension:			
Granite Panelwall Co., a division of Florida Crushed Stone Co.	Box 898 Elberton, GA 30635	Quarry	Kershaw.
Matthews International Corp	Box 606 Kershaw, SC 29067	do	Do.
Limestone (crushed):			
Martin Marietta Aggregates	Box 30013 Raleigh, NC 27612	Quarry and plant	Berkeley and Georgetown.
Southern Aggregates Co	Box 4510 Augusta, GA 30907	Quarry	Berkeley.
Vulcan Materials Co	Drawer 8834 Greenville, SC 29604	Quarry and plant	Cherokee.
Marl (crushed):			
Giant Portland & Masonry Cement Co.	Box 21969 Columbia, SC 29221	Pit	Dorchester.
Gifford-Hill & Co. Inc	Box 326 Harleyville, SC 29448	Pit	Do.
Santee Portland Cement Corp	Box 698 Holly Hill, SC 29059	Pit	Orangeburg.
Vermiculite:			
Carolina Vermiculite Co. Inc	Box 98 Woodruff, SC 29388	Mines and plant	Spartanburg.
W. R. Grace & Co	Route 1 Enoree, SC 29335	do	Laurens.
Patterson Vermiculite Co	do	do	Do.

[1]Also kaolin.

The Mineral Industry of South Dakota

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

By Doss H. White, Jr.,[1] James J. Hill,[2] and Wanda J. West[3]

In 1985, South Dakota's nonfuel mineral industry produced $207.3 million worth of mineral commodities. This value represented an increase of 4% over the 1984 value but was 9% below the record high established in 1980. Value increases in excess of $1 million were recorded for portland cement, gold, construction sand and gravel, and crushed stone. Nationally, the State ranked 33d in nonfuel mineral production. Gold accounted for 55% of the State's mineral value. Cement was the second leading commodity produced in the State. South Dakota was the Nation's second leading producer of gold and one of two States producing beryllium.

Table 1.—Nonfuel mineral production in South Dakota[1]

Mineral	1984 Quantity	1984 Value (thousands)	1985 Quantity	1985 Value (thousands)
Cement:				
Masonry thousand short tons	5	$283	4	W
Portland do	619	30,773	655	W
Clays[2] do	119	343	117	$309
Feldspar short tons	7,219	124	13,721	W
Gem stones	NA	70	NA	70
Gold (recoverable content of ores, etc.) troy ounces	310,527	111,994	356,103	113,119
Gypsum thousand short tons	W	W	34	269
Sand and gravel (construction) do	5,786	12,168	e6,400	e16,000
Silver (recoverable content of ores, etc.) thousand troy ounces	50	407	63	388
Stone:				
Crushed thousand short tons	e3,800	e12,800	4,071	14,412
Dimension do	e60	e18,642	W	W
Combined value of beryllium, clays (bentonite), lime, mica (scrap), and values indicated by symbol W	XX	r11,265	XX	62,772
Total	XX	r198,869	XX	207,339

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

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

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

Table 2.—Nonfuel minerals produced in South Dakota in 1984, by county[1]

County	Minerals produced in order of value
Beadle	Sand and gravel (construction).
Brookings	Do.
Brown	Do.
Brule	Do.
Butte	Sand and gravel (construction), clays.
Campbell	Sand and gravel (construction).
Charles Mix	Do.
Clark	Do.
Codington	Do.
Corson	Do.
Custer	Sand and gravel (construction), mica, feldspar, beryllium.
Davison	Sand and gravel (construction).
Day	Do.
Deuel	Do.
Douglas	Do.
Edmunds	Do.
Fall River	Do.
Faulk	Do.
Grant	Do.
Gregory	Do.
Hamlin	Do.
Hanson	Do.
Harding	Do.
Hughes	Do.
Hutchinson	Do.
Hyde	Do.
Jerauld	Do.
Jones	Do.
Kingsbury	Do.
Lake	Do.
Lawrence	Gold, silver, sand and gravel (construction).
Lyman	Sand and gravel (construction).
McPherson	Do.
Marshall	Do.
Meade	Do.
Miner	Do.
Minnehaha	Do.
Moody	Do.
Pennington	Cement, lime, sand and gravel (construction), clays, gypsum.
Perkins	Sand and gravel (construction).
Roberts	Do.
Sanborn	Do.
Spink	Do.
Sully	Do.
Tripp	Do.
Turner	Do.
Union	Do.
Walworth	Do.
Yankton	Do.
Ziebach	Do.
Undistributed[2]	Stone (crushed and dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of South Dakota business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	699	705	708
Total civilian labor force	do.	334	344	347
Unemployment	percent	5.4	4.3	5.1
Employment (nonagricultural):				
Mining total[1]	thousands	2.6	2.7	2.4
Oil and gas extraction[2]	do.	.1	.2	.1
Manufacturing total	do.	25.9	29.2	27.4
Stone, clay, and glass products[2]	do.	1.1	1.1	1.1
Chemicals and allied products[2]	do.	.2	.2	.3
Construction	do.	8.4	9.3	9.4
Transportation and public utilities	do.	12.3	12.3	12.7
Wholesale and retail trade	do.	62.5	65.3	65.6
Finance, insurance, real estate	do.	12.4	13.1	13.9
Services	do.	54.2	57.8	58.6
Government and government enterprises	do.	56.9	57.2	57.7
Total[3]	do.	235.3	247.0	247.7
Personal income:				
Total	millions	$6,795	$7,606	$7,903
Per capita		$9,726	$10,790	$11,161
Hours and earnings:				
Total average weekly hours, production workers		41.6	42.1	41.8
Total average hourly earnings, production workers		$7.3	$7.1	$7.4
Earnings by industry:				
Farm income	millions	$265	$666	$628
Nonfarm	do.	$4,151	$4,497	$4,712
Mining total	do.	$81	$87	$86
Metal mining	do.	$50	$53	$54
Nonmetallic minerals except fuels	do.	$21	$22	$21
Oil and gas extraction	do.	$10	$11	$10
Manufacturing total	do.	$492	$539	$535
Primary metal industries	do.	$5	$5	$7
Stone, clay, and glass products	do.	$20	$23	$24
Chemicals and allied products	do.	$4	$4	$5
Construction	do.	$249	$288	$298
Transportation and public utilities	do.	$378	$426	$449
Wholesale and retail trade	do.	$863	$915	$939
Finance, insurance, real estate	do.	$242	$266	$304
Services	do.	$886	$971	$1,046
Government and government enterprises	do.	$912	$959	$1,011
Construction activity:				
Number of private and public residential units authorized[4]		2,501	3,221	2,544
Value of nonresidential construction[4]	millions	$103.1	$101.0	$90.4
Value of State road contract awards	do.	$85.4	$101.3	$117.0
Shipments of portland and masonry cement to and within the State	thousand short tons	278	228	296
Nonfuel mineral production value:				
Total crude mineral value	millions	$222.1	$198.9	$207.3
Value per capita		$318	$282	$293

[p]Preliminary. [r]Revised.
[1]South Dakota Department of Labor mining totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]Data may not add to totals shown because of independent rounding.
[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

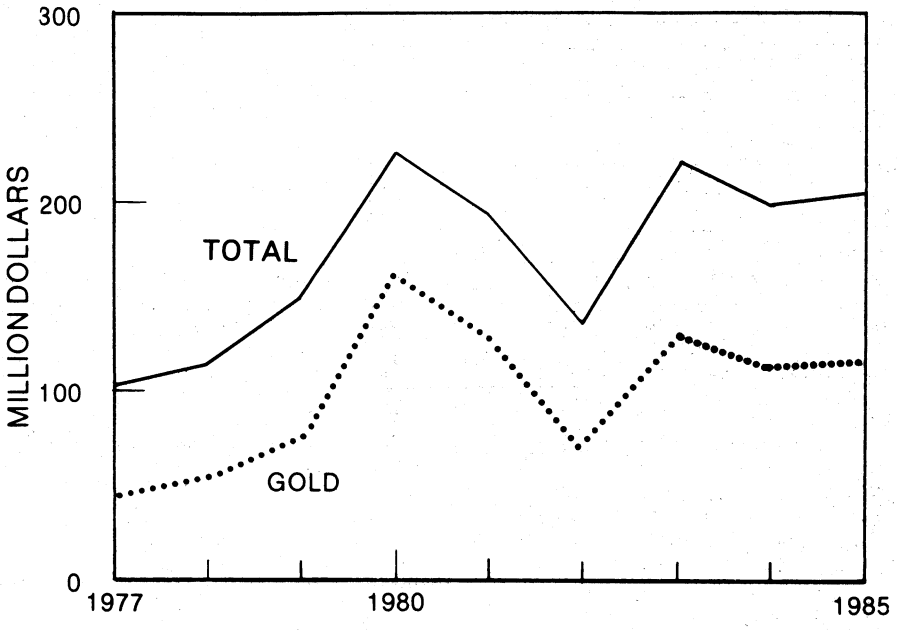

Figure 1.—Value of mine production of gold and total value of nonfuel mineral production in South Dakota.

Trends and Developments.—During 1985, the State of South Dakota issued 11 mining permits for nonfuel minerals, 1 less than in 1984. The life-of-mine permits, which went into effect in 1982, allow mining companies to continue operations as long as permit requirements are met. Prior to 1982, permits had to be renewed periodically. Permits were issued to nine companies with operations in four counties. Table 4 summarizes permitting activity in 1985.

Table 4.—South Dakota: Life-of-mine permits issued in 1985

Company	County	Commodities
A & H Minerals	Custer	Pegmatite minerals.
G. L. Bland	do	Do.
W. M. Boggs	do	Feldspar.
L. Brazell	do	Do.
H. Bruch & S. Bestgen	Meade	Shale.
Hills Materials Co	Custer	Limestone.
Pacer Corp	do	Pegmatite minerals.
South Dakota Cement Commission	do	Gypsum.
Do	Pennington	Do.
Do	do	Sand.
Strawberry Hill Mining Co	Lawrence	Gold and silver.

Several developments occurred in the State's mineral industry. In the metallic sector, Homestake Mining Co. announced in February that it was being forced to undertake a cost-cutting program because of falling gold prices. Salaried workers at the mine received a 5% pay cut beginning March 1. By early April, 55 salaried workers and 38 hourly employees had accepted a company offer of early retirement in the cost-cutting program that was expected to save $4 million by yearend. Major nonproduction expenditures at the mine and plant were also canceled to conserve cash flow. At the time, there were about 1,200 hourly and 300 salaried workers at the mine. Hourly workers were not affected by the cutbacks because the mine needed to operate at full

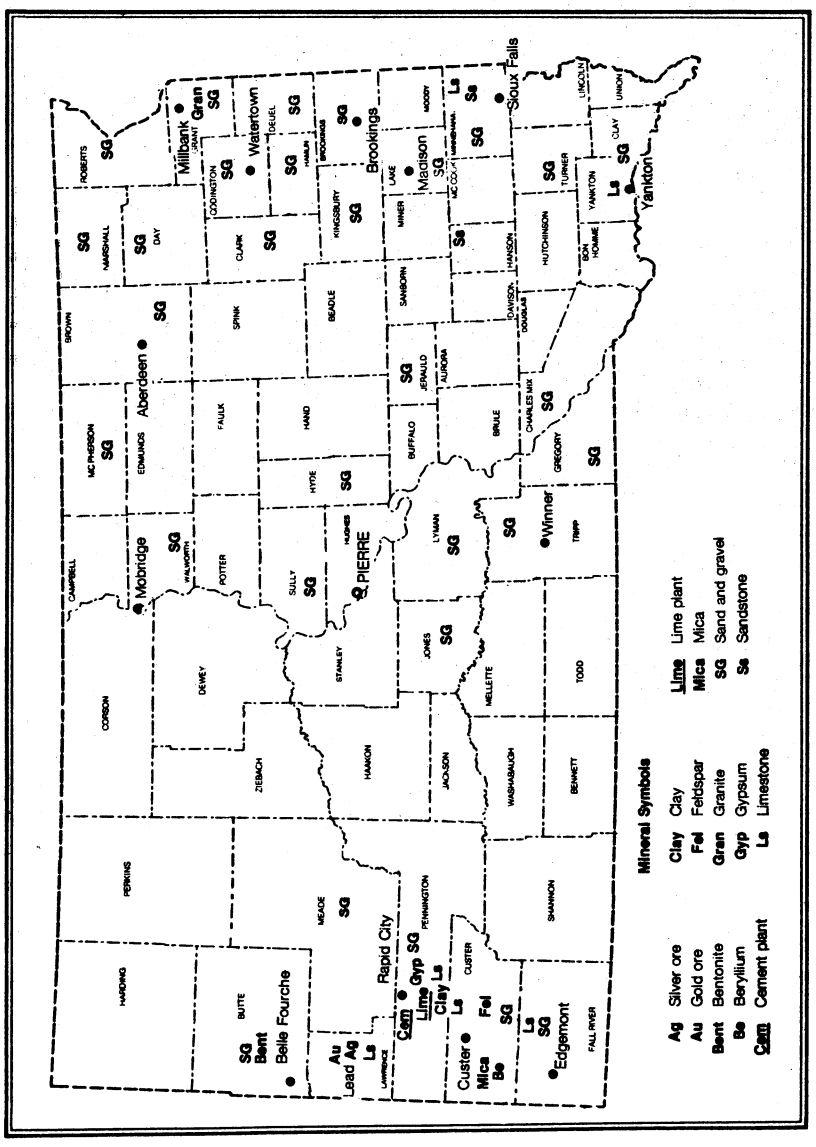

Figure 2.—Principal mineral producing localities in South Dakota.

capacity to keep production costs down.

In May, Homestake announced plans to develop a large, modern open pit in the historic "Open Cut" after conducting a successful 2-year test mining project on the site near the former townsite of Terraville. Gold ore from the surface mine was to be crushed and transported to Homestake's processing facilities via a 6,700-foot conveyor system that was expected to be completed by 1987.

The public focus on mining was heightened during 1985 by the proposed expansion of an open pit heap-leach gold mine at Annie Creek, 1 mile northwest of Terry Peak, a ski area in Lawrence County. The Lawrence County Board of Commissioners approved a zoning change and granted a permit to Wharf Resources (USA) Inc. to expand its heap-leach gold mining operation on a 183-acre tract at Foley Ridge where richer ore reserves were identified. Local property owners opposed the expansion saying it was only the beginning of extensive open pit mining in the northern Black Hills and questioned whether tourism and winter recreation would be of greater economic benefit to the local economy.

Wharf Resources was expected to apply for a State mining permit in early 1986. The company applied to the Denver regional office of the U.S. Environmental Protection Agency (EPA) for a Federal water discharge permit for the operation. When the EPA received the application, it published notices requesting public comment; after receiving extensive comments, EPA officials said that a hearing on the water discharge permit would be held in conjunction with the State's hearing on Wharf Resources' application for a mining permit for its planned expansion into the Foley Ridge area. EPA officials stated that the hearing might lead to a major study of cyanide heap-leach mining methods in the Black Hills.

Cleanup of uranium mill tailings at a former Tennessee Valley Authority uranium mill near Edgemont was under way in 1985. Scheduled for completion in 1986, the $2.7 million program was being conducted under the Federal Uranium Mill Tailings Remedial Action Program to remove mill tailings used as building material on 110 properties within Edgemont.

Site preparation was also under way on a 70-acre disposal area, 2 miles south of Edgemont, where 5 million tons of tailings was to be deposited in a separate $39 million project. Completion of this project was expected to take about 5 years.[4]

Employment.—Total nonagricultural employment in the State rose to about 247,700 persons, the highest level ever recorded in South Dakota. Employment in the State's mining industry totaled 2,400 persons in 1985, 300 less than were employed in mining during 1984. Employment levels were fairly strong in the beginning of the year but weakened in the second half. Lower prices for precious metals and oil and gas, and a limited demand for road construction materials were the primary reasons for the decline.

Average weekly wages in mining were $522.41, an 8% increase over 1984 wages. Compared with all other industry groups, mining employees received the highest average weekly wages during the past 5 years.

Exploration Activities.—Exploration for gold and other precious metals was conducted at an almost feverish pace during the year, mainly in the northern Black Hills. Eight companies were issued exploration permits in 1985 and planned to drill several hundred holes. Permitting activities are summarized in table 5.

Table 5.—South Dakota: Exploration permits issued in 1985

Company	County	Commodities
Freeport Exploration Co	Custer and Lawrence	Precious and base metals.
Homestake Mining Co	Lawrence	Gold and silver.
Moruya Gold Mines of North America Inc	do	Do.
Pete Lien & Sons Inc	do	Iron ore.
St. Joe American Corp	do	Gold and silver.
Strawberry Hill Mining Co	Custer	Pegmatite minerals.
Utah International Inc	Lawrence	Precious metals.
Wharf Resources (USA) Inc	do	Gold and silver.

Moruya Gold Mines of North America Inc., a public Australian company, acquired the Golden Reward properties for Anaconda Minerals Co. during the year. The properties consisted of patented claims on 2,828 acres in the Ruby Basin District.[5]

The U.S. Bureau of Land Management had records of approximately 10,000 active mining claims in South Dakota as of year-end. All the claims were in seven counties in the western part of the State. Lawrence County had the greatest number of active

claims, followed by Pennington and Custer Counties.

Legislation and Government Programs.—Several mineral industry-related pieces of legislation were enacted into law during 1985:

House bill 1112 provided for the exemption of certain severed mineral interests from taxation.

House bill 1159 repealed a statute that was thought to be unconstitutional and provided a procedure for joining severed mineral interests with the surface estate.

Senate bill 12 repealed certain statutes relating to mine safety.

Senate bill 13 revised certain service requirements for the Board of Minerals and Environment.

Senate bill 162 provided for limited oil and gas exploration with vibrator-equipped trucks without filing a notice of intent.

Senate bill 166 required the registration for extensions of oil, gas, or mineral leases.

The South Dakota Supreme Court overturned a circuit court ruling that one section of the State's 1981 severance tax law was unconstitutional. Homestake contended that a provision exempting any company that mined less than 1,000 ounces of precious metal per year from the State's tax of 6% on gold sales was discriminative and unequal taxation. The circuit court ruled in 1983 that Homestake should be exempted from paying the taxes on the first 1,000 ounces, just like smaller companies, and ordered the State to repay $69,433 in principal and $16,792 in interest for taxes already collected. The U.S. Supreme Court ruling found that the tax was constitutional and stated "that the appropriate level or rate of taxation is essentially a matter for legislative, and not judicial resolution." The 1984 legislature replaced the 1981 severance tax by combining a 2% severance tax with an 8% tax on the mines' net income.[6]

Several State and Federal agencies had programs that related, directly or indirectly, to the South Dakota mineral industry. The South Dakota Geological Survey (SDGS), with offices at Vermillion, maintained a full-time staff of 31 persons; 21 of whom were geologists, hydrologists, and chemists. During 1985, the SDGS continued work on its 25-year-old cooperative program with the U.S. Geological Survey to prepare a geologic-hydrologic study for each county in eastern South Dakota. Thirty-eight studies had been completed or were ongoing. The program was reorganized in 1983 to develop a complete geologic-hydrologic investigation of the Big Sioux River Basin, leading to a computerized ground water model that would allow for optimum development of the basin's water resources through proper management.

The SDGS also had an urban-rural program that provided for water resource studies at the request of local government agencies. Approximately 110 such studies had been completed since 1959.

Other ground water studies involved the construction of digital models to determine the optimum number of irrigation permits for an area; a series of statewide water supply studies for the U.S. Army Corps of Engineers; the hydrogeology of till; and the ground water protection aspects of landfill and nuclear waste repository siting and hazardous waste spills.

In December, a U.S. Department of the Interior task group released a preliminary evaluation of irrigation drainage water quality. The study, while confirming that a number of sites had high selenium levels, found no evidence of widespread harm to wildlife or human health. Areas with high selenium levels, which included the Angostura and Belle Fourche Reservoirs in South Dakota, were to be investigated further.[7]

The U.S. Bureau of Mines distributed $252,000 to the South Dakota School of Mines and Technology at Rapid City, the designated Mining and Mineral Resources and Research Institute for the State under title III of Public Law 95-87. The funds were provided as part of a program to assist the institute's efforts in training engineers and scientists in mineral-related disciplines.

The Federal Government distributed $797,407 to South Dakota for its share of funds generated by activities (mineral leasing, recreation, timbering, user fees, etc.) on national forest lands in fiscal year 1985. This compared with $1,091,350 in funds the State received in fiscal year 1984. South Dakota's local governments received $1,542,405 in fiscal year 1985 funds as "payments in lieu of taxes" for Federal tax-exempt lands within their boundaries.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

In 1985, metal production accounted for 55% of the State's mineral value. South Dakota ranked 2d of 14 States in gold production, 2d of 2 States in beryllium production, and 11th of 17 States in silver production.

Beryllium.—Pacer Corp. recovered a small tonnage of hand-cobbed beryl, along with feldspar and mica, at its pegmatite operations during the year. The firm operated several leased mines in the Custer County area with contract miners, and it also purchased beryl from independent miners. When sufficient quantities of beryl were accumulated, the firm trucked the material to Salt Lake City where it was sold to Brush Wellman Inc. Beryl production reported by Pacer fell 67% below the 1984 level, and value decreased 66%.

Gold.—South Dakota ranked second behind Nevada in the production of gold and produced 14% of the Nation's total in 1985. Although production increased 15% above the 1984 level, value increased only 1% because of the depressed gold price.

Table 6.—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)
1981	1	1	1,677	278,162	$127,854	56	$587
1982	1	--	1,059	185,038	69,558	26	209
1983	2	--	1,771	309,784	131,348	62	713
1984	2	--	2,252	310,527	111,994	50	407
1985	2	--	2,309	356,103	113,119	63	388
1876-1985	NA	NA	NA	38,970,185	2,103,130	13,706	16,318

NA Not available.
[1]Excludes placer gravel.

The State's gold industry consisted of two companies; namely, Homestake with a new surface mine, an underground mine, and a mill near Lead, and Wharf Resources with a surface mine and ore treatment/heap-leach pads near Trojan.

At Homestake, mining and exploratory work continued below the 6,800-foot level, and major development work occurred on the 6,950-, 7,100-, and 8,000-foot levels. Preparation work for sinking the No. 4 Winze continued on a reduced schedule.

According to its annual report to stockholders, Homestake produced 343,103 troy ounces of gold in 1985, the company's highest output since 1974. Over 2.3 million short tons of ore was mined, and the average ore grade was 0.174 ounce per ton. The ore tonnage milled was the highest in the mine's history, and the unit production costs were the lowest since 1979. The overall ore grade fell 5% and mill recovery 1% because of the increased tonnage of lower grade ore from the test mining in the old open pit.

Homestake's South Dakota mining costs in 1984 averaged $324 per ounce. In 1985, gold prices on the world market fell to an average of $317.66 per ounce. By implementing a cost containment program, which included work force and pay reductions and early retirements, production costs were reduced to $294 per ounce.

In August, Homestake dedicated a new $10 million waste water treatment plant that used the bacterium *pseudomonas paucimobilis mudlock* to digest cyanide, lead, zinc, and other toxins into carbon and ammonia. Other bacteria attacked the ammonia, which was broken into harmless byproducts.[8]

The mining of Homestake's north test pit in the historic "Open Cut" at Lead, which began in 1984, was completed in August 1985. Almost 316,000 tons of ore was mined and over 22,000 ounces of gold was recovered. Both tonnage and grade were close to the original reserve estimates, and the company decided to put the opencut into full-scale production. In October, Homestake announced that it had awarded a 5-year, $50 million contract to two firms to expand the original open pit. Approximately 50 million tons of waste will be removed from the opencut to expose the first 2.5 million tons of ore.

At Wharf Resources, ore was mined by conventional surface methods, crushed, spread on leach pads, and treated with a cyanide solution that dissolved the gold, which was then recovered and the solution reused. During much of 1985, Wharf Resources personnel concentrated on acquiring the necessary permits from the Lawrence County Commission to expand mining to a 183-acre site on nearby Foley Ridge. In

December, Wharf Resources received a conditional use permit covering 90% of the proposed mine area, and a zoning change was made that would allow the expansion. The company still required a State mining permit and a second conditional use permit for the remaining 10% of the site. The expansion plans were the center of a major controversy involving property owners in the area. At yearend, a group of concerned owners were considering a petition for a referendum on the mine expansion or a civil suit to challenge the commission's actions that permitted the Foley Ridge expansion.[9]

Silver.—South Dakota's silver production was obtained as a coproduct of gold recovery at the Homestake mill. Output increased 26% in quantity, but because of a decrease of $2.00 per troy ounce in the average price, the total value fell by 5% compared with that of 1984.

INDUSTRIAL MINERALS

In 1985, industrial minerals accounted for 45% of the State's mineral value.

Cement.—The State-owned cement plant at Rapid City was the only producer in South Dakota. The plant, with an annual clinker capacity of 880,000 short tons, was equipped with two wet-process and one dry-process kilns. Clay, gypsum, limestone, and sand mined instate and iron materials brought in from out of State were used for cement manufacture. Both portland and masonry cement were produced; portland shipments increased 6%, whereas masonry sales declined 20%. Approximately 94% of the cement produced at the Rapid City facility is sold in Colorado, North Dakota, South Dakota, and Wyoming. Minor markets exist in Iowa, Minnesota, Montana, and Nebraska.[10]

In December, the Cement Commission, at the request of the Governor, agreed to pay the State treasury a "largest ever" dividend of $33 million. Since 1979, the cement plant has added $94 million to the South Dakota treasury.[11]

Clays.—South Dakota's clay industry—two companies operating two mines in the western part of the State—produced both bentonite and common clay.

American Colloid Co. mined bentonite in Butte County by open pit methods and trucked it to its Belle Fourche plant where it was crushed, dried, ground, sized, and shipped in bulk and bagged form, mostly by rail, to consumers. The Belle Fourche plant was one of four operated by the company in Montana, South Dakota, and Wyoming. American Colloid's principal markets were the foundry and drilling industries. Production in 1985 decreased 16% from that reported for 1984 as the demand for oil well drilling mud, a major market for South Dakota bentonite, declined sharply as world oil prices plummeted.

The South Dakota Cement Commission mined common clay for use in manufacturing cement at its Rapid City plant. Production was about 2% less than in 1984.

Feldspar.—South Dakota was one of six States producing feldspar—an anhydrous aluminum silicate used as a flux in glass and ceramics manufacture. Pacer owns several surface mines and a grinding plant in Custer County. The plant in Custer grinds ore mined by approximately 25 independent operations, all in the pegmatite district of the Southern Black Hills. Sales, in both bulk and bag form, were primarily to the electrical, porcelain, and pottery industries.

Gem Stones.—The collection of gem stones and mineral specimens was a small but active segment of South Dakota's mineral industry. Several varieties of agate are found in the State, including the Fairburn agate, the State gem stone. The Fairburn agate is found in a belt extending from Farmingdale, SD, to Orella, NE. Also, many types of fossils, both vertebrate and invertebrate, are found in many areas of the State.

A mine 17 miles west of Custer produced Teepee Canyon agates,[12] and several of the independent feldspar miners stockpiled rose quartz and other mineral specimens for sale. The Tip Top Mine near Custer was the site of a previously undescribed mineral discovery. Tiptopite, as the new mineral was named, is a "secondary phosphate mineral derived from triphylite and beryl."[13]

Gypsum.—The South Dakota Cement Commission produced crude gypsum at a surface mine in Pennington County where it was crushed and shipped by rail to the Commission's cement plant in Rapid City. Ground clinker was mixed with gypsum for use as a setting retardant in portland cement. Gypsum production paralleled cement demand, and output increased over that of 1984.

Lime.—One company, Pete Lien & Sons Inc., produced both hydrated lime and quicklime at a plant in Rapid City that had both a rotary and a vertical kiln. Limestone was mined by surface methods from a property in Pennington County. Principal sales were for road and soil stabilization, sulfur removal from stack gases, and basic oxygen

furnace steel. Output and value decreased 4% for hydrated lime and 14% for quicklime from 1984 levels.

Mica.—Pacer produced mica-bearing pegmatite material from a surface mine in Custer County. After drilling and shooting, the ore was crushed before it was trucked to one of two plants in the Custer area. One plant used gravity separation to obtain a crude mica product and the second utilized crushing and screening.

Sand and Gravel (Construction).—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

South Dakota's sand and gravel industry in 1985 was similar to that of 1984 when 106 firms and government agencies operated 183 pits in 50 counties. The five leading counties in terms of tonnage were in the eastern part of the State. The estimated 1985 production exceeded the 1984 reported output by 614,000 tons. Historically, almost 50% of the sand and gravel output in South Dakota has been for road construction and stabilization.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Crushed stone output, reported by 11 companies operating 13 quarries in 4 southwestern and 3 eastern counties, increased 7% in quantity and 13% in value over that of 1984. Limestone production, totaling over 3 million tons, was reported from 10 quarries and represented nearly three-quarters of the total. Sandstone and quartzite from three quarries constituted the remainder.

Table 7.—South Dakota: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	14	53
Filter stone	13	52
Coarse aggregate, graded:		
Concrete aggregate, coarse	97	618
Bituminous surface-treatment aggregate	41	321
Combined coarse and fine aggregates: Other construction[2]	181	839
Chemical and metallurgical: Cement manufacture	950	1,994
Other unspecified[3]	2,777	10,534
Total[4]	4,071	14,412

[1]Includes limestone, quartzite, and sandstone.
[2]Includes bituminous aggregate (coarse), graded road base or subbase, unpaved road surfacing, stone sand (concrete), terrazzo and exposed aggregate, stone sand (bituminous mix or seal), and fine aggregate (screening).
[3]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[4]Data may not add to totals shown because of independent rounding.

Controversy developed during the year when two construction companies—one South Dakota-based and the other based in Iowa—applied for quarry permits in Minnehaha County in the southeastern part of the State. The companies were attracted to the areas because the Iowa Department of Transportation changed its specifications for highway construction materials to a standard that could only be met by a rock type such as that found in the area. County residents protested the applications because of concerns about declining property values, blasting damage, and increased dust, noise, and traffic. Action on the permit applications was expected in early 1986.[14]

Dimension.—South Dakota ranked fifth among 20 States in the quarrying and cutting of dimension granite. Production was centered in Grant County in the northeastern part of the State where four companies operated eight quarries. Quantity and value of sales, all for construction and monumental uses, decreased moderately compared with 1984 figures.

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[1]State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.
[2]State Mineral Officer, Bureau of Mines, Minneapolis, MN.
[3]Editorial assistant, Bureau of Mines, Minneapolis, MN.
[4]The Rapid City Journal. Tailings To Be Moved to Safer Spot Next Spring. Sept. 21, 1985.
[5]Lead Daily Call. Anaconda Lands Sold. July 5, 1985.
[6]———. Gold Tax Refund Rejected by Court. Sept. 6, 1985.
[7]U.S. Department of the Interior News Release. Interior Expands Water Quality Review; Preliminary Study Finds No Widespread Toxic Effects From Selenium. Dec. 11, 1985.

[8]The Rapid City Journal. Bacteria Doing Their Bit To Improve Environment. Aug. 15, 1985.
[9]———. Wharf Needs Expansion To Keep Its Golden Eggs in Hills Basket. Dec. 22, 1985.
[10]———. Cement Plant OK's Transfer of $8 Million to State Fund. June 14, 1985.
[11]———. Cement Plant To Pay State $33 Million. Dec. 4, 1985.
[12]The Rapid City Journal. Custer Family Upholds Independent Mining Tradition. Jan. 5, 1985.
[13]———. Tech Curator, Student Discover a New Mineral. May 7, 1985.
[14]Argus Leader (Sioux Falls, SD). Four-Corner Tussle Has Participants on Rocky Ground. Dec. 6, 1985.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Beryllium concentrate:			
Pacer Corp	Box 912 Custer, SD 57730	Mine and plant	Custer.
Cement:			
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	3 rotary kilns	Pennington.
Clays:			
American Colloid Co	5100 Suffield Ct. Skokie, IL 60076	Open pit mine and plant	Butte.
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Open pit mine	Pennington.
Feldspar:			
Pacer Corp	Box 912 Custer, SD 57730	Open pit mines and dry-grinding plant.	Custer.
Gold:			
Homestake Mining Co	Box 875 Lead, SD 57754	Underground and open pit mines, cyanidation mill, refinery.	Lawrence.
Wharf Resources (USA) Inc	Box 897 Lead, SD 57754	Open pit mine and heap leaching.	Do.
Gypsum:			
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Open pit mine	Pennington.
Lime:			
Pete Lien & Sons Inc	Box 440 Rapid City, SD 57709	1 rotary kiln, 1 vertical kiln, continuous-hydrator plant.	Do.
Mica:			
Pacer Corp	Box 912 Custer, SD 57730	Mine and dry-grinding plant	Custer.
Sand and gravel (construction, 1984):			
W. E. Bartholow & Son Construction Co.	Route 3 Huron, SD 57350	Pits and plants	Jerauld.
Birdsall Sand & Gravel Co. Inc	Box 767 Rapid City, SD 57709	do	Fall River, Pennington, Sully.
Bowes Construction Inc	Box 451 Brookings, SD 57006	do	Brookings.
Fisher Sand & Gravel Co	Box 1034 Dickinson, ND 58601	do	Pennington, Roberts, Tripp, Ziebach.
Myrl & Roy's Paving Inc	1500 East 39th St. North Sioux Falls, SD 57101	Pit and plant	Minnehaha.
Rechnagel Construction Co	Hurley, SD 57036	Pits and plants	Turner.
Sweetman Construction Inc	100 South Dakota Ave. Summit, SD 57266	do	Minnehaha and Roberts.
Silver:			
Homestake Mining Co	Box 875 Lead, SD 57754	See *"Gold"*	Lawrence.
Stone:			
Crushed:			
Limestone:			
Pete Lien & Sons Inc	Box 440 Rapid City, SD 57709	Quarries and plants	Custer and Pennington.
Northwestern Engineering Co. (Hills Materials Co.).	Box 2320 Rapid City, SD 57709	do	Fall River and Pennington.
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Quarry and plant	Pennington.
Sandstone-quartzite:			
Concrete Materials Co	Box 809 Sioux Falls, SD 57101	do	Minnehaha.
L. G. Everist Inc	313 South Phillips Sioux Falls, SD 57101	do	Do.
Spencer Quarries Inc	Box 25 Spencer, SD 57374	do	Hanson.
Dimension:			
Granite:			
Cold Spring Granite Co.	202 South 3d Ave. Cold Spring, MN 56320	Quarries	Grant.
Dakota Granite Co	Box 1351 Milbank, SD 57252	do	Do.

The Mineral Industry of Tennessee

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

By Doss H. White, Jr.,[1] and Ray Gilbert[2]

The value of nonfuel mineral production in Tennessee in 1985 was reported at $472 million, $5 million below the record high established in 1984. Despite the slight decrease in overall mineral value, the State ranked 16th in the United States in the value of mineral production.

The decrease in mineral output and value was due primarily to a $32 million decrease in zinc production.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] thousand short tons	r1,165	r$21,690	1,244	$25,913
Gem stones	NA	5	NA	5
Phosphate rock thousand metric tons	1,368	33,275	1,233	27,600
Sand and gravel:				
Construction thousand short tons	6,304	19,830	e7,200	e22,000
Industrial do.	650	6,903	569	6,156
Stone:				
Crushed do.	e36,200	e138,000	37,939	155,760
Dimension do.	e7	e1,097	5	773
Zinc (recoverable content of ores, etc.) metric tons	116,526	124,854	104,471	92,971
Combined value of barite, cement, clays (fuller's earth), copper, lead, lime, pyrites, silver, and stone (crushed granite, 1985)	XX	r131,918	XX	141,109
Total	XX	r477,572	XX	472,287

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

Table 2.—Nonfuel minerals produced in Tennessee in 1984, by county[1]

County	Minerals produced in order of value
Anderson	Clays.
Benton	Sand and gravel.
Campbell	Do.
Carroll	Sand and gravel, clays.
Coffee	Sand and gravel.
Cumberland	Do.
Decatur	Do.
Fayette	Do.
Fentress	Do.
Gibson	Clays.
Giles	Phosphate rock.
Greene	Sand and gravel.
Hamilton	Cement, sand and gravel, clays.
Hardeman	Sand and gravel.
Hardin	Do.
Henry	Clays, sand and gravel.
Hickman	Phosphate rock.
Humphreys	Sand and gravel.
Jefferson	Zinc, silver, copper, lead.
Knox	Cement, zinc, clays, sand and gravel.
Lauderdale	Sand and gravel.
Loudon	Barite.
McMinn	Lime.
McNairy	Sand and gravel.
Madison	Do.
Marion	Do.
Maury	Phosphate rock.
Obion	Sand and gravel.
Overton	Do.
Polk	Pyrites, copper, zinc, silver.
Putnam	Sand and gravel.
Roane	Do.
Sevier	Do.
Shelby	Do.
Smith	Zinc.
Sullivan	Clays.
Tipton	Sand and gravel.
Union	Lime.
Washington	Clays.
Wayne	Sand and gravel.
Weakley	Clays.
Williamson	Phosphate rock.
Undistributed[2]	Stone (crushed), stone (dimension), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Tennessee business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	4,689	4,726	4,762
Total civilian labor force	do	2,181	2,220	2,245
Unemployment	percent	11.5	8.6	8.0
Employment (nonagricultural):				
Mining total[1]	thousands	7.9	8.0	7.5
Metal mining[2]	do	1.0	1.1	.9
Nonmetallic minerals except fuels[2]	do	3.0	3.1	3.2
Coal mining[2]	do	2.9	3.0	2.9
Oil and gas extraction[2]	do	.8	.6	.4
Manufacturing total	do	468.6	497.1	489.3
Primary metal industries	do	15.5	16.2	17.1
Stone, clay, and glass products	do	12.9	14.3	14.2
Chemicals and allied products	do	43.0	41.5	40.2
Petroleum and coal products	do	.8	.7	.9
Construction	do	69.6	78.3	82.1
Transportation and public utilities	do	83.6	89.1	91.3
Wholesale and retail trade	do	389.9	413.3	437.7
Finance, insurance, real estate	do	81.9	85.9	89.3
Services	do	323.4	344.3	359.3
Government and government enterprises	do	294.1	296.1	304.4
Total[3]	do	1,719.0	1,812.0	1,860.8
Personal income:				
Total	millions	$45,549	$50,126	$53,539
Per capita		$9,714	$10,607	$11,243
Hours and earnings:				
Total average weekly hours, production workers		40.5	40.9	41.0
Total average hourly earnings, production workers		$7.5	$7.9	$8.3

See footnotes at end of table.

Table 3.—Indicators of Tennessee business activity —Continued

		1983[r]	1984	1985[p]
Earnings by industry:				
Farm income	millions	$248	$643	$523
Nonfarm	do	$34,063	$37,499	$40,338
Mining total	do	$250	$275	$276
Metal mining	do	$27	$23	$22
Nonmetallic minerals except fuels	do	$60	$66	$72
Coal mining	do	$104	$121	$125
Oil and gas extraction	do	$60	$65	$57
Manufacturing total	do	$9,455	$10,337	$10,761
Primary metal industries	do	$425	$464	$490
Stone, clay, and glass products	do	$308	$371	$388
Chemicals and allied products	do	$1,637	$1,271	$1,313
Petroleum and coal products	do	$29	$28	$26
Construction	do	$1,952	$2,300	$2,501
Transportation and public utilities	do	$2,417	$2,688	$2,905
Wholesale and retail trade	do	$6,028	$6,555	$7,091
Finance, insurance, real estate	do	$1,734	$1,888	$2,160
Services	do	$6,585	$7,530	$8,232
Government and government enterprises	do	$5,494	$5,780	$6,262
Construction activity:				
Number of private and public residential units authorized[4]		29,960	37,085	38,126
Value of nonresidential construction[4]	millions	$900.7	$839.8	$1,352.4
Value of State road contract awards	do	$254.0	$415.0	$310.0
Shipments of portland and masonry cement to and within the State	thousand short tons	1,334	1,513	1,634
Nonfuel mineral production value:				
Total crude mineral value	millions	$407.3	$477.6	$472.3
Value per capita		$87	$101	$99

[p]Preliminary. [r]Revised.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

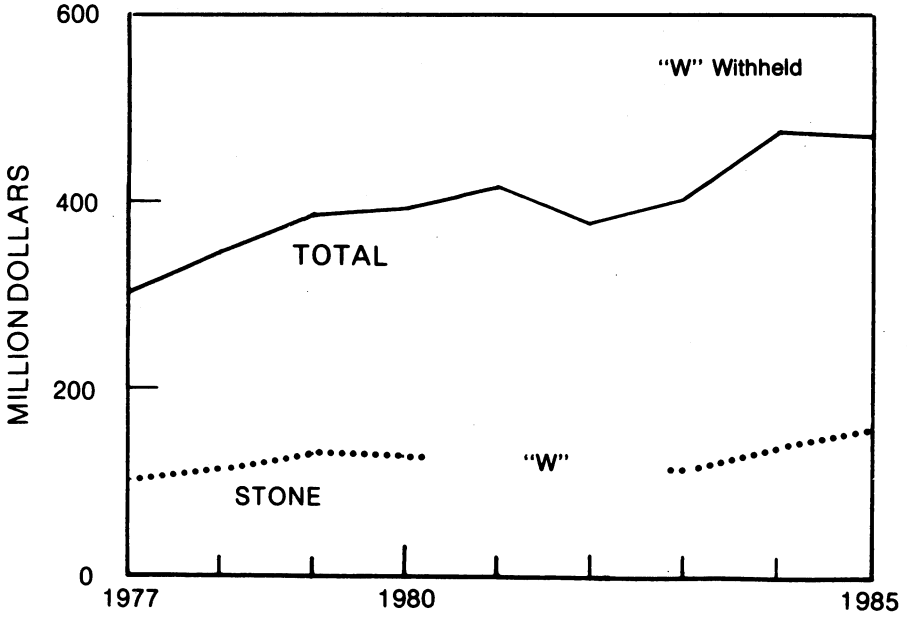

Figure 1.—Value of stone and total value of nonfuel mineral production in Tennessee.

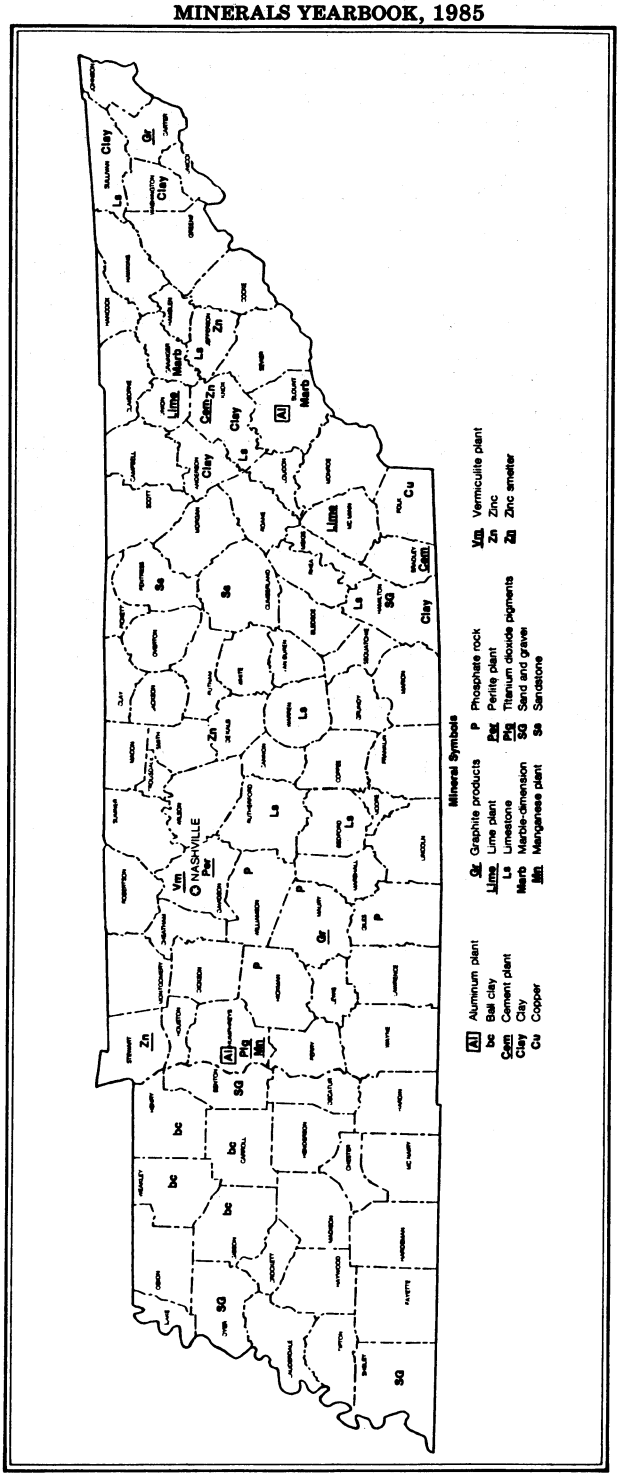

Figure 2.—Principal mineral producing localities in Tennessee.

Trends and Developments.—In 1985, Tennessee's value of mineral production declined over $5 million from the record high established in 1984. Two companies, Tennessee Chemical Co. and Monsanto Co., reported plans to terminate mining and, in Monsanto's case, phosphorus manufacture. A depressed zinc market forced the temporary closing of one zinc mine, and the State's aluminum production was only a fraction of capacity because of foreign imports and high power rates.

The decrease in the value of Tennessee's mineral production was miniscule when compared with the effects on individual families and local economies created by mine shutdowns and temporary plant closings. Approximately 1,300 people will lose their jobs as a result of the Tennessee Chemical and Monsanto closings, and a study on the Tennessee Chemical closing by the Tennessee Valley Authority (TVA) indicated that an additional 1,900 jobs will be lost in the three-county copper basin area from the drastic cut in the Tennessee Chemical payroll.

On a more positive note, Vanderbilt University in Nashville was named one of five commercial space development centers that will study materials and metallurgical processing, macromolecular crystallography, and space remote sensing. The specific area of interest for Vanderbilt will be metallurgical processing. The centers are described by the National Aeronautics and Space Administration as "joint undertakings of government, industry, and academic teams." The companies involved in the Vanderbilt program include Special Metals Corp., Aluminum Co. of America (Alcoa), Engelhard Industries Div., General Electric Co., Lockheed Missiles and Space Co., Teledyne Inc., Armco Co., GTE Sylvania, Cabot Corp., and the Delco-Remy Div. of General Motors Corp.

Legislation and Government Programs.—During 1985, the Tennessee Legislature passed a bill (Public Acts of 1985, Chapter 189), which provided that revenue from sales of State mineral lands be deposited in a trust fund with interest used for purchase of recreation lands or for historical preservation projects.

A mineral severance tax enacted in 1984 was declared unconstitutional by the State Attorney General. The State law required a two-thirds vote by the State's county legislative bodies within 120 days after passage for the law to become effective. The Attorney General ruled that whether or not a General Legislative Enactment becomes law cannot be left to the counties; only the legislature can mandate law. The ruling led several counties to consider a county mineral tax. In July, Giles County Commissioners approved a resolution that had been approved by the Tennessee General Assembly earlier taxing dry phosphate and limestone $0.15 per short ton. The resolution was adopted as a private act and, although passed by the Tennessee General Assembly, only affects Giles County. Other counties were considering a tax on aggregate commodities, chert, limestone, and sand and gravel, with revenue earmarked for the county highway departments.

During 1985, the Tennessee Division of Geology, with principal offices in Nashville and field offices in Knoxville and Memphis, increased field mapping strength in all areas except the westernmost part of the State. Some support strength was also added in the Nashville office.

Oil and gas activities were down slightly compared with that of 1984. This was true in the number of permits issued as well as slight decreases in oil and gas production.

At the Federal level, the U.S. Bureau of Mines conducted several programs relating to Tennessee's mineral industry. All mineral producing companies in the State were canvassed to develop baseline data on mineral output and value as part of a nationwide program to monitor mineral production and demand, mineral trends, and areas where research could improve mineral recovery and better protect the environment.

During the year, the Bureau's clay waste dewatering research was evaluated by Stauffer Chemical Co. in Mount Pleasant. The company obtained excellent results with small-scale experimentation using the Bureau's findings and was testing the methodology for company application using larger equipment.

TVA researchers demonstrated a promising new phosphate flotation method, which allows direct, one-stage separation of phosphate from accessory minerals present in the phosphate ore matrix. The new method, if applicable on a large scale, could revolutionize phosphate beneficiation.

In other Federal activity affecting the Tennessee mineral sector, the U.S. Department of Energy awarded Fisk University in Nashville a $135,000 grant to investigate microbial liquefaction of peat. The U.S. Department of Labor certified the 800 miners who will lose their jobs when Tennessee Chemical closes its mines in 1987 to apply

for benefits under the Trade Readjustment Act (TRA). In addition to the TRA funds, $400,000 was made available to the State to assist in retraining programs under the Job Training Partnership Act.

Abandoned mines in two areas of Tennessee have furnished sediments that led to problems with the State's water supplies. TVA has been involved with surface mine reclamation for a number of years, and in 1985, the agency seeded and fertilized 500 to 600 acres denuded by copper smelting operations in southwestern Tennessee. Runoff from the area severely impacted the Ocoee River, a nationally known white-water recreation river. TVA was active in the upper Duck River Basin near Columbia, TN, where trees and shrubs were planted on approximately 100 acres of abandoned land that had been mined for phosphate. TVA also had ongoing reclamation projects for abandoned mines in western North Carolina. Sediments from these mines have affected the water intake structures of Greeneville and Jonesboro, TN, 100 miles downstream from the sediment sources.

In other mine land reclamation activity, a Federal judge ruled that Abingdon-based Rapoca Energy Co. must pay more than $200,000 in reclamation fees for mining done on company lands by independent companies. Rapoca contracted with 48 companies to mine coal on Rapoca land and then purchased the coal from the independent miners. The money will be placed into the Office of Surface Mining's Abandoned Mine Lands Fund used to pay for reclamation on abandoned surface coal mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

The mining of industrial minerals accounted for 78% of the State's mineral value during 1985. This was a 6% increase over that reported for 1984. The increase was due mainly to an increased output of portland cement, construction sand, and crushed stone used primarily by the construction industries, which experienced an increase in sales during 1985.

Barite.—One firm, A. J. Smith Co., produced barite from open pit mining in Loudon County in the southeastern part of the State. After washing, the ore was shipped to Georgia for further processing for the chemical and paint industries.

Cement.—Two companies in eastern Tennessee comprised the State's cement industry.

Dixie Cement Co. Inc. is a subsidiary of Moore McCormack Cement Inc., and Signal Mountain Cement Co. is owned by IFI International.

During the latter part of 1985, Allied International Marketing Service Corp., a Romanian cement export company, established offices in Memphis. Imported cement transported up the Mississippi River could have a significant impact on domestic sales in western Tennessee.

Table 4.—Tennessee: Cement industry, 1985

Company	Location	Process	Number of kilns	Annual clinker capacity (thousand short tons)
Dixie Cement Co. Inc	Knoxville	Dry	2	550
Signal Mountain Cement Co	Chattanooga	Wet	2	450

Clays.—The State's clay industry, 9 companies that operated 33 mines in 5 eastern and 4 western counties, produced ball clay, common clay and shale, and fuller's earth.

Table 5.—Tennessee: Clay industry and production in 1985, by type

Type	National ranking	Number of companies	Number of mines	Quantity (thousand short tons)	Value (thousands)	Average value per ton
Ball clay	1	4	23	665	$24,601	$37.02
Common clay and shale	12	4	9	579	1,312	2.27
Fuller's earth	8	1	1	W	W	W

W Withheld to avoid disclosing company proprietary data.

Ball clay was produced in four contiguous counties in northwestern Tennessee: Carroll, Gibson, Henry, and Weakley. The clay is composed of fine-grained kaolinite with lesser amounts of chlorite, illite, and smectite. Processing of the Eocene age deposits was essentially identical with all producers. After surface mining, the clay was trucked to the processing plant where it was shredded, dried, and pulverized. Shipments of the shredded clay were made both predried and postdried. Two companies also shipped clay in a slurry form, and a third was constructing slurry facilities at yearend.

H. C. Spinks Clay Co. Inc., Paris, TN, began expansion of its plant near Gleason, which will include a slurry plant. The new facility will encompass 16,500 square feet with an additional 30,000 square feet designated for storage. The company operates a second grinding plant near Paris.

Table 6.—Tennessee: Ball clay sold or used by producers, by kind and use

(Short tons)

Use	1984[r]			1985		
	Air-float[1]	Unprocessed	Total	Air-float[1]	Unprocessed	Total
Electrical porcelain	18,296	--	18,296	17,319	--	17,319
Fine china and dinnerware	27,748	--	27,748	20,085	--	20,085
Floor and wall tile, ceramic	59,134	W	59,134	62,714	W	62,714
Pottery	117,399	W	117,399	101,787	W	101,787
Sanitary ware	36,350	W	36,350	108,379	W	108,379
Other[2]	158,950	124,119	283,069	153,233	159,978	313,211
Exports	61,476	1,441	62,917	38,784	2,276	41,060
Total	479,353	125,560	604,913	502,301	162,254	664,555

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes water-washed.
[2]Includes animal feed; common bricks; catalysts (oil refining); crockery and earthenware; firebrick, block and shapes; high-alumina refractories; kiln furniture; mortar and cement; pesticides and related products; roofing granules; rubber; unknown uses; and data indicated by symbol W.

Common clay and/or shale was produced in Anderson-Knox, Sullivan-Washington, and Hamilton Counties in the eastern part of the State, and in Henry County in western Tennessee. Most of the clay was used in the manufacture of building brick, tile, and portland cement. Output and value increased over 1,800 short tons and $147,000 over production and sales in 1984.

Lowe's Inc. mined a montmorillonite fuller's earth by open pit methods in Henry County. The clay was trucked to a processing plant in Paris where it was shredded, dried, sized, and bagged. The processed material was marketed as an industrial and pet waste absorbent and as an insecticide and fungicide carrier.

American Olean Tile Co., a division of National Gypsum Co., completed construction of a $20 million mosaic tile plant in Jackson. Annual plant output is scheduled to exceed 10 million square feet of glazed and unglazed tile.

Graphite (Synthetic).—Two companies operated three plants in Tennessee to produce electric-furnace electrodes and high-modulus graphite fibers using petroleum coke and coal tar pitch as the basic raw material. Pertinent statistics data on the industry were as follows:

Company	City	County	Principal product
Great Lakes Carbon Corp	Elizabethton	Carter	High-modulus graphite fibers.
Union Carbide Corp	Clarksville	Montgomery	Electric-furnace electrodes.
Do	Columbia	Maury	Do.

During the year, Union Carbide Corp. suspended operations at its Clarksville facility because of the depressed electrode market.

Lime.—Tennessee's lime industry consists of Tenn-Luttrell Lime Co., a subsidiary of Penn-Virginia Corp. and Bowater Southern Paper Corp. Penn-Virginia operates a surface mine, 800-short-ton-per-day lime plant, and grinding plant at Luttrell near

Knoxville. The lime plant houses a 15-foot by 170-foot rotary coal-fired kiln.

Blue Ridge Mining Co. Inc. has responsibility for material flow from the extraction point to the kiln and grinding stockpiles. The grinding plant processes undersize material into uncalcined, chemical-grade products.

Bowater produced lime as a byproduct step in the papermaking process. Principal markets for Tennessee's lime production were the paper, steel, and water purification industries.

Lithium.—Foote Mineral Co. produced organo-lithium compounds at a plant at New Johnsonville. Lithium carbonate and lithium metal obtained from company operations at Kings Mountain, NC, and Silver Peak, NV, were used to produce a variety of compounds included in lubricants, pharmaceuticals, and rubber manufacture.

Magnesia (Fused).—C-E Minerals Inc.'s wholly owned subsidiary, Tennessee Electrominerals, produced fused magnesia at its fused silica plant in Greeneville. Three refractory grades with silica content ranging from 0.7% to 5% SiO_2 and magnesia content varying from 91% to 98.9% MgO were produced, as well as several grades of electrical magnesia.

Perlite (Expanded).—Chemrock Corp. received crude perlite from New Mexico as head feed for an expansion plant in Nashville. The expanded material was marketed for horticultural uses, construction applications, and as a filter medium. The tonnage of crude perlite expanded increased during 1985; however, sales decreased slightly.

Phosphate Rock.—The State ranked fourth in phosphate rock production; the top three were Florida, North Carolina, and Idaho. The State's phosphate rock reserves occur in residual clays weathered from Ordovician age limestones and were mined by surface methods in Giles, Hickman, Maury, and Williamson Counties in the southern part of the State. Three companies, Monsanto and Occidental Chemical Corp. in Columbia and Stauffer Chemical in Mount Pleasant, converted the rock into elemental phosphorus, which was manufactured into a variety of individual chemicals. Late in the year, Monsanto announced that it would close its Columbia operation in October 1986, terminating approximately 400 jobs.

Pyrites.—Tennessee Chemical mined and processed pyrite in the Ducktown Basin in Polk County in the southern part of the State. The company's chemical complex produced sulfuric acid and liquid sulfur dioxide. Byproducts included blister copper, magnetite, and zinc concentrates. In January, the company announced that the mining operation would be closed by 1987, affecting 900 jobs. Raw material will be purchased to supply feed to the chemical complex.

Refractories.—C-E Minerals operated a fused silica and fused magnesium plant in Greeneville. Fused silica was used in the manufacture of silica nozzles and shrouds in continuous casting and in the manufacture of coke oven door liners, glass tank block, crucibles, special shapes, and foam block. Fused magnesium oxide was used in basic brick and ramming mixes and in steel melting furnaces.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend. The estimated production of construction sand and gravel increased 896,000 short tons, and the value increased approximately $2.2 million over the 1984 value.

Industrial.—Production and value of industrial sand fell 81,000 short tons and $747,000, respectively.

Silica (Fused).—Tennessee Electrominerals, a wholly owned subsidiary of C-E Minerals, produced fused silica at a plant in Greeneville. Revolving electric arc furnaces fused high-purity sands into 1- to 2-short-ton oval ingots. The ingots were cleaned, crushed, and processed into several grain and powder sizes for the refractory, foundry, filler, and extender markets.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—The production and value of crushed limestone increased 1.7 million short tons and $17.8 million, respectively, over the estimated figures for 1984.

Table 7.—Tennessee: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	42	160
Riprap and jetty stone	533	2,035
Filter stone	444	1,728
Other coarse aggregate	68	168
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,719	15,767
Bituminous aggregate, coarse	4,206	18,291
Bituminous surface-treatment aggregate	520	2,290
Railroad ballast	106	496
Other graded coarse aggregate	29	110
Fine aggregate (-3/8 inch):		
Stone sand, concrete	1,057	5,952
Screening, undesignated	1,394	5,307
Combined coarse and fine aggregates:		
Graded road base or subbase	12,137	55,744
Unpaved road surfacing	1,249	4,150
Terrazzo and exposed aggregate	22	198
Crusher run or fill or waste	2,558	8,833
Other construction[2]	1,493	5,955
Other coarse and fine aggregate	270	613
Agricultural:		
Agricultural limestone	627	2,397
Poultry grit and mineral food	5	31
Other agricultural	101	449
Special:		
Mine dusting or acid water treatment	8	56
Asphalt fillers or extenders	108	446
Other fillers or extenders	451	4,514
Other miscellaneous[3]	702	2,584
Other unspecified[4]	6,088	17,484
Total[5]	37,939	155,760

[1]Includes dolomite, granite, limestone, marble, sandstone, and excludes a minor amount of granite withheld to avoid disclosing company proprietary data.
[2]Includes stone sand (bituminous mix or seal), and stone used for other construction and maintenance uses.
[3]Includes stone used for cement manufacture and lightweight aggregate (slate).
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Dimension.—Output of dimension stone decreased 2,000 short tons and $324,000, respectively, below the output and value estimated for 1984.

Vermiculite (Exfoliated).—W. R. Grace & Co. shipped crude vermiculite from its operation in South Carolina to its construction products division in Nashville. The crude material was exfoliated and used primarily by the insulation market.

METALS

In general, 1985 was not a prosperous time for the State's mineral industry. The year was marked by falling metal prices and foreign metal imports, domestic production curtailments, rumored plant closings, labor problems, temporary mine closings, and the announcement of a permanent mine closing affecting almost 2,000 jobs. The value of zinc and byproduct concentrates from pyrite treatment, the only metal values canvassed by the U.S. Bureau of Mines, fell $32 million from the value reported in 1984.

Aluminum.—Tennessee's two aluminum companies, Alcoa with a smelter at Alcoa in east Tennessee and Consolidated Aluminum Corp. with a smelter at New Johnsonville on the Tennessee River in the central part of the State, represent 7% of the Nation's ingot-producing capacity. Both smelters operated at reduced rates during the year since foreign imports and low aluminum prices had consumers wary about maintaining high inventory levels. At yearend, Alcoa reportedly was operating its 220,000-short-ton-per-year smelter at 75% of rated capacity, while the 144,000-short-ton-per-year Consolidated facility was operating at 12% of capacity.

Despite the weak market, Alcoa continued work on a $250 million expansion of its rolling mill at Alcoa. The expansion will improve the production of flat sheet used primarily in beverage cans. Can stock comprised over one-fifth of U.S. shipments in 1985; imports, primarily from Australia, Canada, and Japan, captured almost 10% of the domestic market. In July, the company reduced the thickness of beverage can sheet aluminum to 0.0002 inch, a 33% reduction,

which enhances Alcoa sheet and will save the can manufacturers money.

In March, a Consolidated Aluminum official noted that the New Johnsonville smelter would close unless the market improved drastically, and the official indicated the future of the facility depended on future primary aluminum prices and TVA power rates. In May, the company reorganized its operations into two groups, separating the basic aluminum business from "high profit, value-added" diversified operations. The reorganization, in line with changes within the domestic industry, allows the company to concentrate on value-added and finished goods to counter softening ingot and basic mill product prices.

Copper.—Tennessee Chemical continued as the only primary copper producer in the Southwestern United States. The company operated an underground and surface mine, mill, smelter, and chemical manufacturing complex in the Ducktown-Copperhill area of southeastern Tennessee.

Table 8.—Tennessee: Mine production (recoverable) of copper, lead, silver, and zinc

		1983	1984	1985
Mines producing: Lode		9	8	9
Ore sold or treated:				
Copper-zinc	thousand metric tons	1,822	W	W
Zinc	do.	4,019	W	W
Total	do.	[1]5,842	6,071	5,374
Production:				
Quantity:				
Copper	metric tons	W	W	W
Lead	do.	--	W	W
Silver	troy ounces	W	W	W
Zinc	metric tons	109,958	116,526	104,471
Value:				
Copper	thousands	W	W	W
Lead	do.	--	W	W
Silver	do.	W	W	W
Zinc	do.	$100,336	$124,854	$92,971

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

In January, Tennessee Chemical announced that the mining operation would be phased out by 1987, and the company would focus entirely on chemical and acid production; raw materials will be purchased to supply the manufacturing complex. The mine closing would affect 800 employees and decrease the annual payroll from about $40 million to $13 million. A TVA study released in October on Tennessee Chemical's closing found that an additional 1,100 jobs would be lost in the immediate area, jobs dependent on the company's payroll. The additional job losses would result in a further $22 million reduction to the area's economy.

During 1985, Tennessee Chemical continued to operate the Cherokee surface and underground mines. Ore was transported by rail to the London mill where a bulk copper-iron-zinc concentrate was produced by flotation. A concentrate separation was then made with the copper and iron converted into a variety of industrial chemicals; the zinc concentrate was sold without further processing. Approximately 30% of Tennessee Chemical's sales consisted of copper and copper chemicals, 10% was miscellaneous organics, and the remainder was sulfuric acid and liquid sulfur dioxide.

Ferroalloys.—The State ranked third nationally in ferroalloy output. Four companies produced a variety of ferrophosphorus, ferrosilicon, and specialty silicon alloys.

Table 9.—Tennessee: Ferroalloy producers, 1985

Company	Plant location	Alloy
International Minerals & Chemical Corp	Kimball	Ferrosilicon and specialty silicon alloys.
Monsanto Co	Columbia	Ferrophosphorus.
Occidental Petroleum Corp	do.	Do.
Stauffer Chemical Co	Mount Pleasant	Do.

The Chromium Mining & Smelting Corp., unable to find a buyer for the mothballed ferrochrome plant at Woodstock, began work on dismantling the facility. Monsanto announced that it would terminate mining and ferrophosphorus production at its Columbia facility.

Germanium.—Germanium residues from zinc smelting at Jersey Minière Zinc Co.'s smelter at Clarksville were shipped to Métallurgie Hoboken-Overpelt SA, Belgium, for refining. Most of the residues were obtained from concentrates from the Elmwood and Gordonsville Mines in central Tennessee.

Iron and Steel.—Wheland Foundry, a division of North American Royalties Inc., began expansion work on its Chattanooga foundry. The $6.5 million project, scheduled for completion by April 1986, included expansion of the melting and molding facilities and construction of a new cleaning and inspection plant. The expansion will increase the output of general purpose and automobile castings of ductile iron.

Pomini Farrel S.p.A., Milan, Italy, and Aetna Standard Engineering Co. of Ellwood City, PA, are installing a complete rolling mill for bar, rod, and structurals at the plant of Knoxville Iron Co., Knoxville, a subsidiary of Goldfields American Industries Inc. The $15 million expansion, which will include the installation of a 50-short-ton electric furnace, was scheduled for completion in 1986.

In October 1984, Knoxville Iron began operating its No. 2 furnace using Great Lakes Carbon Corp. (GLC) composite water-cooled electrode, which, under a GLC trademark, was known as the Permtrode System. Continuous operation of the system in Knoxville Iron's 35-ton electric furnace reduced electrode wear by 20% to 25% while maintaining or improving furnace productivity.

Lead.—The State's secondary lead industry comprised General Smelting & Refinery Co., College Grove; Refined Metals Corp., Memphis; and Ross Metals Inc., Rossville. The three companies recovered lead from scrap materials, primarily automobile batteries.

Manganese.—Foote, New Johnsonville, continued to market manganese metal produced in the Republic of South Africa. Foote terminated manganese metal production at the New Johnsonville facility in 1983. During the fourth quarter, Foote completed the conversion of one electrolytic manganese metal cell room to produce electrolytic manganese dioxide used in primary alkaline batteries. As a result of the $16.9 million conversion, the facility has a capacity of 10,000 short tons per year.

Tennessee Eastman Co. continued work on modification to the Kingsport plant that will result in the termination of byproduct manganese sulfate. This will have a significant impact on the supply of fertilizer-grade manganese, since approximately 80% of the plant's manganese sales are to the fertilizer industry to supply a micronutrient for neutral or alkaline soils.

Nickel.—Martin Marietta Energy System Inc., Oak Ridge, and Cummings Engine Co. Inc. signed a license agreement for commercial application of nickel and nickel-iron aluminide alloys developed by Oak Ridge National Laboratory. Cummings plans further research on the alloys for use in high-temperature components in diesel engines. The nickel and nickel-iron aluminide alloys become stronger at elevated temperatures (up to 800° C), are ductile with the addition of trace elements, and can withstand temperatures to 1,000° C. Projected alloy applications included high-performance jet engines, gas turbines, heat exchangers in nuclear and coal-fired steam plants, and in advanced heat engines.

A second nickel alloying operation, Activated Metals and Chemicals Inc., produced nickel alloys and metal catalysts at a plant in Sevierville.

Platinum.—National Refining Corp.'s Platinum Group Metals Div. operated a precious metals scrap refinery at Gallatin. The division specialized in precious metals recovery services for the chemical, petrochemical, petroleum, and pharmaceutical industries.

Rare Earths and Thorium.—Davison Chemical Div., a subsidiary of W. R. Grace, operated a rare-earth and thorium plant in Chattanooga. Monazite from Australia and Malaysia was imported for plant feed. The principal product was a rare-earth chloride used in the manufacture of fluid cracking catalysts. Other products from the facility and their uses were as follows:

Product	Uses
Rare-earth fluorides and oxides.	Carbon arc industry and metallurgical alloys.
Rare-earth chloride	Textile paint industries.
Cerium compounds	Specialty glass.
Cerium oxides	Glass and plastic lens polishing media.

Silver.—P. A. Industries Inc. of Chattanooga introduced a new range of aluminum-, copper-, silver-, and zinc-coated glass spheres in the 10- to 300-micrometer size. Silver-coated spheres were designed for use in electromagnetic interference shielding applications; copper-coated spheres were used in flooring media to overcome static problems such as those experienced in computer rooms; and aluminum and zinc spheres were used for surface coating applications.

Uranium.—Flexible manufacturing cells for nuclear weapons component fabrication began operating in the early part of the year at the Martin Marietta Energy plant at Oak Ridge. The cells were installed at a cost of between $4 million and $5 million and will be used to machine uranium forged billets into rounded parts.

Inventory checks at the U.S. Department of Energy's Gaseous Diffusion Plant at Oak Ridge revealed a 70-pound uranium deficit. The discrepancy was believed to be due to the method of calculating the amount of uranium produced rather than theft. The plant was scheduled for closure in a cost-cutting move.

Zinc.—Tennessee continued as the Nation's leading State in zinc production despite a drop in production of 12,000 metric tons. Four companies operated eight mines in eastern (six mines) and central (two mines) Tennessee. One company operated a 90,000-short-ton-per-year electrolytic zinc refinery in Clarksville, northwest of Nashville.

Table 10.—Tennessee: Tenor of zinc ore milled and concentrates produced

		1984	1985
Total material	metric tons	6,071,125	5,373,817
Metal content of ore:[1] Zinc	percent	2.02	2.02
Concentrates produced and average content:			
Zinc concentrate	metric tons	193,970	172,027
Average zinc content	percent	63.27	63.25

[1]Figures represent metal content of crude ore only as contained in the concentrate.

Table 11.—Tennessee: Zinc industry, 1985

Company	Mine	Mill
ASARCO Incorporated	Coy	Mascot.
Do	Immel	Do.
Do	New Market	New Market.
Do	Young	Mascot.
Inspiration Resources Corp	Beaver Creek	Jefferson City.
Jersey Minière Zinc Co	Elmwood	Elmwood.
Do	Gordonsville	Do.
United States Steel Corp	Jefferson City	Jefferson City.

All mining was by underground methods; the mills used flotation to recover a concentrate, which was moved by truck or truck and barge to the smelter.

During 1985, the zinc industry was faced with dual problems of major concern—severely depressed zinc prices and union contract expiration. Depressed zinc prices forced the closing of one mine, and five were closed during part of the year because of strikes.

Table 12.—Tennessee: Zinc industry closings, 1985

Company	Mine	Employees affected	Closed	Reopened	Remarks
ASARCO Incorporated	Immel, Coy, Young	312	Apr. 1985	Oct. 1985	Strike.
Do	New Market	125	May 1985	Sept. 1985	Do.
Inspiration Resources Corp	Beaver Creek	100	Dec. 1984	Feb. 1985	Do.
Do	do	120	Dec. 1985		Low zinc prices.
United States Steel Corp	Jefferson City	NA	May 1985.[1]	May 1985[1]	Fire.

NA Not available.
[1]Equipment fire closed mine for 1 day.

The Inspiration Resources Corp. strike ended with employees accepting a $1.50 per hour paycut and relinquishing one holiday. The company agreed to a $0.07 per hour wage increase for every cent that zinc prices rose above $0.52 per pound. ASARCO Incorporated employees at the New Market Mine approved a 3-1/2-year contract, which canceled, for 1 year, the cost-of-living raise, increased the deductible on insurance, and provided for "coding" in the mill. Employees at the Coy, Immel, and Young Mines approved a 3-year contract, which also suspended the cost-of-living increase for 1 year and did not allow for a wage increase.

During the second quarter, Asarco closed its 104,000-ton-per-year zinc refinery in Corpus Christi, TX. Asarco signed an agreement with Jersey Minière to supply Jersey Minière's Clarksville refinery with 3,000 tons of zinc concentrate per month. Asarco will receive 1,350 tons per month of refined zinc in return. The toll agreement allowed the refinery, which was operating at 75% capacity, to operate at full capacity.

[1]State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.
[2]Geologist, Tennessee Division of Geology, Knoxville, TN.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum smelters:			
Aluminum Co. of America	Box 158 Alcoa, TN 37701	Plant	Blount.
Consolidated Aluminum Corp	1102 Richmond St. Jackson, TN 38301	do	Humphreys.
Barite:			
A. J. Smith Co	Route 3 Sweetwater, TN 37874	Open pit mine	Loudon.
Cement:			
Dixie Cement Co. Inc.[1 2], a subsidiary of Moore McCormack Cement Inc.	Box 14009 Knoxville, TN 37914	Plant	Knox.
Signal Mountain Cement Co	1300 American National Bank Bldg. Chattanooga, TN 37402	do	Hamilton.
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.
Lowe's 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 1301 Rockwood, TN 37643	Plant	Roane.
Union Carbide Corp	Box 513 Columbia, TN 38401	do	Maury.
Lime:			
Bowater Southern Paper Corp	Calhoun, TN 37309	do	McMinn.
Tenn-Luttrell Lime Co	Box 69 Luttrell, TN 37779	do	Union.
Perlite (expanded):			
Chemrock Corp	Osage St. Nashville, TN 37208	do	Davidson.
Phosphate rock:			
Monsanto Co.[4]	Columbia, TN 38401	do	Do.
Occidental Chemical Corp.[4]	Box 591 Columbia, TN 38401	do	Do.
Stauffer Chemical Co.[4]	Box 89 Mount Pleasant, TN 38474	do	Do.
Sand and gravel (1982):			
Dixie Sand & Gravel Co	515 River St. Chattanooga, TN 37402	Pits	Hamilton.
Memphis Stone & Gravel Co	Box 1683 Memphis, TN 38101	do	Benton, Dyer, Shelby.

See footnotes at end of table.

Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel (1982) —Continued			
Rogers Group Inc.[2]	Box 25250 Nashville, TN 37202	Pits	Tipton.
Standard Construction Co. Inc	Box 38289 Germantown, TN 38138	Pit	Shelby.
Stone:			
Limestone:			
American Limestone Co	Box 2389 Knoxville, TN 37901	Quarries	Jefferson, Knox, Sullivan.
Hoover Inc	Box 17346 Nashville, TN 37217	do	Bedford, Hamilton, Rutherford, Warren.
Vulcan Materials Co	Box 7 Knoxville, TN 37901	do	Do.
Marble:			
John J. Craig Co	Box 9300 Knoxville, TN 37920	Quarry	Blount.
Imperial Black Marble Corp	8013 Chesterfield Dr. Knoxville, TN 37919	do	Grainger.
Sandstone:			
Ross L. Brown Cut Stone Co. Inc.	Box 398 Crab Orchard, TN 37723	do	Cumberland.
Crab Orchard Stone Co. Inc	Drawer J Crossville, TN 38555	do	Do.
Crossville Limestone Co. Inc	Box 485 Crossville, TN 38555	do	Do.
Mountain Stone Co	Box 246 Jamestown, TN 38556	do	Fentress.
Vermiculite (exfoliated):			
W. R. Grace & Co	4061 Powell Ave. Nashville, TN 37204	Plant	Davidson.
Zinc:			
ASARCO Incorporated[2]	Mascot, TN 37806	Underground mines and plant.	Jefferson and Knox.
Inspiration Resources Corp	Box 32 Jefferson City, TN 37760	Underground mine and plant.	Jefferson.
Jersey Minière Zinc Co	Elmwood, TN 38560	Underground mines, plant, smelter.	Smith.
United States Steel Corp.[2]	Jefferson City, TN 37760	Underground mine	Jefferson.

[1]Also clays.
[2]Also stone.
[3]Also pyrites, silver, and zinc.
[4]Also ferroalloys.

The Mineral Industry of Texas

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Bureau of Economic Geology, The University of Texas at Austin, for collecting information on all nonfuel minerals.

By Jane P. Ohl[1] and Mary W. McBride[2]

Total value of nonfuel minerals produced in Texas in 1985 was $1.7 billion, an insignificant increase over that of 1984; the State again ranked second in the Nation.

In 1985, 19 nonfuel minerals were produced in the State, 18 industrial minerals and 1 metal. Texas again was the Nation's leading producer of native asphalt, portland cement, both calcined and crude gypsum, magnesium chloride for metal, crushed stone, and Frasch and recovered elemental sulfur. Texas ranked second in output of clays, crude and Grade-A helium, salt, construction sand and gravel, and talc.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	291	$24,409	263	$22,114
Portland do.	10,423	557,421	10,242	532,494
Clays do.	r [2]3,517	r [2]17,091	4,107	28,059
Gem stones	NA	175	NA	175
Gypsum thousand short tons	2,166	19,431	1,981	17,299
Lime do.	1,157	61,214	1,192	65,927
Salt do.	8,184	69,672	8,390	80,434
Sand and gravel:				
Construction do.	62,389	199,461	e57,800	e198,000
Industrial do.	2,028	29,282	1,968	29,095
Stone:				
Crushed do.	e89,200	e300,000	85,764	306,821
Dimension do.	e47	e11,236	37	11,760
Sulfur (Frasch) thousand metric tons	2,994	W	2,979	W
Talc and soapstone thousand short tons	r240	r4,125	261	5,245
Combined value of asphalt (native), clays (fuller's earth and kaolin, 1984), fluorspar, helium (crude and Grade-A), iron ore, magnesium chloride, magnesium compounds, mica (scrap), sodium sulfate, and values indicated by symbol W	XX	r419,861	XX	435,936
Total	XX	r1,713,378	XX	1,733,359

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

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

[2]Excludes fuller's earth and kaolin; value included with "Combined value" figure.

Table 2.—Nonfuel minerals produced in Texas in 1984, by county[1]

County	Minerals produced in order of value
Atascosa	Sand and gravel.
Bastrop	Sand and gravel, clays.
Bell	Sand and gravel.
Bexar	Cement, sand and gravel, lime, clays.
Borden	Sand and gravel.
Bosque	Lime.
Bowie	Sand and gravel.
Brazoria	Magnesium chloride, magnesium compounds, salt, sand and gravel.
Brazos	Sand and gravel.
Brewster	Fluorspar.
Burleson	Sand and gravel.
Burnet	Sand and gravel, lime.
Calhoun	Lime.
Callahan	Do.
Cass	Iron ore.
Chambers	Salt, sand and gravel.
Cherokee	Iron ore, clays.
Coke	Sand and gravel.
Coleman	Clays.
Colorado	Sand and gravel.
Comal	Cement, lime.
Comanche	Clays.
Cooke	Sand and gravel.
Coryell	Do.
Crane	Do.
Crosby	Do.
Culberson	Sulfur, talc, mica, sand and gravel.
Dallas	Cement, sand and gravel, clays.
Deaf Smith	Lime.
Denton	Sand and gravel, clays.
Donley	Sand and gravel.
Duval	Sand and gravel, salt.
Eastland	Clays, sand and gravel.
Ector	Cement, salt.
Ellis	Cement, sand and gravel, clays.
El Paso	Cement, sand and gravel.
Fannin	Sand and gravel.
Fayette	Sand and gravel, clays.
Fisher	Clays.
Fort Bend	Salt, sand and gravel, clays.
Freestone	Sand and gravel.
Gaines	Sodium sulfate.
Galveston	Sand and gravel.
Gillespie	Gypsum, sand and gravel.
Gonzales	Clays.
Gregg	Sand and gravel.
Guadalupe	Clays, sand and gravel.
Hale	Sand and gravel.
Hall	Do.
Hardeman	Gypsum.
Hardin	Sand and gravel.
Harris	Cement, salt, sand and gravel, clays.
Harrison	Clays.
Hays	Cement, sand and gravel.
Henderson	Sand and gravel, clays.
Hidalgo	Sand and gravel.
Hill	Lime.
Hood	Sand and gravel.
Hudspeth	Talc, gypsum.
Hutchinson	Sand and gravel.
Jefferson	Salt, sand and gravel.
Johnson	Lime, sand and gravel.
Jones	Sand and gravel.
Kerr	Do.
Kimble	Gypsum, sand and gravel.
Lampasas	Sand and gravel.
Liberty	Sand and gravel, sulfur.
Limestone	Clays, sand and gravel.
Live Oak	Sand and gravel.
Lubbock	Do.
McCulloch	Do.
McLennan	Cement, sand and gravel, clays.
Matagorda	Salt.
Maverick	Sand and gravel.
Medina	Sand and gravel, clays.
Midland	Sand and gravel.
Milam	Do.
Montgomery	Do.
Motley	Do.
Nacogdoches	Clays.
Navarro	Clays, sand and gravel.
Newton	Sand and gravel.

See footnotes at end of table.

Table 2.—Nonfuel minerals produced in Texas in 1984, by county[1] —Continued

County	Minerals produced in order of value
Nolan	Cement, gypsum, sand and gravel, clays.
Nueces	Cement, sand and gravel.
Oldham	Sand and gravel.
Orange	Cement, sand and gravel.
Palo Pinto	Sand and gravel, clays.
Parker	Do.
Pecos	Sulfur, sand and gravel.
Potter	Cement, sand and gravel, clays.
Reeves	Sand and gravel.
Robertson	Do.
Runnels	Do.
Rusk	Clays.
Smith	Sand and gravel, clays.
Somervell	Sand and gravel.
Starr	Do.
Stonewall	Gypsum.
Tarrant	Cement, sand and gravel.
Taylor	Sand and gravel.
Terry	Sodium sulfate.
Throckmorton	Sand and gravel.
Travis	Lime, sand and gravel.
Uvalde	Sand and gravel.
Val Verde	Do.
Van Zandt	Salt, clays.
Victoria	Sand and gravel.
Walker	Clays.
Waller	Sand and gravel.
Ward	Do.
Webb	Do.
Wharton	Sulfur.
Wise	Sand and gravel, clays.
Wood	Do.
Yoakum	Salt.
Young	Sand and gravel.
Undistributed[2]	Stone (crushed and dimension), helium, asphalt (native), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Texas business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	15,816	16,083	16,370
Total civilian labor force	do.	7,637	7,913	8,053
Unemployment	percent	8.0	5.9	7.0
Employment (nonagricultural):				
Mining total[1]	thousands	262.9	269.1	259.9
Nonmetallic minerals except fuels[2]	do.	7.8	7.3	6.4
Oil and gas extraction	do.	253.2	259.9	251.5
Manufacturing total	do.	963.7	1,004.3	1,004.6
Primary metal industries	do.	33.8	35.8	33.7
Stone, clay, and glass products	do.	45.8	49.3	49.4
Chemicals and allied products	do.	77.5	77.6	78.0
Petroleum and coal products	do.	43.3	43.0	41.0
Construction	do.	424.0	446.3	447.8
Transportation and public utilities	do.	366.2	374.0	383.3
Wholesale and retail trade	do.	1,554.0	1,640.8	1,703.7
Finance, insurance, real estate	do.	394.1	419.8	442.4
Services	do.	1,186.3	1,274.6	1,345.0
Government and government enterprises	do.	1,042.0	1,063.5	1,094.7
Total[3]	do.	6,193.6	6,492.4	6,681.3
Personal income:				
Total	millions	$189,067	$205,834	$220,715
Per capita		$11,954	$12,798	$13,483
Hours and earnings:				
Total average weekly hours, production workers		40.9	41.7	41.2
Mining		45.9	46.5	43.8
Total average hourly earnings, production workers		$8.9	$9.0	$9.4
Mining		$10.3	$10.3	$11.0

See footnotes at end of table.

Table 3.—Indicators of Texas business activity —Continued

		1983[r]	1984	1985[p]
Earnings by industry:				
Farm income	millions	$2,590	$2,319	$2,848
Nonfarm	do	$144,108	$157,507	$168,830
Mining total	do	$9,635	$10,117	$10,023
Metal mining	do	$30	$19	$17
Nonmetallic minerals except fuels	do	$203	$201	$197
Coal mining	do	$44	$60	$66
Oil and gas extraction	do	$9,358	$9,838	$9,744
Manufacturing total	do	$24,538	$26,348	$27,808
Primary metal industries	do	$1,000	$1,090	$1,032
Stone, clay, and glass products	do	$1,039	$1,153	$1,207
Chemicals and allied products	do	$2,838	$2,873	$3,043
Petroleum and coal products	do	$2,148	$2,089	$1,988
Construction	do	$12,092	$14,324	$14,628
Transportation and public utilities	do	$11,017	$11,839	$12,641
Wholesale and retail trade	do	$26,635	$28,785	$30,614
Finance, insurance, real estate	do	$9,399	$10,640	$11,956
Services	do	$27,707	$31,612	$34,856
Government and government enterprises	do	$21,326	$23,088	$25,476
Construction activity:				
Number of private and public residential units authorized[4]		276,684	195,509	143,114
Value of nonresidential construction[4]	millions	$6,325.4	$7,816.8	$7,419.6
Value of State road contract awards	do	$867.1	$974.0	$1,340.0
Shipments of portland and masonry cement to and within the State	thousand short tons	10,359	11,355	11,179
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,508.5	$1,713.4	$1,733.4
Value per capita		$95	$107	$106

[p]Preliminary. [r]Revised.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

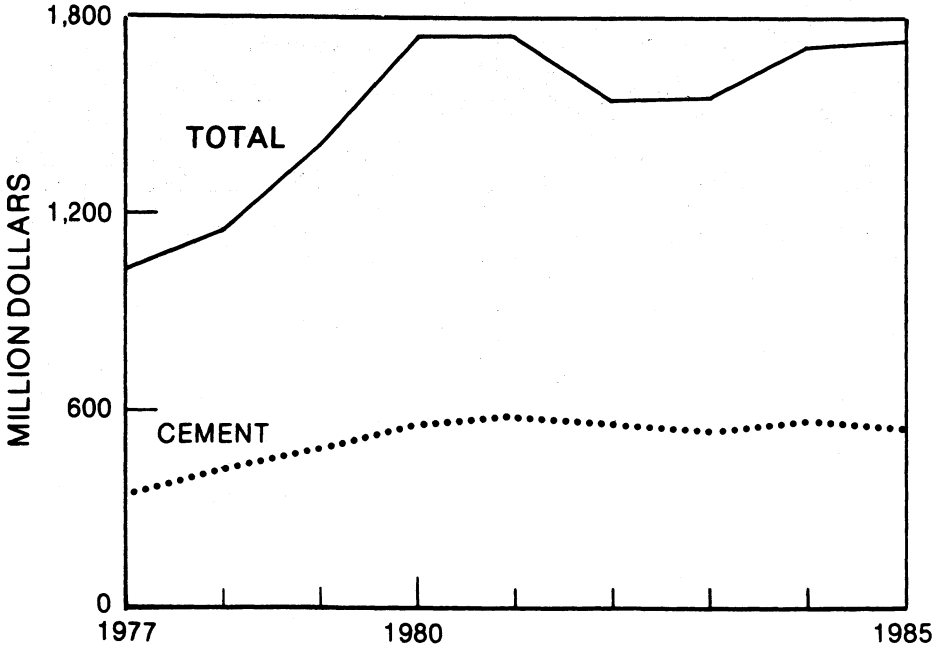

Figure 1.—Value of cement and total value of nonfuel mineral production in Texas.

Trends and Developments.—For most of 1985, the value of the gross State product was stagnant. Activity in the construction and manufacturing sectors, both of which utilized mined industrial minerals, slowed, in contrast to nonmanufacturing, which showed increased activity and higher levels of employment.

The Bureau of Business Research at The University of Texas at Austin estimated that about 20% of the gross State product was produced by oil and gas extraction, refining, petrochemicals, oilfield machinery, and other drilling-related manufacturing. Five years earlier, this proportion peaked at 27%.

The percentage of taxes raised from Texas oil and gas production continued to fall, matching the declines in oil prices. Erosion of the tax base led to cuts in the Texas State budget. Oil-related industries, such as drilling-mud suppliers, steel drill-pipe manufacturers, and cement firms, also suffered.

In 1985, the cement industry paid $5.8 million in State cement taxes, compared with $6.3 million in fiscal year 1984, reflecting a slight decline in cement production, according to the Texas Comptroller of Public Accounts (Fiscal Notes, Issue 86:1, January 1986).

Employment.—Employment in mining fell from 269,100 (revised) in 1984 to 259,900 in 1985. The State unemployment rate increased from 5.9% in 1984 to 7.0% in 1985. For most of 1985, the State's unemployment rate moved from being noticeably lower than the national rate to nearly identical with it.

Environment.—ASARCO Incorporated installed state-of-the-art stack and fugitive lead emission control equipment at its El Paso lead and copper smelter. Calculations indicated, however, that when operating at peak capacity the Asarco plant still could not meet the lead emissions standard. The Environmental Protection Agency considered giving the Texas Air Control Board a 2-year extension to August 13, 1989, to meet the Federal standards.

Exploration Activities.—A 2-year project, jointly funded by the U.S. Bureau of Mines and the Texas General Land Office, was under way at the Texas Bureau of Economic Geology to assess the nonfuel mineral resource potential of State-owned lands in far west (Trans-Pecos) Texas. Although evaluations were to focus on known native sulfur, talc, and silver districts, other commodities also were to be studied.

Exploration for beryllium in Hudspeth County continued, and evaluation of prospects was nearly complete at yearend.

Legislation and Government Programs.—In April 1985, the U.S. Bureau of Land Management began the Texas Acquired Minerals Project to inventory Federal mineral interests in the State. One purpose of the project was to locate heretofore unplatted Federal mineral interests. Another purpose was to assist in developing new plats and historical indexes for each county containing Federal interest.[3]

Texas received $966,956,000 from the Federal Highway Administration under Interstate Cost Estimate legislation for aid to highway programs.[4] Large quantities of industrial minerals, such as sand and gravel and cement, will be required for this construction.

The Texas Supreme Court ruled in June that the State did not own the surface mineral rights to 817 acres the State sold in 1907 under the Texas Land Sales Act. The Texas Minerals Act (different from the Land Sales Act), which reserves to the State all minerals on any State lands sold by the State, unless expressly conveyed, was in effect at the time of the sale.

The Supreme Court's ruling pertained only to coal and lignite deposits, but State Land Office officials were concerned that a broad interpretation of the ruling might jeopardize revenues from the mineral rights on lands containing such minerals as gypsum, limestone, metallics, and talc, possibly causing the State major revenue losses. A rehearing requested by the Texas Land Commissioner was pending at yearend.

On June 14, 1985, the Governor signed Senate bill 699 that regulates certain iron ore and iron ore gravel mining and reclamation activities. His action amended Section 4: Texas Surface Coal Mining and Reclamation Act (Article 5920-11, Vernon's Texas Civil Statutes).

The Texas Bureau of Economic Geology completed new facilities at The University of Texas (Austin) Balcones Research Center. This complex included a research and administration building, a well sample and core repository and research center, and a mineral studies laboratory.

The U.S. Bureau of Mines supported mineral and mining engineering research done under the Mineral Institute program at The University of Texas, which issued reports on the tectonic development of the Trans-Pecos area and on the origin of silver-copper-lead deposits in the area.[5]

Additionally, the Texas Bureau of Economic Geology issued an updated computer printout of Texas mineral producers (exclusive of oil and gas).[6]

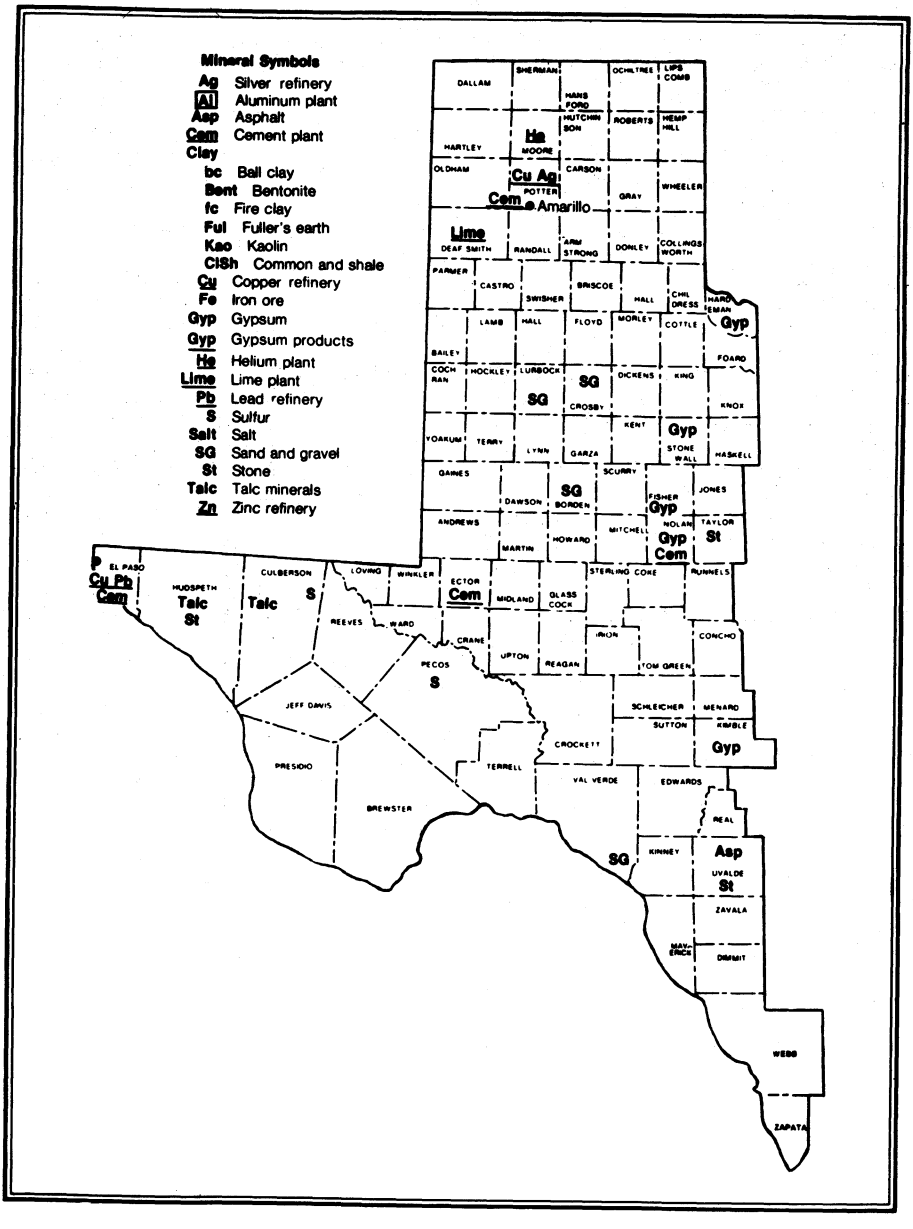

Figure 2.—Principal mineral producing localities in Texas.

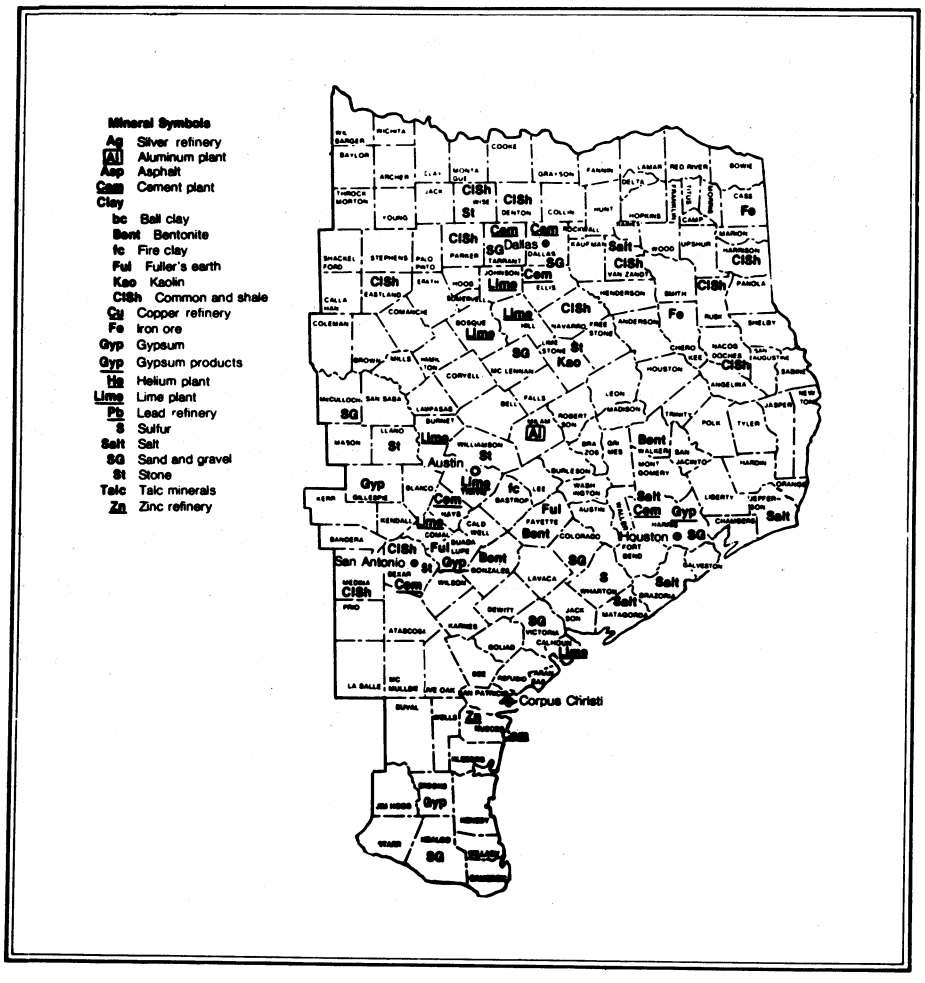

Figure 2.—Principal mineral producing localities in Texas—Continued.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Ammonia (Anhydrous) and Urea.—On May 1, 1985, Cominco Ltd., a Canadian firm, realigned itself into Cominco Chemicals & Fertilizers Div. and Cominco Metal Div. Cominco Chemicals & Fertilizers produced anhydrous ammonia and urea at its nitrogen fertilizer plant at Borger, Hutchinson County. Ammonia production was 343,100 short tons, compared with 360,000 tons in 1984; the reduction was due mainly to a 3-week shutdown for repairs to a draft fan. Urea production was 77,800 tons, compared with 51,700 tons in 1984. Nitrogen products at Borger amounted to 314,100 tons, down from 319,000 tons in 1984. At yearend, 75 employees were on the payroll, compared with 81 at yearend 1984, according to Cominco's 1985 annual report.

Asphalt (Native).—Texas was the larger of two native asphalt producing States. Native asphalt, or bituminous limestone, used primarily as a paving material for street and road repair, was produced by R. L. White Co. at its Dabney Quarry in Uvalde County.

Barite.—Milchem Inc., a subsidiary of Baker International Corp., and Eisenman Chemical Co., a subsidiary of Newpark Resources Inc., formed a partnership—Milpark—to run their merged barite mining and grinding facilities. Eisenman's Corpus Christi mill and Milchem's plant in Galveston were operational. No barite was mined in Texas.

Cement.—The Texas cement industry continued to be the largest in the Nation. A summary of the cement industry's history, 1880-1984, stated that the industry employed about 19,000 persons in 1984 and paid $5.8 million in State taxes in fiscal year 1985, down from $6.3 million in 1984, primarily because of recent sluggishness in the Texas building industry.[7]

Eighteen portland cement plants produced 10.1 million short tons of cement. Plants in the northern half of Texas used 93% of capacity; plants in the southern half, 72.4%. Total tonnage declined less than 2% from that of 1984.

Clinker production was 7.6 million tons. Five wet-process and four dry-process plants in northern Texas used 90.1% of clinker capacity; one wet-process plant, four dry-process plants, and one plant using both processes in southern Texas used 76.5% of capacity.

Masonry cement was produced at seven plants in northern Texas, amounting to 199,000 tons, and at five plants in southern Texas, amounting to 64,000 tons. Total tonnage declined about 10% from that of 1984.

The average price of portland cement shipped from northern Texas was $57.75 per ton, down from $59.78 in 1984; from southern Texas, $45.97, down from $47.61. Masonry cement shipped from northern Texas rose $1.68 to $85.37 per ton; however, masonry cement shipped from southern Texas followed the downward trend in value, averaging $81.18 per ton, compared with $84.30 in 1984.

Ready-mixed concrete companies used 51.3% (in northern Texas) and 65.5% (southern Texas) of the finished portland cement produced, followed, in decreasing order of amount used, by miscellaneous contractors, concrete product manufacturers, highway contractors, building material dealers, miscellaneous customers, and government agencies.

Cement and clinker imports, notably from Mexico and Spain, continued to increase at the Texas gulf coast ports of Galveston, Houston, and Port Arthur. Almost 900,000 tons came into these ports in 1985, compared with approximately 300,000 tons in 1983. The total Texas finished cement production was 10.76 million tons in 1985 and 10.04 million tons in 1983. By yearend, none of the Texas gulf coast plants was producing clinker.

Alamo Cement Co. closed down its Cementville plant in midtown San Antonio and put the land up for sale. The firm added new finish mills at its 1604 plant, north of the city, and had 80 employees on the payroll at yearend.

Construction of the new Box-Crow Cement Co. plant at Midlothian, southwest of the Dallas metroplex, continued throughout 1985. Construction included a precalciner kiln system that had a 930,000-ton clinker capacity. Projected finished grinding capacity was 1.5 million tons. The new kiln and milling installation was to be completed in late 1986 or early 1987.[8]

Box-Crow, the third cement plant in Ellis County, joins the Texas Industries Inc. Midlothian plant in the million-plus-ton-per-year category.

At Capitol Aggregates Inc.'s Capitol Cement Div. in San Antonio, another step in a

series of improvements and additions was completed when the No. 5 finish mill was started up in the second quarter of 1985. This plant had 850,000 tons per year of capacity.[9]

Centex Cement Corp. shut down its kilns and mills at Corpus Christi in July, laying off 59 people. Three finish mills continued to grind clinker from the Buda plant until early December; eight more employees were then laid off at the finish mill. The layoffs were blamed on inability to compete with foreign imports.

Centex planned to spend about $1 million to upgrade its cement lines and unloading system on Corpus Christi Bay. Railroad car loading was to be automated, and the dock area was to be dredged out to handle 13,000-ton ships.

Ideal Basic Industries Inc. operated two cement terminals in Texas, one north of Dallas at Lewisville, in Denton County, and the other at Houston. Both ground low-cost foreign clinker and imported foreign cement, according to the firm's 1985 annual report.

Lone Star Industries Inc. operated portland cement plants at Houston (550,000-ton annual rated capacity) and at Maryneal (545,000). Primary fuel at the dry-process Maryneal plant was coal.

Lone Star Industries continued to hold its cement manufacturing and distribution facilities in Texas when it sold off its aggregate quarries and ready-mixed concrete plants in southern Texas to Pioneer Concrete of Texas Inc. Lone Star Industries transferred its headquarters from Connecticut to Houston in August 1985.[10]

As the leading cement producer in the United States, Lone Star Industries became the leading importer of cement when it formed a partnership with Falcon Investments Inc. in late 1985. Falcon Investments was a subsidiary of Redec Inc. of Delaware.

The newly formed joint venture company was named Lone Star-Falcon, headquartered in Houston, according to Lone Star Industries 10K Annual Report to the Securities and Exchange Commission. Falcon Investments contributed its two Houston cement terminal facilities to the new partnership, including its recently constructed 60,000-ton deepwater terminal on the Houston Ship Channel.[11]

Southwestern Portland Cement Co. brought on-line a new 3,000-horsepower finish mill system at its Odessa plant in May 1985. The system incorporated an air separator, a two-compartment ball mill, and dust collectors.

The firm also mothballed its "small, high cost" El Paso plant and was using the facility as a grinding operation and distribution terminal for purchased Mexican clinker and cement.[12]

By yearend 1985, Texas Industries Inc. (TXI), Dallas, had finished 90% of its modernization program of the clinker handling and storage systems at its 1.2-million-ton Midlothian plant. To be completed by March 1, 1986, the project formed part of a total TXI program for modernizing clinker handling and storage at the facility.[13] The firm also improved its electrostatic precipitators.

Table 4.—Texas: Masonry cement salient statistics

(Short tons unless otherwise specified)

	1984	1985
Number of active plants	12	12
Production	291,746	262,705
Shipments from mills:		
Quantity	291,022	263,198
Value	$24,408,725	$22,113,992
Stocks at mills, Dec. 31	27,369	26,012

Table 5.—Texas: Portland cement salient statistics

(Short tons unless otherwise specified)

	1984	1985
Number of active plants	18	18
Production	10,321,445	10,118,497
Shipments from mills:		
Quantity	10,423,083	10,242,074
Value	$557,421,275	$532,494,482
Stocks at mills, Dec. 31	609,643	588,782

Clays.—Clays sold or used in Texas increased in output and value over 1984 figures. Texas retained its position as the second ranking clay producer in the Nation. Nine of the State's 33 companies each produced more than 100,000 short tons of clay, accounting for 80% of total output and 55% of total value.

The 33 companies operated 75 pits in 33 of Texas' 254 counties: 64 pits produced common clay and shale; 1 each, fuller's earth or kaolin; 8, swelling or nonswelling bentonite; and 6, ball clay or fire clay.

With a 15% output increase over that of 1984, Texas held its place as the Nation's major producer of common clay and shale.

Texas ranked fourth of five States that produced ball clay. Output was 30,201 tons, 23% more than in 1984.

The State ranked sixth of 13 States that

produced bentonite. Output decreased 25% from that of 1984. Average value of bentonite increased from about $15 per ton in 1984 to $18 in 1985.

Fire clay and kaolin production fell approximately 13% and 2%, respectively, but fuller's earth output increased almost 66% over that of 1984.

A Brick Institute of Texas spokesperson stated that popular new architectural styles could prevent Texas brick manufacturers from experiencing an economic slowdown quite as much as other building product makers. The new styles usually include a great deal of brick and clay. Brick manufacturers, in particular, and the construction industry, in general, experienced a strong market in 1985.[14]

Texas clays had many uses, and values ranged widely but averaged $6.83 per ton.

Acme Brick Co., Fort Worth, planned to build a brick plant 20 miles west of Houston near Sealy on a 400-acre site in Austin County. The plant was to have an annual capacity of 65 million brick equivalents after completion of the first phase, in early 1986.

W. S. Dickey Clay Manufacturing Co.'s plant, Saspamco, at San Antonio, and the firm's distribution yards at Dallas, El Paso, Houston, and San Antonio continued to serve the State. Dickey's parent company was Hepworth Ceramic Holdings Ltd. of England.

A. P. Green Refractories Co., a subsidiary of USG Corp., continued work on the multimillion-dollar expansion of its Sulphur Springs, Hopkins County, plant in northeastern Texas. The expansion will enable the facility to produce high-alumina brick and specialty products for the growing Southwestern market.

TXI, with its shale quarry and 650,000-cubic-yard-per-year expanded lightweight aggregate plant at Streetman, Navarro County, was one of the leading producers of lightweight aggregate.[15] Nationwide, production of lightweight aggregate was 4.8 million cubic yards.

A clay brick tile factory in the St. Andrew area of Barbados, owned by Building Supplies Ltd., a U.S. firm, planned to introduce floor and roof tile lines at its recently purchased factory and sell 80% and 90% of its production in the United States, especially in the Florida and Texas markets. The firm hoped to take advantage of the Caribbean Basin Initiative, which eliminated import duties for most Caribbean products through 1995.[16]

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
1981	112	5,251	116	8,265	42	259	3,902	15,359	4,172	29,135
1982	114	5,036	100	5,161	38	234	3,940	16,067	4,193	26,497
1983	123	4,985	75	2,876	44	288	3,714	14,427	3,955	22,575
1984	25	613	62	926	24	190	3,407	15,362	[2]3,517	[2]17,091
1985	120	8,736	47	850	21	156	3,919	18,318	4,107	28,059

[1]Data may not add to totals shown because of independent rounding.
[2]Excludes fuller's earth and kaolin.

Fluorspar.—Texas was one of three States to report fluorspar production. Although output increased substantially over that for 1984, value per short ton fell about 6%. Machaca Resources, formerly known as D & F Minerals Co., produced metallurgical-grade fluorspar from its mine in Brewster County.

Gypsum.—Texas was the Nation's leading crude and calcined gypsum producer, although output of the crude ore fell almost 9% from that of 1984.

Among the Nation's 10 leading individual mines were USG's Sweetwater Mine (second), Nolan County, and Georgia-Pacific Corp.'s Acme Mine (ninth), Hardeman County.

Genstar Building Materials Co. at Sweetwater changed its name to Genstar Gypsum Products Co. in January 1985.

In late December 1985, a National Gypsum Co. management-investor group planned to acquire the firm in a leveraged buyout transaction. The $1.1 billion transaction was to be completed in early 1986.[17]

Windsor Gypsum Co., of McQueeney (home office in Houston), initiated construction of a gypsum wallboard plant near Tatum, in northeastern Texas. The plant was to be near the Martin Lake powerplants of Texas Utilities Co. The raw material feed for the wallboard plant was to be

high-quality synthetic gypsum from the flue gas desulfurization system (sulfurated scrubber sludge) of Texas Utilities' powerplant. Designed to produce 1.5 million square feet of wallboard per day, the plant was to use approximately 1,000 short tons of the sulfurated scrubber sludge. This was the first time that a wallboard plant had been designed and constructed in the United States solely on the basis of a synthetic gypsum feed. The plant was to open in late 1986.

Helium.—Texas was one of two States to produce crude helium, and one of three to process Grade-A helium. Output of the crude declined 13% from that of 1984, but Grade-A increased about 22%.

During 1985, the U.S. Bureau of Mines operated the Exell helium extraction plant, 1 mile southwest of Masterson, Moore County, and produced crude and Grade-A helium. All Federal helium was produced at this plant. The Bureau sold 388 million cubic feet of helium to Federal agencies, primarily for use in space shuttle activities and Strategic Defense Initiative programs.

The U.S. Department of Defense prepared to test the operation of a pressurized system for opening a missile silo, using helium as the pressurizing agent. Representatives from three defense contractors visited the U.S. Bureau of Mines Helium Field Operations Center at Amarillo to obtain information about handling helium.

Air Products and Chemicals Inc. produced Grade-A helium from its noncryogenic extraction plant at Phillips Camp in Hansford County.

Lime.—Lime value increased to $55 per short ton, $2 higher than that of 1984; output increased insignificantly.

Table 7.—Texas: Lime sold or used by producers, by use

Use	1984		1985	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Road stabilization	413,242	$23,394	455,754	$27,033
Soil stabilization	135,278	7,119	W	W
Water purification	134,216	7,002	118,897	6,124
Steel, electric	100,746	4,531	W	W
Paper and pulp	46,926	2,481	42,443	1,968
Mason's lime	32,931	1,842	W	W
Other[1]	293,432	14,845	575,323	30,802
Total	1,156,771	61,214	1,192,417	65,927

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes acid water neutralization, aluminum and bauxite, agriculture, basic oxygen furnace steel, finishing lime, food (animal and other), magnesium, oil and grease (1984), oil well drilling, open-hearth steel, other chemical and industrial uses, petroleum refining, sewage treatment, sugar refining, and uses indicated by symbol W.

Magnesium Compounds.—Magnesium compounds, produced from gulf coast seawater, were valued at $2,069 per short ton of magnesium oxide equivalent.

The Dow Chemical Co. at Freeport produced magnesium oxide (MgO) and other compounds. Plant capacity was 75,000 tons of MgO equivalent.

Mica.—Alamo Mining Corp. of Van Horn, Culberson County, ceased producing ground mica during 1985.

Perlite (Expanded).—Texas had 7 active perlite expanding plants and ranked seventh among the Nation's 31 expanded perlite producers. Quantity produced and quantity sold and used increased slightly over those figures for 1984. Average value per short ton of expanded perlite was $216, up from $214 in 1984.

Salt.—Texas ranked second of 15 salt producing States. Output was increased by 206,000 short tons over that of 1984; average value rose from about $8.51 per ton in 1984 to nearly $9.59 per ton in 1985.

Seven salt producing companies operated in Brazoria, Chambers, Duval, Ector, Fort Bend, Harris, Jefferson, Matagorda, and Van Zandt Counties.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Texas was the Nation's second ranking State in construction sand and gravel output during 1985. The U.S. Bureau of Mines estimated production to be 7% less than reported in 1984; value, however, was estimated to be down only slightly.

During the year, Lone Star Industries completed transferring its southern Texas

aggregate quarry and ready-mixed concrete plant operations to Pioneer Concrete. The transfer included assets of one stone plant, four sand and gravel operations, and seven ready-mixed concrete plants, plus inventories and spare parts. Transfer of the northern Texas operations occurred in 1984. Pioneer Concrete, whose Texas operations were based in Houston, already had several aggregate quarries and ready-mixed concrete plants in the State.

Industrial.—Industrial sand and gravel output and value decreased insignificantly from figures for 1984. Texas ranked sixth in output among 38 industrial sand and gravel producing States in 1985.

Twelve firms operated industrial sand and gravel pits in Atascosa, Colorado, Hardin, Harris, Johnson, Liberty, Limestone, Live Oak, McCulloch, and Newton Counties. Three firms in McCulloch County accounted for 42% of the State's and 2.8% of the Nation's industrial sand and gravel output.

U.S. Borax and Chemical Corp. purchased the plant and quarry of Pennsylvania Glass Sand Corp., which produced hydrofracturing sand for oil and gas operations. The quarry is in the Cambrian age Hickory Sandstone Member of the Riley Formation, in McCulloch County.

Sodium Sulfate.—Production of sodium sulfate declined insignificantly from that of 1984, and value per short ton fell from $93 to $90 in 1985.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Texas producers again led the Nation in crushed stone output; production represented 8.6% of the national total. Within the State, however, output declined 3.8% and value increased 2.3% compared with estimated figures for 1984. Almost 29% of the counties—73 of 254—produced crushed stone during 1985. Most output came from 152 limestone quarries, but dolomite, marble, marl, sandstone, traprock, and other crushed stone also were extracted.

The four largest crushed stone producers in the State were Texas Crushed Stone Co., TXI, Gifford-Hill & Co. Inc., and Parker Bros. & Co. Inc. Operating 11 quarries, these 4 companies together produced 31% of the quantity and 24% of the value of the State's crushed stone in 1985. Each company's output was more than 4 million short tons; 20 other companies (from 53 quarries) each produced 1 million or more tons for 72% of the crushed stone tonnage and 66% of its value.

The combined output of crushed limestone and crushed dolomite was 82.9 million tons valued at $290.8 million. Unit values ranged from $1 to $28.58 and averaged $3.58 per ton, compared with $1 to $40 and $3.13, respectively, in 1983.

In order of decreasing price per ton, the more highly priced uses were for roofing granules, lightweight aggregate, fillers or extenders, poultry grit and mineral food, flux stone, riprap and jetty stone, bituminous surface-treatment aggregate, chemical stone, and dam construction; in all, Texas producers listed 31 specific uses of crushed stone.

Of the total crushed stone shipped, 86.4% was transported by truck, and 9.9%, by railroad; the remainder was transported by unspecified methods.

Gifford-Hill enlarged its Servtex crushed stone facility in Comal County (north of San Antonio), and the company's asphaltic concrete operations were transferred to the site.[18]

Redland Worth Corp. installed one of the largest mobil crushing plants in the world at its San Antonio facility. Built by Orenstein & Koppel AG's Cement Plant and Processing Div. in the Federal Republic of Germany, the plant reduces feed limestone from 5 feet in diameter to less than 4 inches in diameter and processes 5,000 tons per hour. The plant is about 220 feet long, 56 feet wide, and 66 feet high.[19]

TXI increased production and decreased operating costs at its quarry near Bridgeport by adding an 85-ton, electric-drive, rear-dump haul truck to its fleet.

Table 8.—Texas: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Concrete aggregate (+1-1/2 inch):		
Riprap and jetty stone	631	3,480
Filter stone	236	933
Coarse aggregate, graded:		
Concrete aggregate, coarse	12,721	52,852
Bituminous aggregate, coarse	4,538	20,777
Bituminous surface-treatment aggregate	1,136	5,757
Railroad ballast	1,262	5,254
Fine aggregate (-3/8 inch):		
Stone sand, concrete	2,539	8,858
Stone sand, bituminous mix or seal	927	2,617
Screening, undesignated	802	2,860
Combined coarse and fine aggregates:		
Graded road base or subbase	23,718	61,470
Unpaved road surfacing	374	966
Crushed run or fill or waste	2,270	8,231
Other construction[2]	989	2,622
Agricultural:		
Agricultural limestone	365	1,246
Poultry grit and mineral food	203	1,247
Chemical and metallurgical:		
Cement manufacture	12,198	24,353
Lime manufacture	2,021	8,779
Flux stone	122	686
Chemical stone	136	684
Sulfur oxide removal	741	1,802
Special:		
Lightweight aggregate	28	658
Other miscellaneous[3]	1,366	10,666
Other unspecified[4]	16,440	80,024
Total[5]	85,764	306,821

[1]Includes dolomite, limestone, marble, marl, sandstone, traprock, and miscellaneous stone.
[2]Includes stone used in terrazzo and exposed aggregate, dam construction, other uses not specified, and stone used for other construction and maintenance purposes.
[3]Includes stone used in dead-burned dolomite manufacture, mine dusting or acid water treatment, asphalt fillers or extenders, other fillers or extenders, disinfectant porcelain, roofing granules, abrasives, and paper manufacture.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Dimension.—Output of dimension stone fell almost 21% from that of 1984; value, however, increased from $239 per short ton in 1984 to nearly $316 in 1985. Eight quarries were operated in 1985. Quarries in Burnet, Gillespie, and Llano Counties produced dimension granite; quarries in Jones, Somervell, and Williamson Counties produced dimension limestone.

In decreasing order of output, dimension stone was used for sawed stone, rough blocks, cut and veneer stone, irregularly shaped stone, and monumental stone.

Sulfate of Potash.—Ideal Basic sold all of its potash properties (under its subsidiary, Potash Co. of America) in the fourth quarter of 1985. The loss on the divestiture of the potash properties included a writedown of Ideal Basic's Dumas sulfate of potash manufacturing plant in Moore County.

In late December 1985, Lundberg Industries Inc. of Dallas purchased the Dumas plant, which employed 25 persons. The facility remained open and continued manufacturing sulfate of potash. Some byproduct hydrochloric acid was sold to the Texas petroleum industry for oil-well acidification. Muriate of potash used as feedstock at the plant was shipped into Texas from New Mexico.

Sulfur.—*Frasch.*—In March, Farmland Industries Inc. closed its Fort Stockton, Pecos County, Frasch sulfur mine because of depleted reserves. The closure left Texas with only two operating mines—Pennzoil Sulphur Co.'s mine in Culberson County and Texasgulf Chemicals Co.'s mine in Wharton County. These operations are three of the Nation's four remaining Frasch sulfur operations.

After restructuring its former Duval Corp. mining subsidiary during late 1984 and early 1985, Pennzoil Co. established Pennzoil Sulphur as a division. Pennzoil Sulphur contains all sulfur assets previously under Duval's control. Included in the sulfur operation was the Western World's largest Frasch sulfur mine, also known as the Orla Sulphur Mine, in Culberson County northwest of Pecos. The 2,400-acre mine had an annual design capacity of 2.5 million long tons. In 1985, Pennzoil Sulphur's 446 employees operated the mine's more than 70 sulfur-recovery wells, averaging 600 feet in depth. Two plants, one hot water and the other hot steam, recovered the sulfur at an

annual recovery rate of 92%.

Production in 1985 amounted to 2,558,400 long tons of sulfur. Proven reserves at yearend were 34,199,200 tons. Improved recovery rates, resulting from improved technology, were to increase the estimate of 1985 reserves by about 12%.

Sulfur sales were made primarily to phosphate industry customers for use in manufacturing phosphate fertilizer. Most of the company's sulfur production was sold in the United States, but Pennzoil Sulphur also supplied customers in Western Europe and other areas of the world.

Average sales price, including transportation costs, was $141.05 per ton, up $12.47 over that of 1984.[20]

Texasgulf Chemicals division of Texasgulf Inc., a subsidiary of Elf Aquitaine Inc., operated three sulfur facilities in Texas during 1985: Beaumont shipping terminal, Comanche Creek sulfur mine, and Newgulf sulfur mine.

The Comanche Creek Mine, 14 miles northeast of Fort Stockton in Pecos County, was closed in December 1983 and remained on standby during 1984-85; however, sulfur melted from aboveground inventories was sent by rail to Texasgulf Inc.'s phosphate operations at Lee Creek, NC.

The Newgulf Mine, on the Boling salt dome, 45 miles southwest of Houston, in Wharton County, produced 372,890 tons of sulfur by the Frasch process in 1985, down 10% from that of 1984, according to the Elf Aquitaine 1985 annual report. Elf Aquitaine, a Delaware corporation, owns most of the U.S. assets of Société Nationale Elf Aquitaine, a French concern.

In its 57th year of operation, the Newgulf Mine brought its cumulative production to 80.6 million metric tons, the most productive sulfur mine in the world. More than 8,500 Frasch sulfur production wells have been drilled since production began at Newgulf in 1929.

Construction of a 70-megawatt cogeneration plant at Newgulf was completed in April 1985 at a cost of about $30 million. The new plant generates electricity for sale and uses the waste heat to provide hot water for the Frasch mining process, thereby lowering sulfur production costs.

Table 9.—Texas: Sulfur produced and shipped from Frasch mines

(Thousand metric tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1981	3,908	3,674	W
1982	2,898	2,360	W
1983	1,915	2,468	W
1984	2,257	2,994	W
1985	2,940	2,979	W

W Withheld to avoid disclosing company proprietary data.

Recovered.—Shipments from Texas accounted for 29% of total recovered elemental sulfur shipments in the United States. Recovered elemental sulfur is a nondiscretionary byproduct from petroleum refining, natural gas processing, and coking plants.

Sulfuric Acid.—Asarco planned a major modernization of the sulfuric acid plants at its Corpus Christi and El Paso smelters, although the Corpus Christi smelter was closed in May 1985.

Talc.—Talc production rose 9% over that of 1984. Value per short ton rose from $17 to $20. Nationally, Texas output ranked second of 10.

The gradual shift from solvent-based paint to alternative paint formulas is increasing the use of such extenders as ground talc in the alternative paint.

Vermiculite (Exfoliated).—Texas was the Nation's fifth ranking State in output of sold and used exfoliated vermiculite. W. R. Grace & Co. and Vermiculite Products Inc. exfoliated vermiculite at plants in Bexar, Dallas, and Harris Counties. No vermiculite was mined in Texas.

METALS

Iron ore was the only metal extracted from Texas mines, but several aluminum, copper, lead, and zinc smelters and refineries operated using ores from out of State.

Primary Smelters and Refineries.—Aluminum Co. of America (Alcoa) produced alumina and chemical products at its Point Comfort plant, and primary aluminum, bar, pigments, powder, rod, and wire at its Rockdale smelter.

Asarco produced antimony, cadmium, copper, and lead at its El Paso smelter;

copper, gold, lead, silver, and tellurium at its Amarillo refinery; and zinc at its Corpus Christi refinery.

Phelps Dodge Refining Corp. produced copper at its El Paso refinery, as well as gold, palladium, platinum, selenium, silver, and tellurium.

Aluminum.—Alcoa suspended aluminum casting operations at El Paso in February 1985. As a result, efforts were under way to find a new Alcoa business for the El Paso plant.[21] Reynolds Metals Co. operated its 1.7-million-metric-ton alumina plant at Corpus Christi, processing bauxite from Australia, Brazil, Guinea, and Jamaica.

Alcoa announced plans in December 1985 to close about 25% of its primary aluminum capacity, saying it would permanently idle about 95,250 tons of capacity at its Palestine and Rockdale plants.

The Palestine primary aluminum smelter (chloride reduction) plant, Anderson County, an experimental 15,000-ton-per-year plant, had stopped operation in 1982 and was permanently closed in December 1985.

The Point Comfort alumina refinery, Calhoun County, processed bauxite imported from Guinea, western Africa. The annual rated capacity at Point Comfort increased from 1.4 million tons in 1984 to 1.6 million tons in 1985.

At a cost of $7 million, Alcoa developed a dry mud lake for better settling and compaction at Point Comfort during 1984-85. Although the dry mud lake was the biggest capital expenditure in 1985, Alcoa also spent $1 million for three Zimpro pumps to service the dry lake. In the fall, Alcoa shut down its sand-filter operation for a 2-week test of converting to cloth filters. If the cloth filters were successful in maintaining product purity (that is, removing iron), the sand filter shutdown would become permanent.

Rockdale Works, Milam County, started up an electromagnetic casting (EMC) unit. EMC ingots have smooth surfaces, require little preparation before fabrication, and generate less scrap.

Rockdale idled 34,200 tons of primary aluminum capacity February 10, 1985. The reduction brought the plant's operating rate to 78% and resulted in laying off about 70 people. Simultaneously, Alcoa restarted 25,000 tons of production in Tennessee, where a lower power-rate offer from the Tennessee Valley Authority and a growing metal inventory at Rockdale combined to influence the company to make the shifts.

At yearend 1985, the Rockdale smelter capacity had been reduced to 242,000 tons per year, down from 310,000 tons per year on July 1, 1985.

The Rockdale smelter had the highest power cost among Alcoa plants. With reconstruction of two generating units in mid-1985 and a third in mid-1986, power costs at Rockdale were expected to fall to a more acceptable level.

Antimony.—Asarco recovered antimony from tetrahedrite copper concentrates at its El Paso smelter.

Cadmium.—Asarco operated a cadmium fume recovery unit at its El Paso smelter.

Chromium.—American Chrome & Chemicals Inc. in Corpus Christi produced sodium bichromates and other chromium chemicals from foreign chromium ore.

Copper.—Asarco operated the El Paso 104,000-metric-ton copper smelter throughout 1985 using copper concentrates from several mined sources. Anodes were transported to Asarco's Amarillo copper refinery where a new monthly production record high of 37,350 tons of refined copper cathodes was set in May. The plant was designed to produce 31,750 tons per month, but the increase in electric current efficiency provided by Asarco's patented Reatrol process enabled it to exceed design capacity using existing equipment. (See "Gold" and "Silver.")

Phelps Dodge operated its refinery at El Paso, which had a capacity of 380,000 tons of electrolytic copper per year. As Phelps Dodge's only refinery after the closure of Laurel Hill, NY, in February 1984, El Paso produced 332,000 tons of copper, as well as byproduct gold and silver in 1985. El Paso also produced copper sulfate and recovered small amounts of palladium, platinum, and selenium in refinery slimes as byproducts of the copper refining process.[22]

Germanium.—In September, Rare Materials International Inc. reported permanently closing and dismantling its 1,200-kilogram-per-year germanium production facility in Irving, Dallas County.

Gold.—Asarco produced 220,100 troy ounces of gold at its Amarillo copper refinery, which has a gold production capacity of 600,000 ounces per year. Output in 1985 was nearly 120,000 ounces less than that of 1984, according to Asarco's 1985 annual report.

Phelps Dodge produced 48,300 ounces of gold at its El Paso refinery.

Gold was not mined in Texas.

Iron Ore.—Hudson Bros. Mining Co. Inc. and Mathis & Mathis Mining & Exploration Co. operated iron ore surface mines in Cherokee and Cass Counties, respectively.

Minor amounts of iron ore were used for cement manufacture and as animal nutrient.

Iron and Steel.—The State's steel industry changed from relying heavily on the energy sector market to greater reliance on the construction industry market. Rebar minimills, such as Chaparral Steel Co. and Structural Metals Inc., had become important in the Texas steel industry. Meanwhile, energy-related steelmakers, such as Lone Star Steel Co. of Dallas and United States Steel Corp., which produced tubular oil country products, began to cut production as sales dropped along with oil production, and imports rose.

Hurricane Industries Inc. closed its minimill at Sealy.

Lone Star Steel idled two open-hearth furnaces and one blast furnace for about 1 month, starting March 17, because of soft demand for steel coils and tubular goods. About 400 workers were laid off. The shutdown coincided with maintenance outages of two rolling mills, which produced hot strip and slabs.

In the fourth quarter of 1985, Lone Star Steel wrote down the value of its steel mill in Lone Star, Morris County, by $89 million. Company officials set no deadline to decide whether the steelmaking parts of the mill would remain open.

TXI of Dallas purchased its second 50% stake in Chaparral Steel from Co-Steel International Ltd., Toronto, Ontario, Canada, for $42 million and an additional contingent payment. Chaparral Steel operated a low-cost steel plant in Midlothian. TXI and Co-Steel started Chaparral Steel as a joint venture in 1975. The contingent payment, based on Chaparral Steel's performance, will be made in 1990. The transaction was completed December 1, 1985.

Lead.—At its 86,200-metric-ton El Paso lead smelting operation, Asarco extracted a variety of metals from lead-bearing materials, such as drosses, sludges, and residues from other nonferrous smelting and refining operations. In 1984, El Paso had produced 43,700 tons of lead bullion compared with the curtailed 1985 output of 30,600 tons, according to Asarco's 10K Annual Report. Lead output was shipped to Asarco's Omaha, NE, refinery for processing. On August 30, 1985, Asarco suspended operations indefinitely at the El Paso lead smelter because of a shortage of feed concentrate, depressed lead and silver prices, and restrictions on lead emissions. The firm laid off 250 of the plant's 850 employees when the 100-year-old smelter closed. The El Paso plant represented about 34% of Asarco's lead-smelting capacity and 14% of total U.S. capacity. The copper smelting part of the El Paso operation continued operating normally.

Magnesium.—Dow announced plans to spend $40 million over the next 3 years to modernize its magnesium facilities. Although Dow was not expected to increase primary magnesium metal production capacity over the 1985 level of 125,000 short tons per year, the modernization was expected to improve energy efficiency, labor productivity, raw material yields, and product quality through the use of new production and foundry technology.

At its Lake Jackson research center near Freeport, Dow developed a new high-purity, corrosion-resistant magnesium specialty alloy for use in sand casting.[23]

Magnesium Chloride.—Magnesium chloride for metal decreased 29% in both quantity and value from figures for 1984.

Platinum and Palladium.—Phelps Dodge recovered small amounts of platinum and palladium at its El Paso copper refinery.

Selenium.—Texas was one of only two States to produce refined selenium in 1985. Primary selenium was recovered from domestic and imported materials at Asarco's copper refinery at Amarillo and at Phelps Dodge's refinery at El Paso.

Selenium was used in agriculture, electronic and photocopier components, glass manufacturing, metallurgy, and pigments and chemicals.

Silver.—Asarco separated silver from anode copper at its Amarillo copper refinery, where the output in 1985 was 42,295,000 troy ounces of silver, 4 million ounces less than in 1984, according to Asarco's 1985 annual report. The plant operated at about 70% of capacity. Silver was contained in the lead bullion produced at Asarco's El Paso lead smelter and was separated from the lead at the firm's Omaha, NE, refinery.

Phelps Dodge produced 2,865,700 ounces of silver at its El Paso copper refinery.

Tellurium.—Texas was the only State to produce refined tellurium in 1985. Commercial-grade tellurium was recovered by Asarco at its Amarillo plant from copper anode slimes, a byproduct of electrolytic copper refining.

Tin.—In March 1985, Associated Metals & Minerals Corp., New York, offered for sale its Texas City tin smelter, the only tin smelter in the Nation. The facility, operated by Associated Metals & Minerals' subsid-

iary, Gulf Chemical & Metallurgical Co., was expected to continue operations at current levels until sold. The smelter had been producing about 3,000 to 5,000 metric tons of refined tin per year, almost 10% of the total amount consumed in the United States.[24]

Vanadium and Molybdenum.—In January, Gulf Chemical & Metallurgical's molybdenum and vanadium plant at Freeport was sold by its parent company, Associated Metals & Minerals, to two Belgian firms, Société Applications de la Chimie, de l'Electricité et des Métaux (SADACEM) and Société Européenne des Derives du Manganese S.A. (SEDEMA).

Freeport recovered molybdenum and vanadium from spent hydroprocessing catalysts generated largely by oil refining and petrochemical industries in the Southern United States. The plant was a recent supplier of vanadium pentoxide to the National Defense Stockpile. Freeport, employing 130 persons, was one of only three such spent catalyst reclamation facilities operating in the United States. The plant treated as much as 30,000 short tons of catalysts per year. Management planned to double this capacity by 1990 and eventually recover the several million pounds of cobalt and nickel left in stockpiled catalyst residues.

Zinc.—Asarco suspended operations indefinitely at its 104,000-metric-ton-per-year zinc refinery at Corpus Christi early in April 1985 and laid off about 275 employees. Between January and April, the refinery produced 11,431 tons of zinc, 60% less than in 7 months of operation in 1984, according to Asarco's 1985 annual report.

Corpus Christi had been operating at about one-half of capacity since reopening in May 1984, producing at the rate of 52,000 tons per year. Earlier, October 1982 through May 1984, production had also been suspended at Corpus Christi. The latest closure represented $120 million of the $216 million writedown the company took for the fourth quarter of 1984. At the time of the Corpus Christi closure, zinc metal prices ranged from $0.325 to $0.380 per pound. The plant had accounted for 26% of domestic primary zinc capacity.

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Table 10.—Texas: Primary smelters, refineries, and reduction plants

Product, company, plant	Location (county)	Material treated
Aluminum:		
Aluminum Co. of America:		
Point Comfort	Calhoun	Bauxite.
Rockdale (reduction)	Milam	Do.
Reynolds Metals Co.:		
Sherwin plant (alumina)	San Patricio	Do.
Antimony:		
ASARCO Incorporated:		
El Paso smelter	El Paso	Ore.
Cadmium:		
ASARCO Incorporated:		
El Paso smelter	do	Do.

Table 10.—Texas: Primary smelters, refineries, and reduction plants —Continued

Product, company, plant	Location (county)	Material treated
Copper:		
ASARCO Incorporated:		
Amarillo refinery[1]	Potter	Blister and anode.
El Paso smelter	El Paso	Ore and concentrates.
Phelps Dodge Refining Corp.:		
Nichols refinery[2]	do	Blister and anode.
Iron:		
Lone Star Steel Co.:		
Daingerfield plant	Morris	Ore and scrap.
Lead:		
ASARCO Incorporated:		
El Paso smelter	El Paso	Ore and concentrates.
Magnesium:		
The Dow Chemical Co.:		
Freeport plant, electrolytic	Brazoria	Seawater.
Tin:		
Associated Metals & Minerals Corp.:		
Texas City smelter	Galveston	Ore and concentrates.
Zinc:		
ASARCO Incorporated:		
Corpus Christi electrolytic[3]	Nueces	Do.
El Paso fuming plant	El Paso	Dusts and residues.

[1]Asarco's Amarillo refinery also produced gold, nickel sulfate, palladium, platinum, selenium, silver, and tellurium.
[2]Phelps Dodge's El Paso (Nichols) refinery also produced copper sulfate, gold, palladium, platinum, selenium, silver, and tellurium.
[3]Asarco's Corpus Christi refinery also produced sulfuric acid and cadmium.

Table 11.—Texas: Secondary metal recovery plants

County and company	Material	Product
Bexar:		
River City Steel & Recycling Co	Scrap metal	Smelter and refined scrap metals.
Standard Industries	Lead scrap, soft lead, drosses	Battery metals, grids, oxides.
Brazoria:		
Texas Reduction Co	Aluminum scrap	Alloyed aluminum ingot.
Collin:		
GNB Batteries Inc	Lead scrap	Battery lead oxide and pig lead.
Dallas:		
Dixie Metals Co	do	Lead pigs, alloys, chemicals.
Laclede Steel Co	Steel scrap	Reinforcing steel.
RSR Corp	Lead scrap	Lead shot, solders, lead pipe.
El Paso:		
Border Steel Rolling Mills Inc	Steel scrap	Reinforcing bars, bar shapes, steel grinding balls.
Proler International Corp	do	Precipitation iron.
Ellis:		
Chaparral Steel Co	do	Steel reinforcing bars and shapes.
Industrial Metals Co	Scrap metal	Metal shapes and ingots.
Gregg:		
Marathon-LeTourneau Co	Steel scrap	Steel castings and shapes.
Southwest Steel Castings Co	do	Steel castings.
Guadalupe:		
Structural Metals Inc	do	Structural steel reinforcing bars.
Harris:		
A & B Metal Manufacturing Co. Inc	Scrap metal	Tungsten carbide.
Federated Fry Metals Corp	Various metals	Lead ingot, solder, copper tubing, bearing metals, sheet lead, lead pipe.
Gulf Reduction Corp	Aluminum zinc scrap	Aluminum and zinc ingots, and alloys.
Houston Lead Co	Lead scrap	Lead pigs, ingots, alloys.
Lead Products Co. Inc	do	Do.
Proler International Corp	Various metals	Zinc slab, aluminum alloys, precipitation iron.
Jefferson:		
Georgetown Texas Steel Corp	Steel scrap	Steel rods and shapes.
Leon:		
NUCOR Corp., Nucor Steel Div	do	Do.
Smith:		
Block 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 12.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt (native):			
Azrock Industries Inc	84 NE. Loop 410 Suite 480 W San Antonio, TX 78216	Quarry and plant	Uvalde.
White's Mines Inc	Box 421 San Antonio, TX 78292	do	Do.
Barite:			
Dresser Industries Inc	Box 6504 Houston, TX 77005	Grinding plants	Cameron and Galveston.
The Milwhite Co. Inc.[1]	Box 15038 Houston, TX 77020	do	Cameron and Harris.
NL Industries Inc	Box 1675 Houston, TX 77001	Grinding plant	Nueces.
Cement:			
Alamo Cement Co	Box 34807 San Antonio, TX 78233	Quarry and plant	Bexar.
Centex Cement Corp	4600 Republic Bank Tower Dallas, TX 75201	Quarries and plant	Hays and Nueces.
General Portland Inc.[2]	Box 324 Dallas, TX 75221	do	Comal, Dallas, Harris.
Gifford-Hill & Co. Inc.[3]	Box 520 Midlothian, TX 76065	Quarry and plant	Ellis.
Southwestern Portland Cement Co.[4]	Box 1547 Odessa, TX 79760	Quarries and plants	Comal and Ellis.
Texas Industries Inc.[5]	8100 Carpenter Freeway Dallas, TX 75247	do	Do.
Clays:			
Acme Brick Co., a division of Justin Industries Inc.	Box 886 Denton, TX 76202	Pits and plants	Denton, Guadalupe, Nacogdoches, Parker, Van Zandt, Wise.
Featherlite Building Products Corp.	Box 141 Ranger, TX 76470	Pit and plant	Eastland.
Henderson Clay Products Co	Box 490 Lindale, TX 75771	Pits and plants	Cherokee, Harrison, Rusk.
Southern Clay Products Inc.[6]	Box 44 Gonzales, TX 78629	Pit and plant	Gonzales.
Texas Clay Industries Inc	Box 469 Malakoff, TX 75148	do	Henderson.
Gypsum:			
Genstar Building Products Materials Co.	Box 720 Sweetwater, TX 79556	Quarry and calcining plant.	Nolan.
Georgia-Pacific Corp	900 SW. 5th Ave. Portland, OR 97204	do	Hardeman.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	Quarries and calcining plants.	Fisher, Kimble, Stonewall.
USG Corp. (formerly United States Gypsum Co.).[7]	101 South Wacker Dr. Chicago, IL 60606	do	Harris and Nolan.
Windsor Gypsum Co	McQueeney, TX 78123	Calcining plant	Guadalupe.
Iron ore:			
Hudson Bros. Mining Co. Inc	Box 301 Rusk, TX 75785	Mine	Cherokee.
Mathis & Mathis Mining & Exploration Co.	1101 Santa Rita Box 2577 Silver City, NM 88062	do	Cass.
Lime:			
Austin White Lime Co	Box 9556 Austin, TX 78766	Plant	Travis.
Chemical Lime Co	Box 427 Clifton TX 76634	do	Bosque.
Holly Sugar Corp	Drawer 1778 Hereford, TX 79045	do	Deaf Smith.
Redland Worth Corp	Route 2, Box 222 San Antonio, TX 78229	do	Bexar.
Round Rock Lime Co., a subsidiary of Dravo Lime Co.	Box 38 Blum, TX 76627	do	Hill.
Texas Lime Co., a subsidiary of Rangaire Corp.	Box 851 Cleburne, TX 70631	do	Johnson.
Salt:			
Diamond Shamrock Corp	717 North Harwood Dallas, TX 75201	do	Chambers.
The Dow Chemical Co.[8]	2020 Dow Center Midland, MI 48640	Brine	Brazoria.
Morton Thiokol Inc	110 North Wacker Dr. Chicago, IL 60606	Underground mine and brine.	Van Zandt.
Texas Brine Corp	2000 West Loop South Houston, TX 77027	Brines	Harris, Jefferson, Matagorda.
Sand and gravel:			
Capitol Aggregates Inc. (H. B. Zachry Co.).	Drawer 33240 San Antonio, TX 78233	Stationary plants	Bexar, Freestone, Travis, Val Verde.
Centex Materials Inc	Box 2252 Austin, TX 78768	Pits and plants	Hays and Travis.

See footnotes at end of table.

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Dresser Industries Inc	Kosse, TX 76653	Pit and plant	Limestone.
The Fordyce Co	Box 1981 San Antonio, TX 78297	Pits and plants	Hidalgo and Victoria.
Oglebay Norton Co., Texas Mining Co.	2104 East Randol Mill Rd. Suite 101 Arlington, TX 76011	Pits and plant	McCulloch.
Parker Bros. & Co. Inc	Box 107 Houston, TX 77001	Stationary plants and dredges.	Colorado, Fayette, Harris, Victoria.
Pennsylvania Glass Sand Corp.	Box 187 Berkeley Springs, WV 25411	Pits	Live Oak and McCulloch.
Thorstenberg Materials Co. Inc., a division of Ideal Basic Industries Inc.	363 North Belt Houston, TX 77054	do	Colorado and Fayette.
UNIMIN Corp	50 Locust Ave. New Canaan, CT 06840	Plant	Johnson.
Sodium sulfate (natural):			
Ozark-Mahoning Co	1870 South Boulder Tulsa, OK 74119	Plants	Gaines and Terry.
Stone:			
Lone Star Industries Inc.[9]	Box 86 Houston, TX 77001	do	Burnet, Nolan, Wise.
Parker Bros. & Co. Inc	Box 107 Houston, TX 77001	Plant	Comal.
Texas Crushed Stone Co	Box 1000 Georgetown, TX 78626	Plants	Llano and Williamson.
Vulcan Materials Co.[10]	Box 13010 San Antonio, TX 78213	do	Bexar, Grayson, Williamson, Wise.
White's Mines Inc	Box 32688 San Antonio, TX 78216	do	Brown, Parker, Taylor, Uvalde.
Sulfur:			
Byproduct:			
Amoco Production Co. (Standard Oil Co., Indiana).	Box 591 Tulsa, OK 74102	Secondary recovery	Andrews, Ector, Galveston, Hockley, Van Zandt, Wood.
Chevron U.S.A. Inc	575 Market St. San Francisco, CA 94105	do	Crane, El Paso, Hopkins, Jefferson, Karnes.
Exxon Chemical Americas	Box 77253-3272 Houston, TX 77079	do	Atascosa, Crane, Harris.
Phillips Petroleum Co	Bartlesville, OK 74003	do	Andrews, Brazoria, Hopkins, Hutchinson.
Smackover Shell Ltd	Rte. 2, Box 152 Eustace, TX 75124	do	Henderson.
Texaco Producing Inc	Box 8 Scroggins, TX 75480	do	Franklin, Freestone, Jefferson.
Native:			
Farmland Industries Inc	Box 850 Fort Stockton, TX 79735	Frasch mine	Pecos.
Pennzoil Sulphur Co	1906 First City National Bank Houston, TX 77002	do	Culberson.
Texasgulf Chemicals Co	Glenwood at Glen Eden Box 30321 Raleigh, NC 27622-0321	do	Wharton.
Talc:			
Clark Minerals Inc	1000 Coolidge St. South Plainfield, NJ 07080	Pits and plant	Hudspeth.
Texas Talc Co. (Dal-Tile Corp.)	Box 17130 Dallas, TX 75217	Pits	Do.
Westex Minerals Co. (The Milwhite Co. Inc.).	Box 15038 Houston, TX 77020	Mines and plants	Culberson and Hudspeth.
Vermiculite (exfoliated):			
W. R. Grace & Co	2651 Manila Rd. Dallas, TX 75200	Exfoliating plants	Bexar and Dallas.
Vermiculite Products Inc	Box 7327 Houston, TX 77008	Exfoliating plant	Harris.

[1]Also clay and shale, Fayette and Walker Counties.
[2]Also clays, Dallas and Guadalupe Counties; and stone, Comal, Dallas, Tarrant, and Wise Counties.
[3]Also clays, Ellis County; sand and gravel, Brazos, Clay, Dallas, McLennan, and Tarrant Counties; and crushed stone, Comal, Ellis, Hudspeth, and Wise Counties.
[4]Also clays, Potter County.
[5]Also clays, Ellis, Fort Bend, Guadalupe, Henderson, Navarro, and Van Zandt Counties; sand and gravel, Colorado, Dallas, Denton, Ellis, Parker, Tarrant, and Travis Counties; and crushed stone, Comal, Ellis, Jack, and Wise Counties.
[6]Also talc, Hudspeth County.
[7]Also lime, Comal County.
[8]Also magnesium compounds, Brazoria County.
[9]Also cement, Harris and Nolan Counties; and sand and gravel, Colorado, Denton, and Liberty Counties.
[10]Also industrial sand, McCulloch County.

The Mineral Industry of Utah

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

By Lorraine B. Burgin[1]

The value of nonfuel mineral production declined from $525 million in 1984 to $312 million in 1985. Metal production fell from two-thirds of the total value of nonfuel minerals in 1984 to one-third in 1985 because of continued low prices and the shutdown of the State's principal producer of copper and its byproducts, gold, molybdenum, and silver. Reflecting the slump in the uranium and steel industries, vanadium production ceased. The total value in industrial minerals output decreased about 5%, with declines in native asphalt (gilsonite), lime, phosphate rock, potash, salt, sodium sulfate, and crushed stone. Industrial mineral production was affected by the downturn in the copper and steel industries, which used the commodities in processing ores, by the use of fewer fertilizers in the agricultural industry, and by the rising Great Salt Lake that flooded solar ponds on its shores and diluted brines being prepared for various industrial products. Portland and masonry cement, gypsum, construction

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

Mineral		1984		1985	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Beryllium concentrate	short tons	6,030	$6	5,738	$6
Clays	thousand short tons	[2]315	[2]2,223	332	2,509
Gem stones		NA	80	NA	80
Gold (recoverable content of ores, etc.)	troy ounces	W	W	135,489	43,039
Gypsum	thousand short tons	277	2,671	413	4,033
Lime	do.	297	16,471	225	11,912
Salt	do.	1,246	28,651	1,189	28,468
Sand and gravel:					
Construction	do.	15,217	34,507	e14,000	e36,400
Industrial	do.	11	W	W	W
Stone (crushed)	do.	e5,200	e16,400	4,657	14,180
Combined value of asphalt (native), cement, clays (fuller's earth, 1984), copper, lead (1984), magnesium compounds, molybdenum, phosphate rock, potassium salts, silver, sodium sulfate, stone (dimension, 1985), vanadium (1984), zinc (1984), and values indicated by symbol W		XX	r424,323	XX	171,732
Total		XX	r525,332	XX	312,359

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

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

[2]Excludes fuller's earth; value included with "Combined value" figure.

Table 2.—Nonfuel minerals produced in Utah in 1984, by county[1]

County	Minerals produced in order of value
Beaver	Sand and gravel.
Box Elder	Sand and gravel, clays, silver.
Cache	Sand and gravel.
Carbon	Do.
Davis	Do.
Duchesne	Do.
Emery	Do.
Garfield	Do.
Grand	Potassium salts, salt.
Iron	Silver, sand and gravel, gold.
Juab	Sand and gravel, gypsum, silver, gold, lead, copper.
Kane	Sand and gravel.
Millard	Lime, sand and gravel, beryllium.
Morgan	Cement, sand and gravel.
Salt Lake	Copper, gold, cement, silver, sand and gravel, molybdenum, salt, lime.
San Juan	Vanadium.
Sanpete	Sand and gravel, gypsum, clays.
Sevier	Sand and gravel, gypsum, salt, clays.
Summit	Clays, sand and gravel.
Tooele	Gold, salt, lime, sand and gravel, magnesium compounds, clays, silver.
Uintah	Phosphate rock, sand and gravel.
Utah	Sand and gravel, clays, silver, copper, gold.
Wasatch	Sand and gravel.
Washington	Do.
Weber	Salt, potassium salts, sodium sulfate, magnesium compounds, sand and gravel.
Undistributed[2]	Stone (crushed), asphalt, gem stones, zinc.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

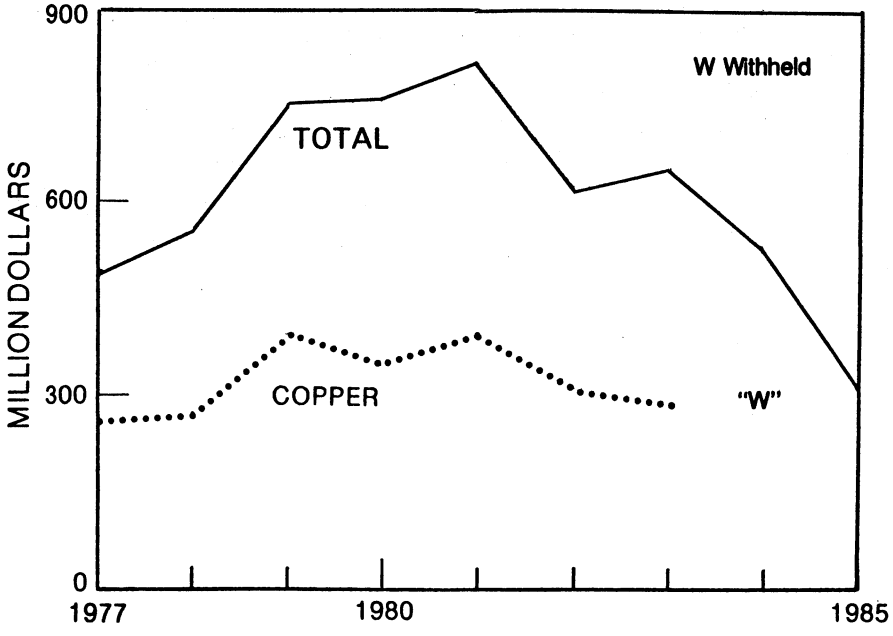

Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Utah.

Table 3.—Indicators of Utah business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	1,595	1,623	1,645
Total civilian labor force	do.	694	702	730
Unemployment	percent	9.2	6.5	5.9
Employment (nonagricultural):				
Mining total[1]	thousands	14.0	12.8	9.7
Metal mining	do.	5.5	4.2	2.2
Nonmetallic minerals except fuels[2]	do.	.9	.8	.9
Coal mining	do.	3.2	2.8	2.9
Oil and gas extraction[2]	do.	5.0	5.0	3.9
Manufacturing total	do.	85.5	94.0	93.9
Primary metal industries	do.	5.8	5.7	4.9
Stone, clay, and glass products[2]	do.	3.6	4.3	4.6
Chemicals and allied products[2]	do.	2.6	2.8	2.8
Petroleum and coal products	do.	1.3	1.0	.9
Construction	do.	28.7	34.8	35.7
Transportation and public utilities	do.	35.9	36.4	37.0
Wholesale and retail trade	do.	133.5	140.8	147.8
Finance, insurance, real estate	do.	28.0	29.8	31.0
Services	do.	112.5	121.1	131.7
Government and government enterprises	do.	128.8	131.5	137.9
Total	do.	566.9	601.2	[3]624.6
Personal income:				
Total	millions	$14,898	$16,273	$17,259
Per capita		$9,337	$10,024	$10,493
Hours and earnings:				
Total average weekly hours, production workers		39.4	39.9	40.3
Mining		41.7	42.9	43.1
Total average hourly earnings, production workers		$8.7	$8.9	$9.4
Mining		$12.5	$12.3	$13.1
Earnings by industry:				
Farm income	millions	$68	$107	$73
Nonfarm	do.	$11,428	$12,640	$13,454
Mining total	do.	$498	$472	$374
Metal mining	do.	$216	$176	$91
Nonmetallic minerals except fuels	do.	$24	$23	$26
Coal mining	do.	$126	$121	$131
Oil and gas extraction	do.	$133	$152	$126
Manufacturing total	do.	$1,920	$2,213	$2,359
Primary metal industries	do.	$204	$219	$200
Stone, clay, and glass products	do.	$84	$108	$112
Chemicals and allied products	do.	$69	$80	$84
Petroleum and coal products	do.	$40	$40	$43
Construction	do.	$881	$1,080	$1,099
Transportation and public utilities	do.	$1,097	$1,164	$1,201
Wholesale and retail trade	do.	$1,918	$2,080	$2,211
Finance, insurance, real estate	do.	$567	$625	$696
Services	do.	$2,064	$2,347	$2,600
Government and government enterprises	do.	$2,447	$2,618	$2,869
Construction activity:				
Number of private and public residential units authorized[4]		14,805	19,698	16,525
Value of nonresidential construction[4]	millions	$362.2	$532.4	$536.0
Value of State road contract awards	do.	$179.0	$187.2	$169.1
Shipments of portland and masonry cement to and within the State	thousand short tons	793	974	1,061
Nonfuel mineral production value:				
Total crude mineral value	millions	$656.6	$525.3	$312.4
Value per capita		$412	$324	$190

[p]Preliminary. [r]Revised.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

sand and gravel, and dimension stone, however, rose in value principally because of an increase in nonresidential construction throughout the State.

Utah's principal mineral commodities, listed in decreasing order of value, included portland cement, copper, gold, construction sand and gravel, salt, phosphate rock, silver, crushed and broken stone, gilsonite, and lime.

Nationally, in value of production, Utah ranked first in gilsonite and beryllium hy-

droxide; second in magnesium chloride; third in potash and copper; fifth in phosphate rock and silver; and sixth in gold. Among the States, Utah's total value of nonfuel mineral output slumped from 9th place in 1983, to 16th in 1984, and 24th in 1985.

Trends and Developments.—Metal production in the State dropped severely as Kennecott's Utah Copper Div. shut down; this shutdown reduced the output of copper, gold, lime, molybdenum, selenium, silver, and sulfuric acid. Factors affecting the value and output of metals included the anticipation of a worldwide oversupply of copper, the continued surplus of molybdenum, and sluggish prices of copper, gold, molybdenum, and silver. Moreover, the strong dollar, though softened against the currencies of Japan and Europe the last half of 1985, continued to keep metal producers at a disadvantage relative to foreign competitors. Substitutions for copper continued: aluminum in electrical equipment, automobile radiators, and refrigerator tubing; optical fibers in telecommunications cable; and plastics in water pipe and plumbing fixtures. Molybdenum oversupply was partly related to cutbacks in the steel markets and in the oil and gas industry. The United States Steel Corp.'s (USS) Geneva Steel Works was the last iron and steel operation in Utah.

The announcement of USS's diversion to a Korean steel company hot-rolled coil beginning in 1989 possibly could signify the end of an era for Utah's basic iron ore and steel industry. Factors contributing to the marginal position of USS's Geneva Steel Works were attributed to the 750-mile distance to markets and competition with imports on the west coast; high fixed costs and an underutilized plant; advent of the minimill using scrap feed rather than coal, iron ore, and limestone; and limited technological improvements instead of a full-scale modernization program.

Most uranium-vanadium mines on the Colorado Plateau were on standby or operating on a reduced scale. Utah uranium-vanadium producers faced major problems of low prices, large inventories of foreign and domestic supplies, long-term import contracts that reduce the need for domestic production, and the high cost of new reclamation requirements. A new trade association, Uranium Producers of America, formed to promote a viable uranium industry, called for the Federal Government to (1) fill future contracts with domestic uranium, (2) place restrictions on future contracts for imported uranium, (3) adopt equitable financing for mill tailings reclamation, and (4) curtail sales of Federal Government stockpiles pending assessment of future uranium needs.

Legislation and Government Programs.—The Governor signed the following bills related to mining that were passed by the 1985 General Session of the 46th Legislature, meeting from January 14 to February 27. Senate bill 97 authorized $96 million for water and flood projects and appropriated $20 million for Great Salt Lake pumping and diking engineering studies, and matching funds for Federal diking money and for dredging the Jordan River. Senate bill 199 required the State engineer's approval before natural streambeds could be altered. House bill 162 removed the requirement that the Utah Geological and Mineral Survey be situated on the University of Utah campus. House bill 163 required penalties and fines collected by the Division of Oil, Gas and Mining be deposited in the Abandoned Mine Reclamation account. House bill 180 stipulated that an appeal from the Board of Oil, Gas and Mining is not a trial de novo and established the standard of judicial review. House bill 181 gave the Board of Oil, Gas and Mining authority to regulate plants that treat and process crude oil obtained from reserve pits, disposal ponds, etc.

U.S. Bureau of Mines, Salt Lake City Research Center, activities, through direct appropriation and cooperative research programs with industry, included advanced applications of column flotation; processing ocean minerals; recovery of critical and strategic minerals from marginal resources, waste materials, and secondary scrap; removal of low-level metal contaminants from residual waters; hydrometallurgical technology for treating ores, concentrates, and solutions; recovery of gallium, germanium, tantalum, tellurium, and titanium by hydrometallurgical methods; and advanced applications of mineral processing using supercritical fluids. Significant results were obtained in developing a column flotation process utilizing a new external bubble generator. Testing of 15 different mineral systems showed that improved economics and better grades and recoveries could be achieved, and various copper, lead, and molybdenum operations were planning and/or testing the process.[2]

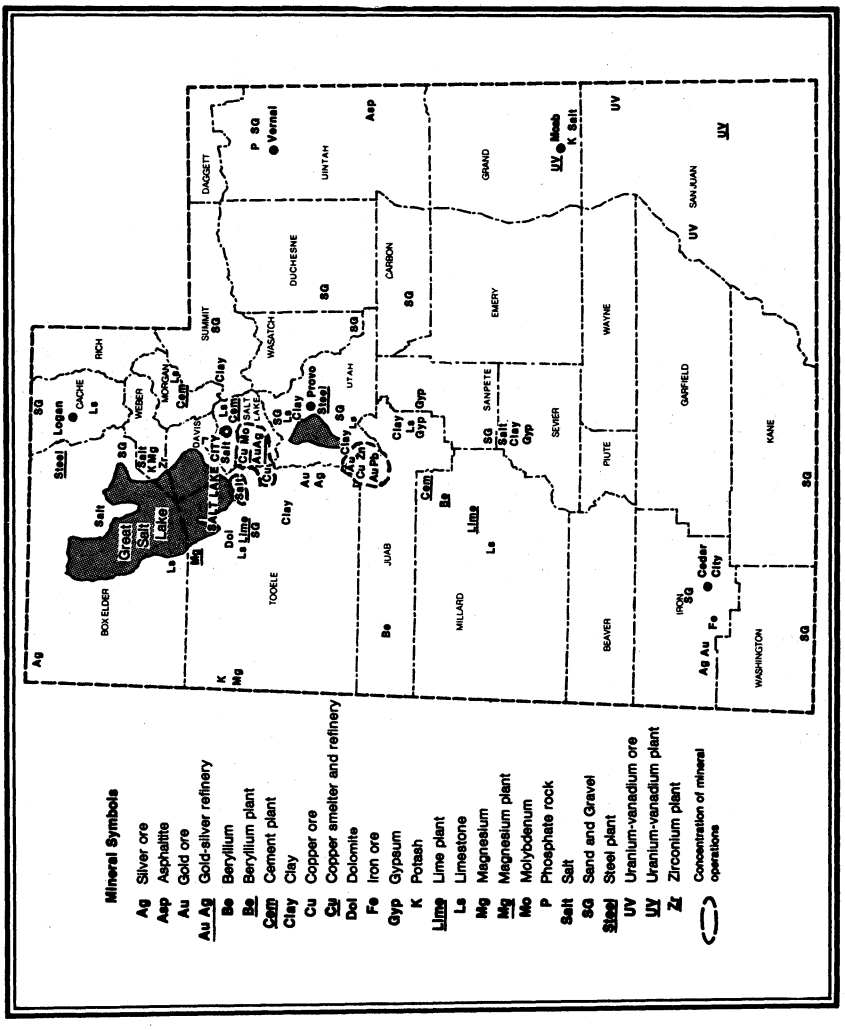

Figure 2.—Principal mineral producing localities in Utah.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Beryllium.—Beryllium ore production declined in quantity and value during 1985. Brush Wellman Inc., the principal producer of beryllium in the United States, was the only company recovering the product from bertrandite ore. According to its 1985 annual report, Brush Wellman produced 377,000 pounds of beryllium in 1985, compared with 402,000 pounds in 1984. The average market price of beryllium remained at $54 per pound. As of December 31, 1985, the company estimated proven bertrandite ore reserves at 5.7 million short tons averaging 0.23% beryllium.

Brush Wellman surface mined bertrandite ore at the Topaz-Spor Mountain area in Juab County and then trucked it to its plant near Lyndall, north of Delta, Millard County. A hydrometallurgical process was used to extract beryllium hydroxide from the bertrandite ores and in a separate circuit from beryl ores that were primarily imported from foreign sources. After treatment, the product was shipped to the company's Elmore, OH, plant for conversion to beryllium alloys, beryllia ceramic, and metallic beryllium. Commenced in 1985, a $10 million program to construct two new pits at its Juab County mine was to be completed in 1986.

Copper.—Copper production in the State plummeted in 1985 when persistent low copper prices, weak markets, high operating costs, and antiquated facilities forced the State's principal producer, Kennecott, to shut down its Utah Copper Div. The Metals Week U.S. producers' average copper cathode price rose insignificantly, from $0.66854 per pound in 1984 to $0.66966 in 1985.

For many years, Utah's principal copper producer had been Kennecott, a subsidiary of Kennecott Corp. acquired in 1981 by Standard Oil Co., formerly Standard Oil Co. of Ohio (Sohio). Standard Oil was 50% owned by British Petroleum Co. Ltd. The Utah Copper Div. at Bingham Canyon, 25 miles southwest of Salt Lake City, included one of the world's largest open pit copper mines and a precipitate plant. Sixteen miles to the north were the company's Bonneville crushing and grinding concentrator and the Magna and Arthur flotation concentrators capable of treating 108,000 short tons of ore per day; a smelter with an annual production capacity of 210,000 tons of copper anode; and a refinery with an annual capacity of 195,000 tons of copper cathode. All of these operations were shut down in 1985. The North Ore Shoot underground mine at Bingham was still being developed.

The Sohio 1985 10K Annual Report to the Securities and Exchange Commission showed that the Utah Copper Div. mined and processed 2,390,000 net tons of ore yielding 50,063 net tons of copper in 1985, compared with 21,965,000 tons of ore yielding 139,891 tons of copper in 1984. The average grade of ore mined increased from 0.663% copper in 1984 to 0.748% in 1985. Byproducts recovered, in descending order of value, were gold, molybdenum, silver, and selenium.

Operations at the Utah Copper Div. were indefinitely suspended March 31, 1985, because of continued operating losses resulting from high production costs. Standard Oil's metal mining losses (principally Kennecott) reached $165 million primarily because of costs associated with closing down the Utah facilities. Kennecott's metal mine operating losses had risen from $91 million in 1983 to $160 million in 1984. The Utah Copper Div. had operated at one-third capacity since July 1984 after union members failed to renegotiate the 1983 3-year labor agreement. In January 1985, the company's second unsuccessful attempt to gain wage and benefit concessions from representatives of its 13 international unions resulted in production being halted at the Utah Copper Div. Approximately 2,000 workers were periodically laid off as the mine, concentrators, smelter, and refinery were idled; by fall, only 250 employees remained for care-and-maintenance work.

The U.S. Department of Labor granted more than $2.6 million in aid for 3,500 to 4,000 Kennecott and support-industry workers idled by the Utah Copper Div. shutdown. Under the Job Training Partnership Act, the Wasatch Front South Private Industry Council administered the program to establish a dislocated-worker resource center and to implement job training assistance.

A 4-year engineering study of methods to modernize Kennecott's Utah facilities to gain a substantial reduction in production costs was completed in December 1985, and the company announced a 3-year, $400 million program to update the antiquated,

labor-intensive operation. The project included constructing movable in-pit crushing facilities, a 5-mile ore-conveying system, a new grinding plant at Copperton, and pipelines to carry slurry from Copperton to the existing flotation concentrators near Magna. The conveyors and pipelines would replace the existing railroad and truck-hauling system. Scheduled for completion in late 1988, the Utah Copper Div. would process 77,000 tons of ore per day and produce 185,000 tons of copper per year, plus gold, molybdenum, selenium, and silver byproducts. Approximately 2,000 hourly and salaried workers were expected to be employed, compared with 7,400 in 1981.

Concerning environmental matters, the U.S. Environmental Protection Agency (EPA) approved the revised Utah State Air Quality Implementation Plan to measure smelter sulfur dioxide emissions at the Utah Copper Div. The multipoint rollback system meant the smelter could average sulfur dioxide emissions over 1 year and would allow an unavoidable breakdown. Kennecott pollution systems removed 92% of the sulfur dioxide emissions before reaching the stack. Acceptance of the plan was critical if the company was to remain operational in Utah and necessary to be resolved before modernization could take place.

With the shutdown of the concentrators at Magna, the tailings ponds began to dry out, and blowing dust brought scores of complaints from local residents. Kennecott initiated a $3.5 million program to control the dust, including water impoundment areas on the ponds, increasing the water flow to 45,000 gallons per minute, and placing chemical stabilizers on roads.

As part of a major restructuring, Atlantic Richfield Co. (ARCO) began divesting its remaining Anaconda Minerals Co. noncoal operations. In February, the pumps were pulled at its Carr Fork underground copper-gold-silver operation, and the mine was allowed to flood. Of the remaining 35 employees, 25 were laid off and 10 retained for care and maintenance. The operation was brought on-stream in August 1979 after a $230 million, 5-year program to develop the property. High mining costs and low copper prices, however, shut down the mine in 1981, and by April 1982, 750 workers were laid off. In mid-September 1985, Kennecott reached an agreement with ARCO to purchase Anaconda Minerals' Carr Fork Mine and property bordering the Bingham Canyon Mine. Consummation of the transaction was expected to solve boundary problems

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
1983, total	6	31,152,258	238,459	$101,106,616	4,566,610	$52,242,019
1984, total	6	W	W	W	W	W
1985:						
Iron	1	265,000	--	--	2,430,000	14,925,546
Salt Lake	1	W	W	W	W	W
Tooele	1	W	W	W	--	--
Utah	1	W	W	W	W	W
Total	4	W	[1]135,489	[1]43,039,301	W	W

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1983, total	169,751	$286,403,329	--	--	--	--	$439,751,964
1984, total	W	W	W	W	W	W	W
1985:							
Iron	--	--	--	--	--	--	14,925,546
Salt Lake	W	W	--	--	--	--	W
Tooele	--	--	--	--	--	--	W
Utah	W	W	--	--	--	--	W
Total	W	W	--	--	--	--	W

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

Table 5.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1985, 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]	2	W	W	W	W	--	--
Silver[2]	1	265,000	--	2,430,000	--	--	--
Total	3	W	W	W	W	--	--
Copper	1	W	W	W	W	--	--
Other lode material:							
Gold cleanup	1	W	W	W	W	--	--
Copper precipitates	1	W	--	--	W	--	--
Total lode	4	W	[3]135,489	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 material that was leached.
[3]Includes data indicated by symbol W.

Table 6.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1985, 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	2,430,000	--	--	--
Smelting of concentrates	W	W	W	--	--
Direct smelting of:					
Ore	W	W	W	--	--
Precipitates	--	--	W	--	--
Cleanup	W	W	W	--	--
Total	[1]135,489	W	W	--	--

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

and facilitate mining Kennecott's North Ore Shoot contiguous with the Carr Fork deposit. Ore reserves were estimated at 100 million short tons averaging 1.87% copper, 0.027% molybdenum, and 0.27 troy ounce of silver per ton.[3] The Carr Fork mill operated only sporadically and was sold later in the year to Ok Tedi Mining Ltd. for use in its Papua New Guinea, gold-copper operation.[4]

The only other copper producer in the State was the Trixie Mine of Sunshine Mining Co., in the East Tintic mining district, Utah County, near Eureka. Sunshine's Trixie gold-silver-copper ore was shipped to Kennecott's Garfield smelter for use as flux. After the Garfield smelter was closed, Trixie concentrates were shipped to ASARCO Incorporated in El Paso, TX, until the East Tintic operations were temporarily suspended on September 1 because of low metal prices and because the State ordered modification of the Burgin mill tailings pond. Fifty of sixty workers at Sunshine's Eureka Div. were laid off at the Trixie Mine and Burgin mill. Development work at the Burgin Mine continued throughout the year.

Gallium and Germanium.—St. George Mining Co., a subsidiary of Musto Explorations Ltd., Vancouver, Canada, continued to develop the old Apex copper-silver-zinc property for gallium and germanium. Situated west of St. George in the Tutsagubet mining district near the southern end of the Beaver Dam Mountains, the property consisted of 22 patented and 9 unpatented mineral claims and 2 leased claims. Mineral occurrence associated with the Apex vein is in the form of an irregular chimney of leached, residual iron oxide in dolomite and limestone. Musto planned to invest more than $12 million to complete the development of the mine and to construct a processing plant.

Using stockpiled ore from the previous operation, the partial operation of the hy-

drometallurgical processing plant commenced October 27; however, some difficulties were experienced in starting up the gallium refinery. At yearend, the germanium refinery was still being constructed.[5]

Production at the Apex Mine reportedly began in December. The prior owners removed most of the copper ore, leaving behind the iron minerals goethite, hematite, and limonite that contained as much as 0.5%, 0.7%, and 0.5% germanium, respectively. As much as 0.7% gallium was concentrated in jarosite and 0.2% in limonite.[6]

Gold.—When Kennecott's Utah Copper Div. closed its Bingham Canyon Mine, byproduct gold recovery ceased and effected a sharp decline in quantity and value of the metal. The drop in the average price of gold from $360.66 per troy ounce in 1984 to $317.66 in 1985 also contributed to the decreased value of gold output. Gold producers, in descending order of output, included the Mercur gold mine of Barrick Mercur Gold Mines Inc., a subsidiary of Barrick Resources Corp. of Toronto, Canada; the Trixie Mine of Sunshine; and the Bingham Canyon Mine of Kennecott. Bingham ranked fourth among the 25 leading gold-producing mines in the United States in 1984; however, after the operation was closed in March 1985, the Mercur Mine became the principal producer in the State and was ranked eighth in the Nation. Nationally, the Trixie Mine ranked 24th.

On June 28, Barrick Resources purchased the Getty Gold Mine Co. Mercur operation from Texaco Inc. Situated in the Camp Floyd (Mercur) mining district, Tooele County, 25 miles southeast of Tooele, the Mercur gold properties acquired by Texaco in its takeover of Getty Oil Co. in 1984 were resold, partly to reduce debt and partly to dispose of Getty's assets that did not fit into Texaco's business plans. Beginning in July 1985, a pilot heap-leaching operation was constructed to add 15,000 ounces of gold per year with two leach pads built to hold a total of 300,000 short tons of low-grade ore. The mill capacity was also raised from 3,000 to 4,000 tons per day. Both improvements were expected to increase gold output from 80,000 to 105,000 ounces per year. Production costs were reported to be about $200 per ounce of gold.[7]

Iron and Steel.—Utah iron ore production from the Iron Springs mining district near Cedar City ceased in 1982, and shipments from the remaining stockpiled ore to the USS Geneva Works were concluded in 1983. Reportedly, small quantities of iron ore were shipped to cement plants in 1984 and 1985.

In 1985, pig iron shipped by the Geneva Works near Provo decreased about 3% in quantity and value; iron and steel slag sold and used decreased 56% in quantity and more than 40% in value.

The future of the Geneva Works was placed in doubt when, in December, USS and Pohang Iron and Steel Co. Ltd. (Posco) of the Republic of Korea announced a 50-50 joint venture to own, operate, and modernize the USS steel plant in Pittsburg, CA. Over the next 4 years, $300 million will be invested in expanding the operation for the more efficient production of cold-rolled sheets, galvanized sheets, tinplate, and tin-free steel, and for marketing the high-quality sheet and tin products throughout the Western United States. As it had since the end of World War II, the Geneva Works was expected to continue supplying the California plant with about 70% of its hot-rolled steel until October 1989. At that time, Federal import restrictions will expire, Posco will become the Pittsburg plant's primary source for semifinished coil, and the disposition of the Geneva Works will be decided. Constructed between 1942 and 1944, the Utah plant, in 1985, needed an estimated $1 billion modernization program that would include a new melt shop to replace outmoded open-hearth furnaces, an updated strip mill, and a continuous caster.

USS continued to supply the Geneva Works with taconite iron ore from its mines in Minnesota, a program that began when its Atlantic City, WY, iron mine was sold in 1983. As part of the divestment of other western raw material sources for the Geneva Works, the company sold its Somerset Mine and coal reserves in Colorado and its coal preparation plant at Wellington, UT, to Kaiser Coal Corp. in December 1985.

In the past 4 years, employment at the USS Utah operations dropped from 5,200 workers to 2,500. Productivity, however, increased dramatically with labor force requirements at its Geneva-Pittsburg combined operation declining from 9.2 hours per long ton of steel to 4.6 hours; 3,300 were employed at these operations.[8]

Nucor Steel Co., a division of Nucor Corp., operated its 400,000-ton-per-year steel minimill at Plymouth, Box Elder County. Products manufactured included angles, channels, coiled rounds, flats, reinforcing bars, and rounds. Nucor's Vulcraft Div. at Brig-

ham City used steel products from the Plymouth operation for manufacturing joists and joist girders. Depressed conditions of the mining industry slowed production of steel grinding balls at the Nucor Grinding Ball Div. near Brigham City.

Operations at Plymouth rose to full capacity by midyear, reflecting the restrictions imposed on foreign producers shipping to Nucor's marketing area on the west coast. Since its construction in 1981, the plant operated at 75% of capacity; however, with the increase over 1984's output, the company was forced to purchase scrap beyond its normal intermountain supply zone and adjust prices upward to meet additional freight charges.

Magnesium.—Magnesium metal production declined in quantity and value. AMAX Magnesium Corp., a subsidiary of AMAX Inc., operated the Nation's second largest magnesium plant on the south arm of Great Salt Lake at Rowley, Tooele County. Magnesium was recovered from lake brines concentrated in 40,000 acres of solar evaporation ponds, processed into magnesium chloride, and electrolytically separated into magnesium metal; chlorine and sodium chloride were produced as byproducts. According to the AMAX 1985 10K Annual Report, heavy precipitation diluting lake brines reduced magnesium metal production to approximately 31,500 short tons in 1985, compared with 35,000 tons in 1984. During the year, the company contracted with Kaiser Aluminum & Chemical Corp.'s potash operation at Wendover to supply brine.

The United Steelworkers of America, representing a majority of workers at the Rowley magnesium plant, accepted a new 3-year labor contract that provided for no wage change for the first and second year, a 25-cent-per-hour increase for the third year, a change in medical benefits, and a cut in sick pay. After the agreement was renewed on March 19, new hires received $1 per hour less than other workers.

AMAX marketed the lightweight, high-strength metal throughout the world; approximately 25% of 1985 sales were exports. Between 8 million and 10 million pounds of magnesium was supplied to the diecasting automotive parts industry.[9]

Molybdenum.—Shutdown of Kennecott's Utah Copper Div.'s Bingham Canyon Mine, the only molybdenum producer in the State, drastically reduced production and shipments of molybdenum concentrate. A byproduct of copper production, the year's quantity of molybdenum recovered dropped 83% as the company's copper output was cut, beginning March 31, 1985. The average price of molybdic oxide fell to $3.33, $0.23 less than the average price in 1984.

Silver.—Silver output tumbled in quantity and in value as the average price of the metal fell from $8.14 per troy ounce in 1984 to $6.14 in 1985 and byproduct silver from copper production was greatly reduced. The principal producer in the State was Hecla Mining Co.'s Escalante Mine, Iron County; followed by Kennecott's Bingham Canyon Mine, Salt Lake County; and Sunshine's Trixie Mine, Utah County.

The Escalante Mine, the sixth ranked silver mine in the Nation, lies 42 miles west of Cedar City, Iron County. With more than 30% of Hecla's silver production, according to the company's 1985 annual report, the operation recovered 2,438,978 ounces of silver in 1985, compared with 2,235,781 in 1984. The average ore grade was 10.15 ounces per short ton, 6.8% above that of 1984. Despite an 8% reduction in Escalante's work force, ore production increased from 286,554 tons in 1984 to 296,946 tons in 1985 and mill recoveries improved. Additional ore was developed on the southerly extension of the vein, and core drilling indicated another vein may extend north of the mine boundaries. As of December 31, 1985, reserves were estimated at 1,689,000 tons of ore with 9.7 ounces of silver per ton, compared with 1,528,000 with 9.1 ounces per ton in 1984.

With the closing of the Bingham Canyon Mine in 1985, Kennecott's Utah Copper Div. dropped out of the 25 leading silver producers in the United States; in 1984, the mine ranked ninth, even though production had been reduced one-third.

Barrick Mercur Gold Mines recovered silver as a byproduct of gold production at Mercur.

Vanadium-Uranium.—Because of the continuing depressed prices for U_3O_8 and increased imports of natural and enriched uranium, vanadium production from uraniferous sandstone ores of the Colorado Plateau ceased. The Engineering and Mining Journal average price for domestic 98% fused vanadium pentoxide (V_2O_5) was $3.35 to $3.65 per pound, a price held since May 1981. Nuexco's Exchange Value prices for U_3O_8 in concentrates, down from a $24 per pound level in 1983, ranged from a low of $14.25 per pound to $17.00 per pound at yearend.[10]

Two companies processed uranium ores

in the State; Umetco Minerals Corp. and Energy Fuels Nuclear Inc. joint venture, 6 miles south of Blanding, and Rio Algom Ltd., near La Sal, recovered uranium, but no coproduct vanadium. Atlas Corp.'s uranium-vanadium mines and mill near Moab remained on standby.

The joint venture of Umetco (70%) and Energy Fuels (30%), on standby since January 1983, resumed operations on October 1, and by October 31, had reached 1,500 short tons per day of its 2,000-ton-per-day rated capacity. The company's White Mesa mill toll processed a small amount of stockpiled ore from independent producers on the Colorado Plateau, and high-grade uranium ore from Energy Fuels' Arizona Strip properties. Between October 1985 and January 1987, Umetco expected to recover 5.7 million pounds of uranium and 2.5 million pounds of vanadium from 638,000 tons of ore. About 103 workers were employed at the Blanding mill.

According to its annual report for the fiscal year ending June 30, 1985, Atlas made one sale of 135,000 pounds of U_3O_8 and completely exhausted its V_2O_5 inventory with the sale of 1,028,000 pounds of the product. The company's Pandora, Rim Columbus, and Velvet Mines and Moab mill were maintained so they could be reactivated within 6 to 8 weeks should the market improve. Feasibility and economic studies on the Farley uranium and vanadium deposit and plans to build a processing plant near Ticaboo, Garfield County, were completed; however, further action depended on better U_3O_8 prices and markets.

On July 2, Argee Corp., Denver, CO, commenced removing radioactive tailings from the 125-acre site of the old Vitro Chemical Co. uranium-vanadium plant in the Salt Lake City metropolitan area. Two years will be required to transport the approximately 3.2 million tons of tailings to the Clive repository site 35 miles west of Grantsville. The Union Pacific and the Denver & Rio Grande Railroads carried the chemically stabilized and monitored shipments. At the 100-acre Tooele County site, tailings were dumped into trenches, covered with 6 feet of radon barrier, and topped with 2 feet of riprap; the Salt Lake site was expected to be used for a refuse-burning system and wastewater treatment plant. The U.S. Department of Energy contributed 90% and the State 10% of the funds for the $42 million project.

Early in February, the families of 24 miners who contracted cancer after working in central Utah uranium mines were awarded more than $1.19 million in partial settlement of a lawsuit against Foote Mineral Co. of Exton, PA. The miners worked at Vanadium Corp. of America's (VCA) operations near Marysvale, Piute County, from 1949 to 1968; VCA was merged into Foote Mineral in 1967. A U.S. District Court judge, on July 1, ruled the Federal Government was immune from the negligence claims of the Marysvale miners. Plaintiffs held the Federal Government had inspected the mines and had failed to warn the miners of the observed high levels of radon-222 gas and its radioactive daughter products in the poorly ventilated uranium mines.

Zirconium.—Western Zirconium Inc. continued producing primary zirconium sponge and coproduct hafnium sponge and converted the zirconium sponge to ingot. At its plant in the Southern Pacific Industrial Park, south of Ogden, Weber County, the product was produced from zircon concentrates imported from Australia.

INDUSTRIAL MINERALS

Asphalt (Native) and Other Bitumens.—Gilsonite, a solidified hydrocarbon found only in Utah and Colorado, was mined from veins near Bonanza, Uintah County, by American Gilsonite Co., a division of Chevron Resources Co. (a subsidiary of Chevron Corp.); Ziegler Chemical and Mineral Corp.; and Hydrocarbon Mining Co. (a subsidiary of Oberon Oil Inc.). The product was marketed for automobile body sealer and radiator paint, inks, oil well-drilling fluids, cement for sand molds in foundries, and other uses. Because of reduced oil well drilling, gilsonite output declined 57%; value, however, decreased only 3%.

Cement.—Finished portland cement output increased 3%; sales increased more than 10.5% in quantity and about 16% in value as nonresidential construction reached a record high and residential building activity, although still depressed, began to recover. The average price per short ton of portland cement rose about 5% in 1985 from $53.93 in 1984. A small amount of cement was transported by rail, but most was trucked in bulk to the consumers.

Masonry cement output declined slightly; however, sales increased 41% in volume and 37% in value. Ideal Basic Industries Inc. was the only producer.

Portland cement producers included the

Southwestern Portland Cement Co. 550,000-short-ton-per-year-capacity, dry-process plant at Leamington, Millard County; the Ideal Basic Industries, 350,000-ton-per-year, wet-process plant at Devils Slide, Morgan County; and the Lone Star Industries Inc., 420,000-ton-per-year, wet-process plant at Salt Lake City.

An experimental precast seawall was erected along a 1,200-foot stretch of Interstate 80 on Great Salt Lake near Black Rock, 20 miles west of Salt Lake City. Seventy-six precast concrete slabs, 8 feet high and 16 feet long, and concrete rods for support were constructed in southwestern Utah at Elsinore, Sevier County; all but two panels were coated with a new polymer to reduce erosion. The State's $9 million contract provided for elevating the highway and laying the dike to prevent Great Salt Lake from flooding the interstate.

Clays.—Clay and shale output, including bentonite, common clay, and fire clay, increased in quantity and value; the average unit value increased marginally from $7.14 in 1984 to $7.55 in 1985.

Producers of common clay included Cedarstrom Calcite & Clay, Interpace Corp., Redmond Clay and Salt Co., Southwestern Portland Cement, and Utelite Corp.

Swelling bentonite was mined by Redmond Clay and Salt and by Western Clay Co. at Redmond, Sevier County. R. D. Wadley Clay Co. mined fire clay at its Wadley pit, Utah County.

The common clays were used mainly for manufacturing face brick and lightweight aggregate, followed by portland cement and animal feed. The expanded aggregate was used largely in structural concrete and block. Swelling bentonite was used for adhesives, animal feed, drilling mud, and waterproof sealant. Fire clay was used for foundry purposes.

Graphite (Synthetic).—Hercules Inc., Aerospace Div., continued producing synthetic graphite at its Bacchus Works near Salt Lake City. Synthetic graphite high-modulus fibers were manufactured for use in place of metals in aerospace equipment, leg braces, tennis rackets, and other purposes where weight was an important factor. Synthetic graphite output increased about 24% in quantity and nearly 33% in value.

Gypsum.—Crude gypsum production increased nearly 49% in quantity and nearly 51% in value, and output of calcined gypsum used for wallboard rose about 12% in quantity and more than 32% in value. Georgia-Pacific Corp. and United States Gypsum Corp. (a subsidiary of USG Corp.) continued as the principal producers of crude and calcined gypsum. Gypsum was mined 9 and 7 miles northeast of the companies' crushing and processing facilities, respectively, at Sigurd, Sevier County.

Crude gypsum was also open pit mined by Thomas Peck & Sons Inc. at the mouth of Salt Creek Canyon, east of Nephi, Juab County. The State Air Conservation Committee temporarily shut down the mine because of excessive dust. The operation supplied gypsum for cement plants in Juab and Salt Lake Counties and to a plant at Inkom, ID.

Lime.—Quicklime production dropped substantially in quantity and value when Kennecott shut down its copper operation. Hydrated lime output, however, gained in quantity and value. Leading quicklime producers included Continental Lime Inc., a subsidiary of Steel Bros. Canada Ltd., 35 miles south of Delta and 6 miles west of the plant at the base of the Cricket Mountains, Millard County; Utah Marblehead Lime Co., a subsidiary of General Dynamics Corp., 35 miles northwest of Grantsville, Tooele County; Genstar Lime Co., a subsidiary of Genstar Corp., Toronto, Canada, at Grantsville, Tooele County; and Kennecott's Utah Copper Div. Genstar continued as the sole producer of hydrated lime.

Magnesium Compounds.—Magnesium compounds output increased 82% in quantity and 13% in value. Great Salt Lake Minerals & Chemicals Corp. obtained magnesium chloride and other products from the brines of Great Salt Lake west of Ogden, Weber County. Magnesium chloride in bitterns, the final product from the solar evaporation of lake brines, was used primarily as a dust suppressant for roads in industrial areas and in the sugar beet processing industry. Kaiser recovered magnesium compounds and other products from subsurface brines of the Bonneville Salt Flats on the western edge of the Great Salt Lake Desert, near Wendover, Tooele County. AMAX contracted to buy brine from Kaiser when a shortage at its plant prevented AMAX from operating at capacity. Great Salt Lake Minerals had a rated production capacity of 100,000 short tons of MgO equivalent; Kaiser, a capacity of 50,000 short tons.

Perlite (Expanded).—Perlite was shipped in from out of State for expansion at the

Pax Co. plant in Salt Lake County and at the Georgia-Pacific plant at Sigurd. Production of the treated product increased 18% in quantity and about 6% in value.

Phosphate Rock.—Chevron Resources continued as the only phosphate rock producer in the State and mined phosphate rock from the Upper Permian age Park City Formation 12 miles north of Vernal, Uintah County.

Marketable phosphate rock production declined about 12% in quantity and 15% in value in 1985, whereas the combined output from Idaho, Montana, and Utah, producing nearly 9% of the Nation's phosphate, fell 18%.

Chevron's $250 million phosphate fertilizer complex under construction in Wyoming and Utah neared completion. Included was a $70 million modernization and expansion project of the mine and beneficiation plant at Vernal, UT, and a 94-mile pipeline (longest in the world) to carry the phosphate rock slurry to a new ammonium phosphate fertilizer plant in Rock Springs, WY. At the Vernal operation, the production capacity was expected to be raised from about 800,000 short tons to 1.3 million tons per year by increasing the portable in-pit crushing capacity from 500 tons to 1,500 tons per hour, upgrading the mill equipment, installing a semiautogenous mill, and other improvements. The 125 workers employed in the Brush Creek area in 1985 will be increased to 180 when the expansion is completed.

Chevron will continue shipping phosphate concentrates to its Garfield plant near Magna for conversion to ammonium phosphate and superphosphoric acid until 1986, when the Rock Springs facility will come on-stream and the Garfield plant will close. Annual capacity of the 30-year-old Garfield plant was 200,000 tons of phosphate concentrate. Reduced industrial demand and a recession in the agricultural industry prompted Chevron to scale down the size of the Rock Springs plant from an annual capacity of 400,000 tons of ammonium phosphate to 200,000 tons.[11]

Potash.—Nationally, Utah ranked second in potash production, behind New Mexico and followed by California. Production in Utah increased 22%, but declined in the other two States. Utah sales, however, plummeted 42% in quantity and 61% in value (K_2O equivalent) because of depressed fertilizer markets and low prices. The increase in output was partly attributed to resumed production at one operation and a change in the harvest schedule of another.

Two companies, Texasgulf Chemicals Co. of Texasgulf Inc. and Kaiser Chemicals of Kaiser Aluminum & Chemical, recovered potassium salts in the State. Texasgulf, a subsidiary of Société Nationale Elf Aquitaine (a 67% French Government-controlled oil company), continued recovering potassium salts at its Cane Creek operation near Moab, Grand County. Pennsylvanian age evaporites were solution mined with geothermal heat used to dissolve the potash at a depth of over 2,700 feet. Brines were evaporated on 400 acres of solar ponds, and salts harvested and processed by flotation to recover potassium salts and byproduct salt.

According to the Elf Aquitaine Inc. 1985 annual report, potash production was 163,000 short tons in 1985, up almost 15% from that of 1984. The increased output was attributed to deferring the harvest of some 1984 potash from the solar ponds until 1985. Sales in North America, however, declined, and the work force at Moab was reduced 18% because of low fertilizer demands.

The Kaiser solar evaporation operation near Wendover covered about 87,816 acres from which, in normal times, natural brines were collected in 140 miles of ditches on the Bonneville Salt Flats of the Great Salt Lake Desert. The brines were concentrated in a primary 8,000-acre evaporation pond. Potassium salts were processed through a flotation concentrator to separate the halite (sodium chloride) and sylvite (potassium chloride). Kaiser resumed production in 1985 after being idle most of 1984 because of excessive precipitation and flooding in the area.

Great Salt Lake Minerals normally recovered potassium sulfate (also called sulfate of potash), salt, sodium sulfate, and magnesium chloride from the concentrated brines of Great Salt Lake. The 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. Production processes included selective crystallization and deposition of salts on solar evaporation ponds. Salts were then harvested and the products either sold in a crude state or processed into finished commodities at nearby plants.

On May 5, 1984, nearly 85% of its solar evaporation ponds were flooded when the outer dike of the system was breached, resulting in severe damage to dikes, pond floors, bridges, pump stations, and other structures. Diluted brine solutions were un-

suitable for producing potassium sulfate. Before the flooding of its ponds, the firm was the largest producer of potassium sulfate, a specialty fertilizer, in the United States. In mid-1985, rebuilding of the pond floors commenced; however, it was expected to take several years before full production of potassium sulfate could be resumed. Output of the product remained at zero. By yearend, repair of the pond system was 90% complete, with the total cost since the breach reaching $11 million; $4.6 million was spent in 1985. The insurance company advanced Great Salt Lake Minerals $22.8 million for restoring production and business interruption by December 31, 1985. From 1983 to 1985, $19.4 million was spent protecting the pond system. High levels of Great Salt Lake delayed the company's program to expand the solar evaporation ponds to 34,000 acres.

Climax Chemical Co. at Grantsville, Tooele County, converted from manufacturing sodium sulfate to manufacturing potassium sulfate. In 1985, 8,000 tons of K_2O equivalent potassium sulfate was produced.

Salt.—Solar salt was produced in Grand County by Texasgulf; in Salt Lake County by Morton Salt Co., a division of Morton-Thiokol Inc.; in Tooele County by American Salt Co., a subsidiary of General Host Corp.; and in Weber County by Great Salt Lake Minerals. In Grand County, Moab Brine Co., a subsidiary of La Sal Oil Co., recovered salt from brine; and in Sevier County, Redmond Clay and Salt obtained rock salt at the American Orsa open pit salt mine at Redmond. Salt sales increased about 5% in quantity; however, its value nearly stabilized with a posted 0.6% decline.

As shown in its 10K Annual Report, Great Salt Lake Minerals produced 260,000 short tons of processed salt and 244,000 tons of wet common salt. The plant has an annual capacity of 400,000 tons of kiln-dried salt, which was partly used for water softening and chemical processing.

Lakepoint Salt Co., purchased from Domtar Industries Inc. by AMAX, was placed into a new subsidiary, Sol-Aire Salt & Chemical Co., formed to market AMAX Magnesium's byproduct salt. Situated 20 miles east of the AMAX plant at Rowley, Lakepoint's salt recovery ponds were flooded by heavy precipitation and the rising waters of Great Salt Lake.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; the 1985 chapter contains only estimates. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel producers continued to face controversy from local residents in the vicinity of proposed or operating pits. The presence of dust, noise, trucks, and the close proximity to homes caused great concern.

The product decreased in quantity, but increased in value.

Industrial.—The U.S. Bureau of Mines surveys industrial sand production every year. Utah's only producer, Salt Lake Valley Sand & Gravel Co., Salt Lake County, marketed the commodity for molding and core and for sandblasting.

Sodium Sulfate.—Sodium sulfate production and value in the State plummeted. Although Great Salt Lake Minerals recovered sodium sulfate from Great Salt Lake brines at its operation west of Ogden in 1984, the May 1984 dike breach completely interrupted production in 1985. The product was sold from stocks for use in detergent, glass industries, and paper.

At its Grantsville, Tooele County, plant, Climax Chemical's modification to produce potassium sulfate instead of sodium sulfate resulted in a loss of 135,000 short tons of sodium sulfate annual capacity.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Crushed stone production declined in quantity and value partly because of the drop in residential construction, the slowdown in steel manufacturing, and the shutdown of the copper industry in the State. Crushed stone use continued for repairing flood-damaged roads and for raising and strengthening dikes protecting the railroads and highways on the shores of Great Salt Lake. In 1985, crushed limestone and dolomite production reached 4,363,850 short tons valued at $13,389,186; crushed sandstone and quartzite, 196,611 short tons valued at $475,836; volcanic cinder and scoria, 96,107 short tons valued at $313,795; and other stone, 195 short tons valued at $1,560. The average unit value of crushed stone quarried was $3.05 per ton. Crushed stone was produced at 36 quarries in 16 counties; the leading county was Box Elder, followed by Juab, Tooele, Morgan, Millard, and Salt

Lake Counties.

Listed in descending order of output, the following companies quarried limestone: Southern Pacific Transportation Co., Box Elder County, for riprap and jetty stone; Southwestern Portland Cement, Juab County, for cement; Continental Lime, Millard County, for lime manufacture; Ideal Basic Industries, Morgan County, for cement; Lone Star Industries, Salt Lake and Tooele Counties, for cement; USS, Utah County, for its steel operation; Gibbons & Reed Co.'s Concrete Products Co. and McFarland & Hullinger, both in Tooele County, for concrete; and Cedarstrom Calcite, Utah County, for poultry grit. Utah Marblehead quarried dolomitic limestone in Tooele County for dead-burned dolomite and a refractory stone for metallurgical purposes. Genstar Lime, Tooele County, also quarried dolomite in Tooele County. The U.S. Forest Service also quarried limestone in Box Elder, Daggett, Duchesne, Garfield, Kane, Millard, Sanpete, Uintah, and Utah Counties. Sandstone was quarried by Ideal Basic Industries, Morgan County, for cement manufacture, while Southwestern Portland Cement mined quartzite in Juab County for the same purpose. The Cache County Road Department crushed sandstone for dense road base and unpaved road surfaces. Volcanic rock was quarried by Diversified Marketing Services Inc., Millard County, for lightweight aggregate, and by Lava Products Inc. for unpaved road surfaces for terrazzo and exposed stone.

Crushed stone and pulverized slag from the Garfield smelter were used to raise Interstate 80 and the Union Pacific Railroad main line along the south shore of Great Salt Lake. The $28 million Union Pacific project was in addition to the company's $90 million program to rehabilitate the former Western Pacific Railroad main line from northern Utah to the San Francisco Bay area.

Table 7.—Utah: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	642	2,169
Other coarse aggregate	84	106
Coarse aggregate, graded: Railroad ballast	147	636
Combined coarse and fine aggregates:		
Graded road base or subbase	894	1,937
Unpaved road surfacing	78	141
Other construction[2]	12	147
Other coarse and fine aggregate	3	6
Chemical and metallurgical: Cement manufacture	1,507	5,173
Special:		
Other miscellaneous[3]	776	2,394
Other unspecified[4]	513	1,471
Total	[5]4,657	14,180

[1]Includes dolomite, limestone, quartzite, sandstone, volcanic cinder and scoria, and miscellaneous stone.
[2]Includes poultry grit and other uses not specified.
[3]Includes lime manufacture, flux stone, and sulfur oxide removal.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data do not add to total shown because of independent rounding.

Dimension.—Star Stone Inc. produced dimension sandstone from its quarry in Box Elder County.

Sulfur (Recovered).—Sulfur recovered from the Chevron Oil Co. refinery declined in quantity produced and shipped; however, value of those shipments increased about 5%.

Sulfuric Acid.—Utah continued to rank third nationally in the output of byproduct sulfuric acid. Recovered as a byproduct of copper production, the quantity and value of the product plummeted with the shutdown of the Utah Copper Div. operation.

Vermiculite (Exfoliated).—Intermountain Products Inc. produced exfoliated vermiculite at its plant in Salt Lake City; the vermiculite was shipped in from out of State. The product was marketed for use principally as block and loose-fill insulation and fireproofing, followed by soil conditioning and concrete and plaster aggregates.

[1]State Mineral Officer, Bureau of Mines, Denver, CO.

[2]Foot, D. G., Jr., J. D. McKay, and J. L. Huiatt. Column Flotation of Chromite and Fluorite Ores. Can. Metall. Q., v. 25, No. 1, 1986, pp. 15-21.

McKay, J. D., D. G. Foot, Jr., and J. L. Huiatt. Column Flotation of Montana Chromite Ore. Min. Metall. Process., v. 3, No. 3, Aug. 1986.

[3]Mine Development. Bimonthly, Boulder, CO, Oct. 31, 1985, p. 2.
[4]Epler, B. Ok Tedi Buys Carr Fork Mill, Options Copper Flats Plant. Rocky Mountain Pay Dirt, No. 76, Jan. 1986, p. 9B.
[5]Walenga, K. Southwestern Utah Mine, Plant Coming On-Line. Rocky Mountain Pay Dirt, No. 77, Feb. 1986, pp. 4A-5A.
[6]Bernstein, L. R. Geology and Mineralogy of the Apex Germanium-Gallium Mine, Washington County, Utah. U.S. Geol. Surv. Bull. 1577, 1986, 9 pp.
[7]Walenga, K. Mercur Expanding Gold Production With Leaching Facilities. Rocky Mountain Pay Dirt, No. 73, Oct. 1985, p. 20A.
[8]Mangum, G., and S. Y. Kim. Geneva in the Utah Economy; Retrospect and Prospect. UT Econ. Bus. Rev., v. 45, No. 12, Dec. 1985, pp. 1-21.
[9]American Metal Market. Aug. 8, 1986, p. 5.
[10]White, G., Jr. Uranium Uncertainties Abound. Eng. and Min. J., v. 187, No. 3, Mar. 1986, pp. 64-65.
[11]Walenga, K. Chevron's $250 Million Fertilizer Project Is Well Along. Rocky Mountain Pay Dirt, No. 78, Mar. 1986, p. 15A.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt:			
American Gilsonite Co., a subsidiary of Chevron Corp.	Kennecott Bldg., Suite 1150 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]	Box 8789 Denver, CO 80201	Quarries and plant	Morgan.
Portland Cement Co. of Utah, a division of Lone Star Industries Inc.[1]	Box 90765 Houston, TX 77290	do	Salt Lake and Tooele.
Southwestern Portland Cement Co., a subsidiary of Southdown Inc.[1 2]	Box 21158 Salt Lake City, UT 84121	do	Millard.
Clays:			
Interpace Corp., Structural Div.	736 West Harrisville Rd. Box 447 Ogden, UT 84402	Open pit mines and plant	Utah.
Interstate Brick Co., a subsidiary of Mountain Fuel Co.	9780 South 5200 West West Jordan, UT 84084	do	Box Elder, Tooele, Utah.
Utelite Corp	Box 387 Coalville, UT 84017	Open pit mine and plant	Summit.
Western Clay Co.[1]	Box 1067 Aurora, UT 84620	Open pit mines	Sevier.
Copper:			
Kennecott, a subsidiary of Kennecott Corp., Utah Copper Div.[3]	1129 East 3900 South Box 6500 Salt Lake City, UT 84106	Open pit mine, mills, smelter, refinery.	Salt Lake.
Gold:			
Barrick Mercur Gold Mines Inc., a subsidiary of Barrick Resources Corp.	Box 838 Tooele, UT 84074	Open pit mine, mill, carbon-in-pulp plant.	Tooele.
Sunshine Mining Co., Precious Metals Group.[4]	815 Park Blvd., No. 100 Boise, ID 83712	Underground mines and mill	Utah.
Gypsum:			
Georgia-Pacific Corp	Box 80 Sigurd, UT 84657	Open pit mine and plant	Sevier.
United States Gypsum Co., a subsidiary of USG Corp.	Box 120 Sigurd, UT 84657	do	Do.
Iron and steel:			
United States Steel Corp.[1]	Geneva Works Box 510 Provo, UT 84603	Steel plant	Iron.
Lime:			
Continental Lime Inc., a subsidiary of Steel Bros. Canada Ltd.[1]	268 West 400 South Suite 201 Salt Lake City, UT 84101	Quarry and plant	Millard.
Genstar Lime Co., a subsidiary of Genstar Corp.[1]	Box 357 Grantsville, UT 84029	Open pit mine and plant	Tooele.
Utah Marblehead Lime Co., a subsidiary of General Dynamics Corp.[1]	Box 596 Grantsville, UT 84029	do	Do.
Magnesium:			
AMAX Magnesium Corp., a subsidiary of AMAX Inc.	238 North 2200 West Salt Lake City, UT 84116	Plant and solar evaporation ponds.	Do.
Phosphate rock:			
Chevron Resources Co., a subsidiary of Chevron Corp.	Manila Star Route Vernal, UT 84078	Open pit mine and plant	Uintah.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Potassium salts:			
Great Salt Lake Minerals & Chemicals Corp., a division of Gulf Resources & Chemicals Corp.[5]	765 North 10500 West Little Mountain Box 1190 Ogden, UT 84402	Plant, concentrator, solar evaporation ponds.	Weber.
Kaiser Aluminum & Chemical Corp., Bonneville Ltd. Div.[6]	Box 580 Wendover, UT 84083	____do _____	Tooele.
Texasgulf Inc., a subsidiary of Société Nationale Elf Aquitaine.[7]	Box 1208 Moab, UT 84532	Solution mine, solar evaporation pond, concentrator, plant.	Grand.
Salt:			
American Salt Co _____	Box 477 Grantsville, UT 84029	Plant _____	Tooele.
Morton Salt Co., a division of Morton-Thiokol Inc.	A.M.F. Box 22054 Salt Lake City, UT 84122	____do _____	Salt Lake.
Sand and gravel:			
Construction:			
Concrete Products Co., a division of Gibbons & Reed Co.[2]	41 West Central Ave. Box 7356 Murray, UT 84107	Pits and plant _____	Davis, Salt Lake, Summit, Tooele, Utah, Weber.
Peter Kiewit and Sons Co.	370 West 5900 South Box 7780 Murray, UT 84107	____do _____	Sevier.
Monroc Inc _____	1730 North Beck St. Box 537 Salt Lake City, UT 84110	____do _____	Salt Lake.
Jack B. Parson Construction Co.	Box 3429 Ogden, UT 84409	Pits and plants _____	Box Elder, Cache, Davis, Morgan.
Industrial:			
Salt Lake Valley Sand & Gravel Co.	800 North 1550 West Orem, UT 84057	Pit _____	Salt Lake.
Silver:			
Hecla Mining Co., Escalante Unit.	Box 308 Enterprise, UT 84725	Underground mine, mill, plant.	Iron.
Stone:			
Crushed:			
Diversified Marketing Services Inc.	Box 1181 Fillmore, UT 84631	Quarry and plant _____	Millard.
Lava Products Inc ____	94 West Tabernacle St. George, UT 84770	____do _____	Washington.
McFarland & Hullinger	Box 238 Tooele, UT 84074	____do _____	Tooele.
Southern Pacific Transportation Co.	One Market Place San Francisco, CA 94105	____do _____	Box Elder.
Dimension:			
Star Stone Inc _____	Box 211 Oakley, ID 83346	____do _____	Do.
Vanadium:			
Atlas Corp., Atlas Minerals Div.	Box 1207 Moab, UT 84532	Underground mines and mill _	Emery, Grand, San Juan.
Energy Fuels Nuclear Inc __	Box 787 Blanding, UT 84511	Underground mines, ore-buying station, research laboratory.	Emery, Garfield, San Juan.
Umetco Minerals Corp., a subsidiary of Union Carbide Corp.	Box 1029 Grand Junction, CO 81501	Underground mines and mill _	Grand and San Juan.

[1]Also stone.
[2]Also clays.
[3]Also gold, lime, molybdenum, rhenium, selenium, and silver.
[4]Also silver.
[5]Also magnesium compounds, salt, and sodium sulfate.
[6]Also magnesium compounds.
[7]Also salt.

The Mineral Industry of Vermont

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Office of the State Geologist, Agency of Environmental Conservation, for collecting information on all nonfuel minerals.

By L. J. Prosser, Jr.,[1] and Charles A. Ratté[2]

The value of nonfuel mineral production in Vermont increased by about $5 million to about $50 million in 1985. An increase in demand resulted in higher unit prices for dimension stone products and in a nearly $6 million gain in value for that commodity. Nationally, Vermont ranked third in dimension stone production, but first in value of production.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel (construction) thousand short tons	3,802	$8,071	e2,700	e$7,000
Stone:				
Crushed do.	e1,800	e7,000	1,689	7,468
Dimension do.	e116	e20,462	116	26,346
Combined value of talc and other industrial minerals	XX	9,565	XX	9,040
Total	XX	45,098	XX	49,854

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

Table 2.—Nonfuel minerals produced in Vermont in 1984, by county[1]

County	Minerals produced in order of value
Addison	Sand and gravel (construction).
Bennington	Do.
Caledonia	Do.
Chittenden	Do.
Essex	Do.
Franklin	Do.
Lamoille	Do.
Orange	Do.
Orleans	Asbestos, sand and gravel (construction).
Rutland	Sand and gravel (construction).
Washington	Do.
Windham	Talc, sand and gravel (construction).
Undistributed[2]	Stone (dimension and crushed), gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Vermont business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	525	530	535
Total civilian labor force	do	265	269	277
Unemployment	percent	6.9	5.2	4.8
Employment (nonagricultural):				
Mining total	thousands	0.6	0.5	0.5
Manufacturing total	do	47.6	49.0	49.5
Stone, clay, and glass products	do	2.1	2.1	2.3
Chemicals and allied products[1]	do	.8	.8	.8
Construction	do	10.9	12.2	14.4
Transportation and public utilities	do	8.7	9.2	9.4
Wholesale and retail trade	do	44.1	46.9	50.1
Finance, insurance, real estate	do	8.9	9.3	10.0
Services	do	49.3	51.3	52.8
Government and government enterprises	do	36.3	36.5	37.0
Total	do	206.4	214.9	[2]223.8
Personal income:				
Total	millions	$5,486	$5,984	$6,482
Per capita		$10,441	$11,292	$12,117
Hours and earnings:				
Total average weekly hours, production workers		40.0	40.6	40.7
Total average hourly earnings, production workers		$7.7	$8.0	$8.4
Earnings by industry:				
Farm income	millions	$92	$84	$79
Nonfarm	do	$3,778	$4,146	$4,551
Mining total	do	$24	$27	$25
Manufacturing total	do	$1,064	$1,143	$1,224
Primary metal industries	do	$15	$18	$18
Stone, clay, and glass products	do	$47	$49	$53
Chemicals and allied products	do	$14	$16	$16
Construction	do	$292	$336	$389
Transportation and public utilities	do	$243	$267	$283
Wholesale and retail trade	do	$599	$657	$736
Finance, insurance, real estate	do	$160	$172	$213
Services	do	$801	$903	$990
Government and government enterprises	do	$567	$612	$661
Construction activity:				
Number of private and public residential units authorized[3]		2,881	3,930	4,161
Value of nonresidential construction[3]	millions	$87.3	$143.2	$160.7
Value of State road contract awards[3]	do	$30.5	$42.5	$68.5
Shipments of portland and masonry cement to and within the State[4]	thousand short tons	137	149	216
Nonfuel mineral production value:				
Total crude mineral value	millions	$42.1	$45.1	$49.9
Value per capita		$80	85	$93

[p]Preliminary. [r]Revised.
[1]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2]Data do not add to total shown because of independent rounding.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.
[4]Has no cement producing plants.

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

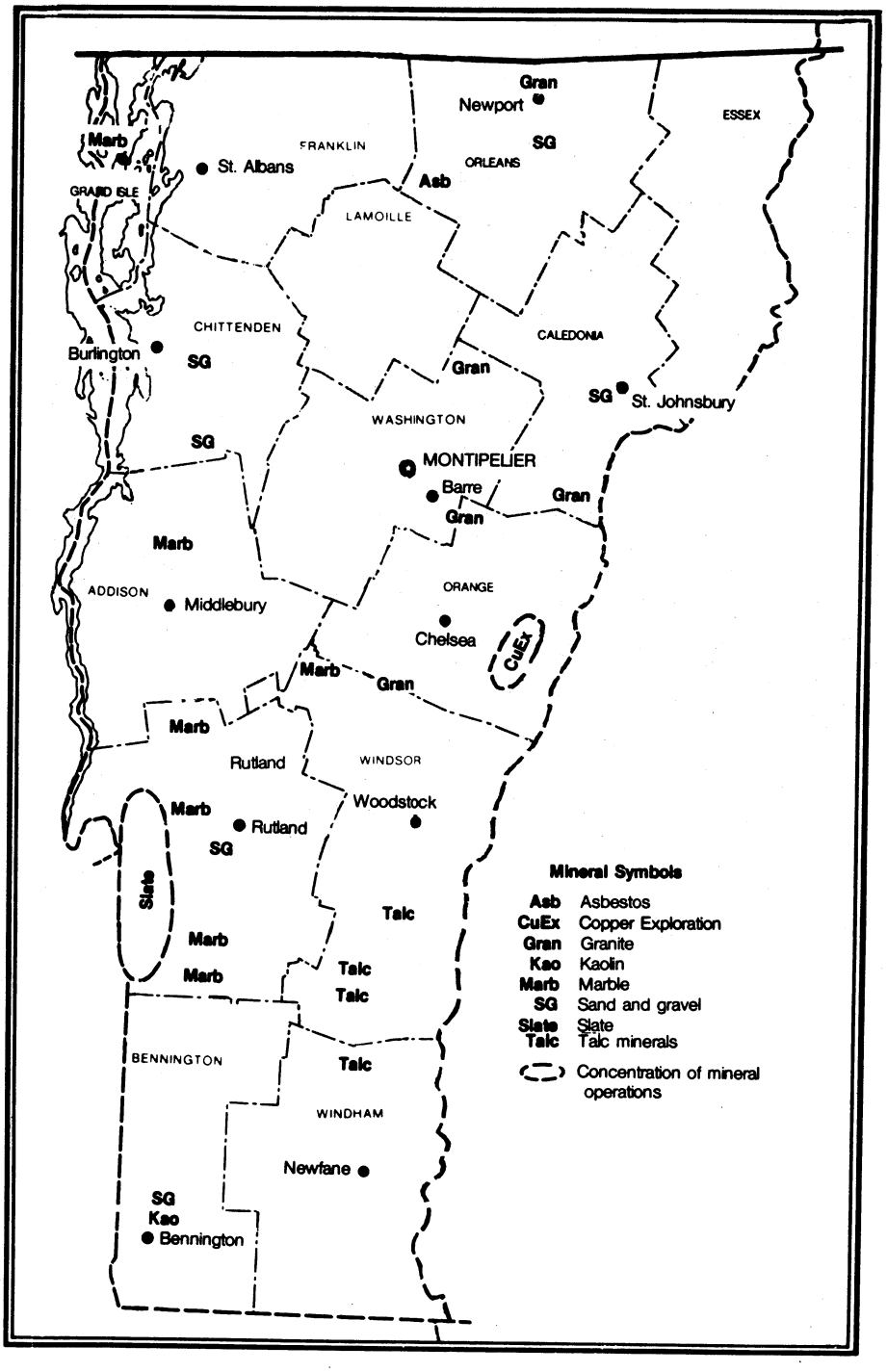

Figure 1.—Principal mineral producing localities in Vermont.

Exploration Activities.—Newmont Mining Corp. discontinued an exploration program for copper in the Corinth-Topsham area in Orange County. Newmont was also interested in precious metals, which are often associated with copper deposits, but copper was considered the primary ore.

In southwestern Vermont near Bennington, Vermont Minerals & Pigments Co., an affiliate of the Holland Co. in Massachusetts, temporarily withdrew plans to mine kaolin at Bald Mountain. The firm has been attempting to receive local approval to operate a strip mine and processing plant at the site since 1979.

Legislation and Government Programs.—In the 1985 legislative session, two bills on ground water that indirectly affect the mining- and minerals-related industries were passed. Public Act 69 abolished the common law doctrine of absolute ownership of ground water, and Public Act 53 established four classes of water and authorized the Agency of Environmental Conservation to develop a ground water management program. Traditionally, the mining industry uses water in both extracting and processing mineral commodities. Legislation to officially create a Vermont Geological Survey died in committee.

The Office of the State Geologist, Agency of Environmental Conservation, continued cooperative agreements with the U.S. Bureau of Mines for the purpose of maintaining statistical data on mineral production and with the U.S. Geological Survey (USGS) for geologic mapping and mineral resource data. During the year, compilation of data for all of the State's industrial mineral resources continued with completion expected by yearend 1986.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Asbestos.—The Vermont Asbestos Group Inc. (VAG) operated one of three domestic asbestos mines at Lowell, Orleans County. Shipments dropped by about 21% in 1985 and since 1983 declined by more than 50%. In December, the U.S. Environmental Protection Agency (EPA) proposed regulations that included phasing out asbestos mining and banning asbestos use within 10 years. At the same time, EPA proposed an immediate ban on the manufacture, importation, and processing of asbestos construction products such as asbestos cement pipes and fittings, roofing and flooring felts, vinyl asbestos, floor tile, and asbestos clothing.

In 1985, VAG employed about 100 workers; in the mid-1970's, nearly 200 workers were employed at the Lowell asbestos operations. Continued health-related concerns about asbestos products culminating with the EPA proposal were expected to eventually result in the closing of the Lowell Mine. However, because VAG's sales are primarily for friction products such as brake linings, the firm was expected to be in operation in 1986. In addition, about 50% of VAG's shipments was overseas.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Based on these estimates, sand and gravel production declined by 1.1 million short tons in 1985.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Since 1983, the year of the last full canvass of crushed stone data, production increased about 26%. A comparison of 1983 and 1985 data showed 10 quarries accounted for all the output in both years. Chittenden County accounted for more than one-half of the State's total production. The quantity of crushed stone produced in the county in 1985 was about 75% greater than the amount reported in 1983. The increased output in Chittenden County was indicative of expansion in Burlington, the State's most populated city.

During the year, one of the State's producers, Swanton Limestone Co. in Franklin County, received approval to mine limestone at a quarry in Fonda Junction. The firm also mined limestone at two other quarries in the county. End products included aglime, marketed primarily in Canada; poultry grit shipped to Maine; and roadstone sold locally.

Table 4.—Vermont: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate, graded: Concrete aggregate, coarse	368	1,690
Combined coarse and fine aggregate: Other construction[2]	1,321	5,778
Special uses: Other unspecified[3]	W	W
Total	1,689	7,468

W Withheld to avoid disclosing company proprietary data; included with "Other construction."
[1]Includes granite, limestone, marble, slate, and miscellaneous stone.
[2]Includes stone used in bituminous aggregate (coarse), graded road base, bituminous surface treatment aggregate, unpaved road surfacing, riprap and jetty stone, filter stone, stone sand (bituminous mix or seal), crusher run or fill or waste, other uses not listed, stone used for other construction and maintenance purposes, and use indicated by symbol W.
[3]Includes production reported without a breakdown by end use and estimates for nonrespondents.

Dimension.—Dimension stone remained Vermont's leading commodity, accounting for more than 50% of the State's total mineral production value. Nationally, Vermont ranked second to Georgia in dimension granite production, and combined with New Hampshire, these three States produced more than one-half of the U.S. total. Vermont ranked second in the Nation in output of dimension marble behind Georgia. In slate, Vermont and Pennsylvania accounted for 70% of the U.S. output. Hilltop Slate Co. with quarries in Vermont and New York was sold to Penrhyn Quarries Ltd., a subsidiary of Alfred McAlpine PLC of the United Kingdom.

Vermont also produced about 40% of the slate sold for roofing in the United States. Output of roofing slate in the State in 1985 was about 4,800 short tons or about four times the amount produced in 1983. Architectural trends, along with concern about forest fires by west coast homeowners, rekindled use of slate in the roofing industry.

Table 5.—Vermont: Dimension stone[1] sold or used by producers in 1985, by use

Use	Quantity (short tons)	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Rough blocks for building and construction	10,782	125	$1,388
Monumental	87,727	1,081	13,780
Dressed stone:			
Flagging	5,541	61	1,709
Roofing slate	4,835	53	1,987
Flooring slate	2,968	33	1,267
Other[2]	4,313	50	6,215
Total	116,166	[3]1,404	26,346

[1]Includes granite, marble, and slate.
[2]Includes ashlars, partially squared pieces, dressed monumental, and stone used for structural and sanitary purposes.
[3]Data do not add to total shown because of independent rounding.

Talc.—Vermont ranked third nationally in talc production. Output in 1985 was up slightly compared with that of 1984. Developments during the year included the purchase of Acqui-Tal Inc. by Vermont Talc Co., a subsidiary of OMYA Inc. Acqui-Tal operated a mill in Johnson and had been purchasing talc from Vermont Talc's mine in Windham. The purchase of the mill in Johnson, in which talc was processed by flotation, enabled Vermont Talc to produce a cosmetic grade of talc and a finer ground grade used as filler in paints.

Windsor Minerals Inc. obtained land use permits to mine property adjacent to its Ludlow operations. Development of an open pit mine is expected to begin in 1986.[3] Windsor, a subsidiary of Johnson & Johnson Inc., also operated a mine near Reading and processed both industrial and cosmetic grades of talc.

Cyprus Industrial Minerals Co. planned to file for State permits to mine talc and operate a processing plant in Chester. Construction of the operations was expected to cost $10 million and have a capacity of 40,000 short tons per year.

[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.
[2]State geologist, Agency of Environmental Conservation, Montpelier, VT.
[3]Mulryan, J. D. Industrial Minerals 1985, Talc. Min. Eng., v. 38, No. 5, May 1985, p. 368.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Vermont Asbestos Group Inc	Box 54B Morrisville, VT 05661	Pit	Orleans.
Sand and gravel (construction):			
Calkins Sand & Gravel Inc	Box 82 Lyndonville, VT 05851	Pits and plant	Caledonia and Orleans.
Joseph P. Carrara & Sons Inc	Route 116 Middlebury, VT 05753	Pits	Addison and Rutland.
William E. Daily Inc	Route 1, Box 51 Shaftsbury, VT 05262	____do	Bennington.
Hinesburg Sand & Gravel Co	Box 200 Hinesburg, VT 05461	____do	Chittenden.
Pike Industries Inc	Route 3 Tilton, NH 03276	____do	Addison, Caledonia, Windsor.
Frank W. Whitcomb Construction Corp	Box 429 Bellows Falls, VT 05101	Pit and plant	Rutland.
Stone:			
Crushed:			
Cooley Asphalt Paving Corp	Box 542 Barre, VT 05641	Quarry	Washington.
Pike Industries Inc	Route 3 Tilton, NH 03276	____do	Caledonia.
Frank W. Whitcomb Construction Corp.	Box 429 Bellows Falls, VT 05101	Quarries	Chittenden.
White Pigment Corp	Florence, VT 05744	____do	Addison and Rutland.
Dimension:			
OMYA Inc	Box 10 Florence, VT 05744	Quarry and plant.	Rutland and Windsor.
Rock of Ages Corp., a subsidiary of John Swenson Granite Co. Inc.	Box 482 Barre, VT 05641	Quarries	Washington and Windsor.
John Swenson Granite Co. Inc	North State St. Concord, NH 03301	Quarry	Washington.
Talc:			
OMYA Inc	Chester, VT 05143	Mine and mill	Windham.
Windsor Minerals Inc	Box 680 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]

Virginia's mineral sales during 1985 reached a new record high, exceeding the record established in 1984 by almost $40 million. Increased sales were reported in 12 of the 14 mineral commodities produced in the Commonwealth, while production increased in 13 of the 14 minerals mined instate.

Nationally, Virginia ranked 15th in industrial mineral production and 21st in total nonfuel mineral output.

Virginia led the Nation in the production of kyanite and in a feldspar mineral marketed as "Virginia aplite," ranked fourth in iron oxide pigment sales, ninth in lime sales, and was one of three States with vermiculite production.

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

Mineral		1984		1985	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	712	$6,004	814	$6,977
Gem stones		NA	20	NA	20
Iron oxide pigments, crude	short tons	W	W	2,080	W
Lime	thousand short tons	562	24,799	633	28,103
Sand and gravel (construction)	do.	8,860	37,359	e10,200	e42,000
Stone:					
Crushed	do.	e47,200	e196,000	51,686	221,900
Dimension	do.	e22	e3,052	10	3,136
Combined value of aplite, cement, gypsum, kyanite, sand and gravel (industrial), talc (soapstone), vermiculite, and values indicated by symbol W		XX	74,355	XX	79,140
Total		XX	341,589	XX	381,276

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

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

Table 2.—Nonfuel minerals produced in Virginia in 1984, by county[1]

County	Minerals produced in order of value
Accomack	Sand and gravel.
Albemarle	Do.
Amelia	Clays.
Augusta	Sand and gravel.
Bedford	Do.
Botetourt	Cement, clays.
Buckingham	Kyanite.
Campbell	Sand and gravel.
Caroline	Do.
Charles City	Do.
Charlotte	Do.
Chesapeake (city)	Do.
Chesterfield	Sand and gravel, clays.
Fairfax	Sand and gravel.
Franklin	Talc.
Frederick	Sand and gravel, lime.
Giles	Lime.
Gloucester	Sand and gravel.
Grayson	Do.
Hanover	Aplite, sand and gravel.
Henrico	Sand and gravel.
Henry	Do.
Isle of Wight	Do.
James City	Do.
King and Queen	Clays, sand and gravel.
King George	Sand and gravel.
King William	Do.
Louisa	Vermiculite.
Middlesex	Sand and gravel.
Montgomery	Clays.
New Kent	Sand and gravel.
Northampton	Do.
Orange	Clays.
Pittsylvania	Sand and gravel.
Prince George	Do.
Prince William	Clays.
Pulaski	Iron oxide pigments.
Roanoke	Clays.
Rockbridge	Do.
Rockingham	Sand and gravel.
Shenandoah	Lime.
Smyth	Gypsum, clays.
Southampton	Sand and gravel.
Spotsylvania	Do.
Stafford	Do.
Suffolk (city)	Do.
Sussex	Do.
Tazewell	Clays.
Virginia Beach (city)	Sand and gravel.
Warren	Cement, lime.
Westmoreland	Sand and gravel.
Wythe	Iron oxide pigments.
Undistributed[2]	Stone (crushed and dimension), clays, gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Virginia business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	5,559	5,636	5,706
Total civilian labor force	do	2,722	2,840	2,872
Unemployment	percent	6.1	5.0	5.6
Employment (nonagricultural):				
Mining total[1]	thousands	17.4	18.3	17.3
Nonmetallic minerals except fuels[2]	do	2.3	2.4	2.5
Coal mining	do	14.9	15.5	14.6
Oil and gas extraction[2]	do	.2	.2	.2
Manufacturing total	do	403.6	421.3	423.3
Primary metal industries	do	10.1	10.9	10.9
Stone, clay, and glass products	do	12.4	13.5	14.6
Chemicals and allied products	do	32.3	32.6	31.4
Petroleum and coal products[2]	do	W	W	W
Construction	do	113.9	132.8	151.3
Transportation and public utilities	do	120.4	127.2	131.8
Wholesale and retail trade	do	480.2	516.5	545.2
Finance, insurance, real estate	do	110.1	117.1	122.9
Services	do	460.4	495.1	537.6
Government and government enterprises	do	500.9	505.0	517.6
Total	do	2,206.9	2,333.3	[3]2,447.1
Personal income:				
Total	millions	$69,516	$76,565	$82,980
Per capita		$12,505	$13,586	$14,542
Hours and earnings:				
Total average weekly hours, production workers		39.7	40.3	40.1
Total average hourly earnings, production workers		$7.8	$8.1	$8.5
Earnings by industry:				
Farm income	millions	$124	$413	$249
Nonfarm	do	$47,947	$53,177	$58,300
Mining total	do	$701	$858	$842
Metal mining	do	$5	$5	$5
Nonmetallic minerals except fuels	do	$49	$56	$62
Coal mining	do	$559	$684	$671
Oil and gas extraction	do	$88	$113	$104
Manufacturing total	do	$8,621	$9,439	$9,996
Primary metal industries	do	$302	$343	$350
Stone, clay, and glass products	do	$251	$287	$317
Chemicals and allied products	do	$961	$1,021	$1,051
Petroleum and coal products	do	$16	$17	$18
Construction	do	$2,882	$3,475	$4,044
Transportation and public utilities	do	$3,553	$3,980	$4,298
Wholesale and retail trade	do	$7,125	$7,931	$8,663
Finance, insurance, real estate	do	$2,180	$2,426	$2,850
Services	do	$9,380	$10,705	$12,155
Government and government enterprises	do	$13,324	$14,182	$15,246
Construction activity:				
Number of private and public residential units authorized[4]		53,773	60,348	64,120
Value of nonresidential construction[4]	millions	$1,409.3	$1,841.6	$2,058.9
Value of State road contract awards	do	$261.0	$773.0	$575.0
Shipments of portland and masonry cement to and within the State	thousand short tons	1,793	2,112	2,293
Nonfuel mineral production value:				
Total crude mineral value	millions	$289.3	$341.6	$381.3
Value per capita		$52	$61	$67

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

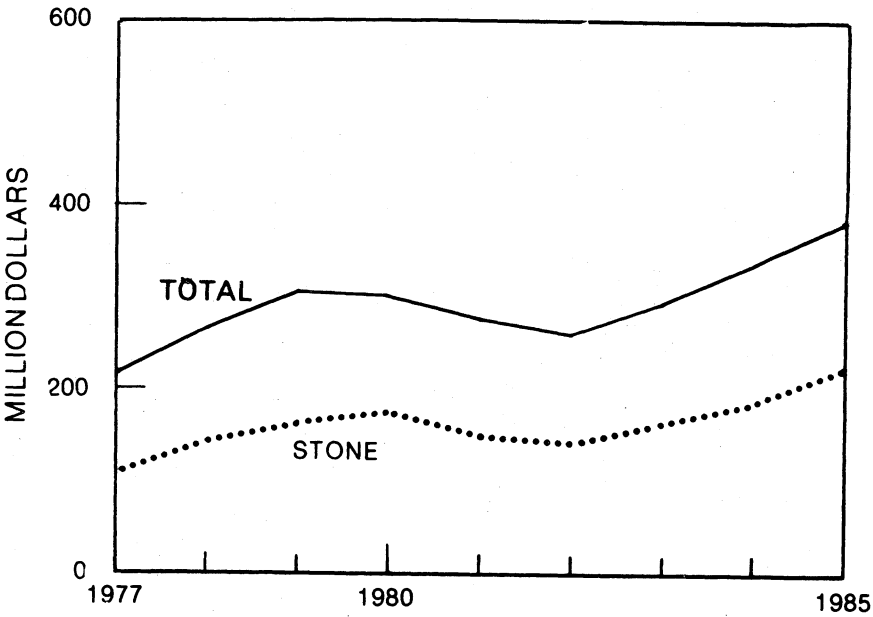

Figure 1.—Value of stone and total value of all nonfuel mineral production in Virginia.

Trends and Developments.—Much of Virginia's nonfuel mineral output is used in construction, and 1985 was a better-than-average year for the State's construction industry. Construction employment averaged 151,300 in 1985, an increase of about 14% over that of 1984. Total housing units authorized by building permits increased 6.3% in 1985 compared with that of 1984. The strong showing by construction resulted in an increase of $31.5 million in sales of construction minerals, clays, sand and gravel, and stone.

The demand for construction mineral commodities was strong in the northern Virginia-Washington, DC, area because of the expansion and growth in the high-technology industries and the demand for residential housing. Growth was also strong in the Richmond area, and aggregate companies in the eastern part of the State benefited from the infusion of Federal funds into the Norfolk-Newport News area. The Elkton area construction mineral producers felt the benefits of the construction of a $5 million brewery.[3]

The State's mineral fuel industry also experienced a good year with a record high 44.3 million short tons of coal produced. The increased production was due primarily to the installation of additional longwall mining equipment. Mineral fuel production for the period 1981-85, as reported by the Virginia Division of Mineral Resources, was as follows:

		1981	1982	1983	1984	1985
Natural gas	million cubic feet	8,902	6,880	4,347	8,900	14,800
Petroleum	barrels	13,244	49,425	65,443	32,000	27,000
Coal	million short tons	42.0	40.5	35.5	41.4	44.3

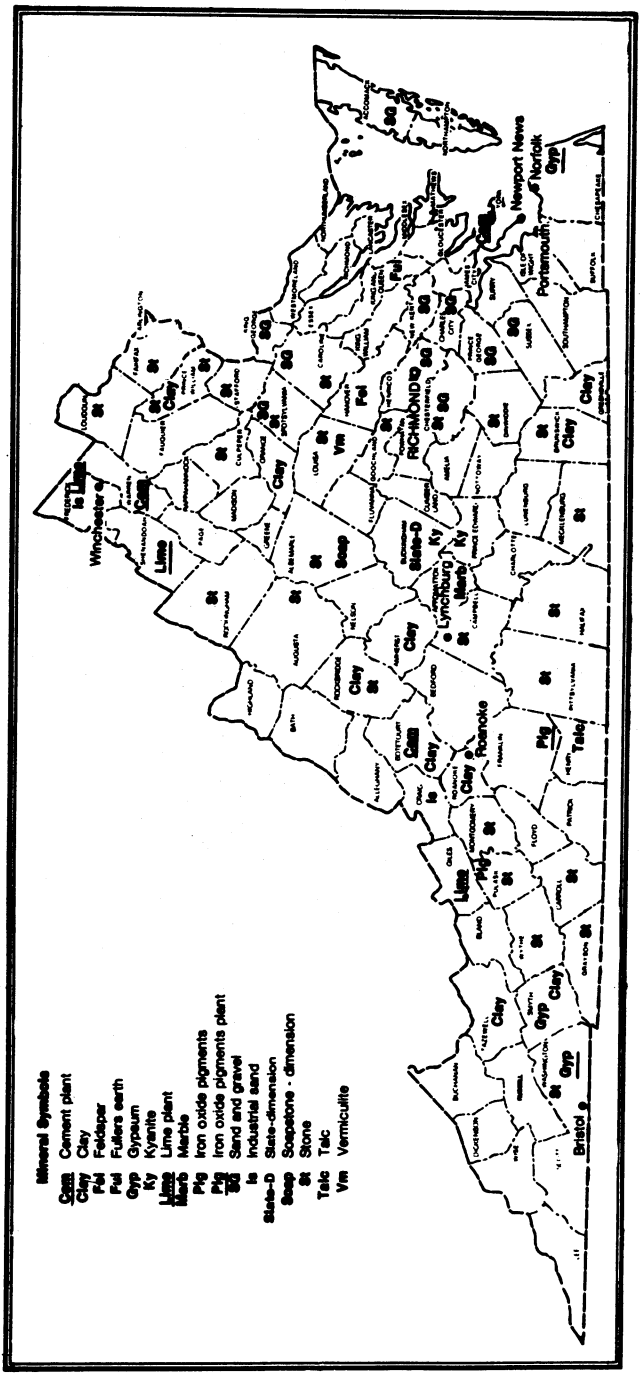

Figure 2.—Principal mineral producing localities in Virginia.

Unfortunately, coal mining employment did not parallel the increase in production. Coal mining employment averaged 14,600 in 1985, down 900 from that of 1984. The unemployment rate in several of the coal mining counties in the southwestern part of Virginia varied from 10% to over 20% during much of the year.

Coal was the largest volume commodity shipped through the Port of Hampton Roads, gaining 22% over the tonnage exported in 1984. Other mineral or mineral-based commodities that experienced an increase during 1985 were petroleum, salt, and fertilizers.

East Tennessee Natural Gas Co., Bristol, announced plans to construct a $20 million natural gas pipeline in 1986. The 33-mile pipeline, which will extend from Nora to Abingdon, will transport gas reserves owned by Equitable Resources Energy Co. A 3,600-horsepower compressor station will be constructed at Nora.[4]

In other fuel-related activity, Virginia Power Corp. unveiled plans to construct a 400-megawatt, coal gasification-combined cycle generating station at Dutch Gap near Richmond. The $500 million facility will use the British Gas-Lurgi slaggering gasification process and General Electric turbines to process 80,000 to 950,000 tons of coal per year. The company is seeking $200 million in Government assistance for the project from the $750 million clean coal technology reserve established by Congress.[5]

Legislation and Government Programs.—The Virginia House of Delegates defeated legislation that would have authorized the construction of a coal slurry pipeline. The bill would have allowed the condemnation of public and private land for the 400-mile, billion-dollar project. The slurry line would have extended from the coalfields in the southwestern part of the State to the Port of Hampton Roads.

The Virginia Division of Mineral Resources, one of four divisions in the Department of Mines, Minerals and Energy, is headquartered in Charlottesville and maintains branch offices in Abingdon, Blacksburg, and Williamsburg.

The division's programs include physiographic research to revise, describe, and promote topographic maps of Virginia, and geologic research and mapping to disseminate information concerning mineral and energy resources and environmental conditions throughout the State. These activities are conducted by a professional staff of 26 geologists supported by geochemical and photographic laboratories, cartographic and editorial personnel, well-cutting and rock sample repositories, a geoscience library, and a sales office through which nearly 14,000 copies of maps and publications are disseminated annually.

Geologic-topographic information and technical assistance is provided to approximately 20,000 governmental, industrial, municipal, educational, civic, and residential clients each year.

Several Federal agencies had programs relating to the State's mineral industry. The U.S. Geological Survey (USGS) announced the recovery of "potentially significant concentrations of minerals" from seafloor deposits off Virginia's coast. The work, part of the exploration of the Exclusive Economic Zone, was carried out aboard the USGS research vessel *J. W. Powell.* Initial onboard analysis of the seabed material indicated concentrations of 3% to 10% heavy minerals, including zircon and ilmenite, from deposits 5 to 10 miles off the coast.

The Office of Surface Mining (OSM) awarded $9.6 million to the State to reclaim 26 abandoned mining sites in 9 southwestern counties. In addition to this grant, OSM provided the State with $1.2 million to administer the reclamation program.

The Mine Safety and Health Administration awarded the State $242,000 for a mine safety education program. The State contributed $50,000 for the program, which was initiated by the 1983 McClure Mine disaster in Dickenson County that killed seven miners.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

The value of Virginia's nonfuel mineral production established a new record high in 1985. Those commodities with the greatest increase in output were crushed stone, construction sand and gravel, and portland cement.

Aplite.—The Hanover-Amherst County area in eastern Virginia contains a feldspar mineral termed "Virginia aplite." The name evolved when rail shipping rates were higher for feldspar than for aplite. In 1985, two companies mined the feldspar mineral as an ingredient in glass manufacture and for aggregate applications.

The Feldspar Corp. operated a mine and beneficiation plant near Montpelier in Hanover County. The ore, 65% feldspar, was mined by open pit methods and trucked to a beneficiation plant adjacent to the mine. After grinding, the material passed through spiral separators, was dried, sized, passed through magnetic separators, and then conveyed to storage silos. Principal sales were to the manufacturers of beer bottles and fiberglass.

Dominion Stone Plant Inc. mined an "aplite" deposit in Amherst County. The material was crushed and screened and sold for use as an aggregate.

Cement.—Virginia's cement industry is centered in Warren and Botetourt Counties and in the city of Chesapeake. Three companies operated seven kilns to manufacture portland, masonry, and calcium aluminate cement. Sales increased 9% over those reported for 1984.

Lone Star Cement Inc. produced portland and masonry cement at a five-kiln plant in western Virginia. Raw materials used included Ordovician limestones, shale, and mill scale purchased from Roanoke Electric Steel Corp.

Lone Star Lafarge Inc. manufactured calcium aluminate cement at a single-kiln plant at Chesapeake on the coast of Virginia. This plant was one of three calcium aluminate cement operations in the United States.

Riverton Corp. operated a one-kiln masonry plant in northern Virginia. Raw material for the process included portland cement purchased from other companies and locally mined limestone.

Clays.—Virginia's clay industry, 10 companies operating 15 mines in 11 counties, ranked 14th nationally in common clay output in 1985.

With one exception, common clay and shale was the only clay material mined. Over 86% of common clay and shale was used in the manufacture of brick. The remainder was processed into pipe tile and lightweight aggregate. The exception was one company that produced cylinders of clay (clay dummies) used for blasthole stemming in coal mining.

During 1985, Old Virginia Brick of Salem was sold and came under new management. The company operated two plants in the Salem area, one producing wood mold brick and the second extruded brick.

Gypsum.—United States Gypsum Co., a subsidiary of USG Corp., operated an underground gypsum mine at Locust Cove in western Virginia. Crude gypsum from the Locust Cove operation was trucked to Plasterco where it was used in a company-owned wallboard plant. The company operated a second wallboard plant at Norfolk using gypsum from company-owned mines in Canada. Anhydrite from the Canadian mines was imported and marketed as a set retarder in cement manufacture.

Iodine.—Chilean Nitrate Sales Corp., Norfolk, is the U.S. marketing agent for Sociedad Química y Minera de Chile (SOQUIMICH). Iodine was produced as a coproduct of nitrate processing in Chile. Chilean Nitrate maintained a terminal and warehouse at Hampton Roads.

Iron Oxide Pigments.—Hoover Color Corp. processed, at a plant at Hiwassee, crude pigments mined under contract for a variety of industrial uses. Hoover also purchased a small tonnage of crude pigment material mined by Virginia Earth Pigments Co. and purchased imported pigment for processing.

Blue Ridge Talc Co. Inc. purchased iron ore stockpiled in northern Michigan for grinding and calcining to produce a pigment material at its grinding plant in the Franklin-Henry Counties area. Much of Blue Ridge's output was used in paint colorant.

Kyanite.—Ore from Kyanite Mining Corp.'s East Ridge and Willis Mountain Mines accounts for the largest part of U.S. production. The mines and processing plant are south of Dillwyn in Buckingham County. Approximately 35% of Virginia's kyanite output is shipped through the Port of Hampton Roads to overseas markets. Much of the production for domestic markets is shipped by rail from Dillwyn. The company also markets a sand obtained during kyanite processing.

Lime.—Virginia ranked ninth among the 36 lime producing States. The State's lime industry is summarized in the following table:

Company	County	Mine type
Chemstone Corp	Shenandoah	Surface.
W. S. Frey Co. Inc	Frederick	Do.
Riverton Corp	Warren	Do.
Shenvalley Lime Corp	Frederick	Plant.
USG Industries Inc	Giles	Underground.
Virginia Lime Co	do	Do.

Table 4.—Virginia: Lime sold or used by producers, by use

Use	1984		1985	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Paper and pulp	183,179	$7,391	W	W
Steel, basic oxygen furnace	106,446	4,558	89,314	$3,967
Water purification	70,936	3,231	W	W
Acid water, neutralization	43,771	1,830	W	W
Other[1]	157,953	7,789	543,386	24,136
Total	562,285	24,799	632,700	28,103

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes alkalies, calcium aluminate cement, citric acid, chrome, fertilizer, insecticides, insulation, other chemical and industrial uses, other metallurgy, paint, precipitated calcium carbonate (1984), road stabilization, soil stabilization, steel (electric), sugar refining, tanning (1984), and data indicated by symbol W.

Lithium Compounds.—Foote Mineral Co. operated a lithium hydroxide plant at Sunbright. The plant in southwestern Virginia received lithium carbonate from Foote's mining-processing complex at Kings Mountain, NC, for converting to the hydroxide state. Output from the Sunbright facility was used primarily for multipurpose grease manufacture.

Mica.—Newport News was the site of mica fabricating plants operated by Asheville Mica Co. and an affiliate, Mica Company of Canada. Plate mica products were fabricated by Asheville Mica from crude sheet mica imported from Madagascar and India. Mica Co. of Canada used splittings from the Asheville Mica operation to fabricate reconstituted plate mica. Scrap from the two operations was shipped to a company plant at Asheville, NC, for grinding. The two companies also imported mica washers.

Phosphate Compounds.—Texasgulf Chemical Co. began operation of an animal and poultry feed supplement plant at Saltville. Raw materials used in the process included phosphate rock and phosphoric acid obtained from the company's mining and beneficiation complex at Lee Creek, NC, and limestone mined in Virginia. The plant is situated at the former Greer Lime Co. facility.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. The data for odd-numbered years are based on annual company estimates made before yearend.

The Directory of the Mineral Industry in Virginia—1985 lists 117 construction sand and gravel companies with operations in 45 of Virginia's cities and counties. The estimated production exceeded that reported in 1984 by 1.34 million short tons.

Industrial.—Three companies in Campbell and Frederick Counties and in the city of Virginia Beach produced industrial sand used in a variety of applications. Sales to the container and flat glass manufacturers exceeded three-quarters of the total sand produced, and other markets included molding sand, specialty products, chemical usage, and traction applications.

Slag—Steel.—Slag produced in steelmaking at Roanoke Electric Steel and Intercoastal Steel Corp. was crushed by individual contractors and sold for aggregate applications.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Virginia's crushed stone industry consisted of 59 companies operating 97 mines in a 47-county-city area. Value and output exceeded that estimated in 1984 by $25.9 million and nearly 4.5 million tons, respectively, because of the strong showing of the State's construction industry.

Table 5.—Virginia: Principal crushed stone producing counties in 1985

County	Number of companies	Stone type	County	Number of companies	Stone type
Albemarle	2	Basalt and granite.	Lee	3	Limestone.
Amherst	2	Slate and feldspar.	Loudoun	5	Diabase.
Appomattox	5	Limestone.[1]	Louisa	1	Granite.
Augusta	2	Limestone.	Montgomery	2	Limestone.
Botetourt	3	Do.	Nottoway	2	Granite.
Brunswick	2	Granite.	Pittsylvania	1	Sandstone.
Buckingham	1	Slate.	Prince William	2	Basalt and diabase.
Caroline	1	Granite.	Pulaski	2	Limestone.
Chesterfield	2	Do.	Richmond (city)	1	Granite.
Culpeper	3	Diabase and sandstone.	Roanoke	1	Limestone.
Dinwiddie	1	Granite.	Roanoke (city)	1	Do.
Fairfax	2	Granite and diabase.	Rockbridge	2	Do.
Fauquier	3	Basalt.	Rockingham	4	Do.
Floyd	1	Amphibolite.	Russell	5	Do.
Frederick	4	Limestone.	Scott	1	Do.
Goochland	3	Granite.	Shenandoah	1	Do.
Grayson	1	Basalt.	Spotsylvania	1	Granite.
Greene	1	Granite.	Stafford	1	Do.
Greensville	1	Do.	Tazewell	4	Limestone.
Halifax	1	Do.	Warren	1	Do.
Hanover	1	Do.	Washington	3	Do.
Harrisonburg (city)	1	Limestone.	Wise	2	Do.
Henrico	1	Granite.	Wythe	5	Do.
Henry	2	Do.			

[1]Includes marble.

Table 6.—Virginia: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	200	696
Riprap and jetty stone	504	2,828
Filter stone	302	1,366
Coarse aggregate, graded:		
Concrete aggregate, coarse	8,967	40,588
Bituminous aggregate, coarse	2,786	13,521
Bituminous surface-treatment aggregate	3,720	18,380
Railroad ballast	1,484	5,838
Fine aggregate (-3/8 inch):		
Stone sand:		
Concrete	2,550	13,117
Bituminous mix or seal	401	1,546
Screening, undesignated	1,592	6,901
Combined coarse and fine aggregates:		
Graded road base or subbase	10,019	41,196
Unpaved road surfacing	2,465	7,581
Crusher run or fill or waste	7,276	28,074
Other construction[2]	2,670	11,096
Agricultural:		
Agricultural limestone	1,021	7,933
Poultry grit and mineral food	47	448
Chemical and metallurgical:		
Cement manufacture	1,616	2,680
Glass manufacture	36	321
Special:		
Asphalt fillers or extenders	6	16
Other fillers or extenders	362	4,201
Roofing granules	(3)	1
Other miscellaneous[4]	1,308	5,198
Other unspecified[5]	2,355	8,372
Total[6]	51,686	221,900

[1]Includes dolomite, granite, limestone, sandstone, slate, traprock, and miscellaneous stone.
[2]Includes stone used in terrazzo and exposed aggregate, coarse aggregate, and stone used for other construction and maintenance purposes.
[3]Less than 1/2 unit.
[4]Includes stone used for lime manufacture, abrasives, mine dusting, sugar refining, and waste material.
[5]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[6]Data may not add to totals shown because of independent rounding.

Dimension.—Eight companies produced a variety of dimension stone types in 1985. Reported value increased slightly over the 1984 figure.

Two companies quarried slate in the Arvonia area of Buckingham County. Arvonia slate production began in the late 1700's, and the area supplied roofing slate for the Commonwealth's capital in Richmond. Roofing tiles are still produced, as well as a wide range of stone for exterior and interior applications.

Table 7.—Virginia: Dimension stone producing counties in 1985

County	Number of quarries	Stone type
Albemarle	1	Soapstone.
Buckingham	2	Slate.
Campbell	1	Quartzite.
Culpeper	1	Diabase.
Fauquier	2	Quartzite.
Hanover	1	Granite.
Nelson	1	Soapstone.

Sulfur (Recovered).—Elemental sulfur was recovered from hydrogen sulfide gas by the Claus process during the refining of crude oil. Amoco Oil Co. operated Virginia's only refinery-sulfur recovery unit in York County near Yorktown.

Talc.—A limited tonnage of talc chlorite dolomite schist was mined under contract for Blue Ridge Talc in Franklin County in south-central Virginia. The material was ground at a plant on the border of Franklin and Henry Counties for sale as a releasing agent in mold coatings. The plant also ground iron ore from Michigan for use as a paint coloring agent.

Vermiculite.—The State continued as one of three with vermiculite production. Louisa County was the site of Virginia Vermiculite Ltd.'s mine and beneficiation plant. The operation, near Boswells Tavern, produced raw vermiculite ore from an open pit mine, which was trucked to an adjacent plant where desliming, flotation, and screening were used to produce four basic-sized products. Most of the material was shipped to exfoliation plants by rail.

METALS

Gold.—Billiton Exploration U.S.A. Inc. continued its exploration activities for gold and silver (precious metals) along the gold-pyrite belt in the central part of the State.

Callahan Mining Corp. drilled several core holes in Fauquier County at two abandoned mines, the Franklin and the Little Elliot. These properties were examined in 1983, and in early 1984, a company spokesperson noted "mixed results". No additional core drilling was programmed.

Iron and Steel.—Two companies, Intercoastal Steel and Roanoke Electric Steel, operated minimills at Chesapeake and Roanoke. The two mills produced carbon reinforcing bars, hot-rolled bars, and bar-sized light shapes.

In 1985, Roanoke Electric Steel's sales exceeded $100 million for the first time; this was a 21.8% increase over 1984 sales. The 1985 figure includes sales performance by Socar Inc., a bar joint manufacturer in South Carolina and Ohio.

Roanoke Electric Steel began a $14 million rolling mill expansion and modernization program in 1984 that is scheduled for completion in 1987. The expansion will increase rolling mill capacity by approximately 100,000 short tons and reduce steel production costs.[6]

Magnetite.—Reiss Viking Corp. operated a grinding plant in Tazewell County to produce ground magnetite used in coal washing plants in Alabama, Kentucky, Tennessee, and Virginia. Lump magnetite was shipped to the plant from out-of-State sources.

Manganese.—Gabon manganese ore was imported by Union Carbide Corp. and ground at a plant at Newport News. The ground material was shipped to company plants for use in battery manufacture.

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

[2]Head geologist, Economic Geology Section, Virginia Division of Mineral Resources.

[3]Rock Products. Aggregates: No Miracles and No Surprises. V. 88, No. 12, Dec. 1985, p. 35.

[4]American Metal Market. Natural Gas Pipeline To Be Built in VA. Aug. 23, 1985.

[5]Synfuels Week. VA Power Plans 400 Mw CGCC Plant. Mar. 25, 1985, p. 1.

[6]American Metal Market. Resco Cracks $100 M Sales Barrier. Jan. 9, 1986, p. 3.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County or city
Aplite:			
The Feldspar Corp	Route 1, Box 305 Montpelier, VA 23192	Quarry and plant	Hanover.
Cement:			
Lone Star Cement Inc.[1]	Box 27 Cloverdale, VA 24077	do	Botetourt.
Lone Star Lafarge Inc	Box 5128 Chesapeake, VA 23320	Plant	Chesapeake (city).
Riverton Corp.[2]	Riverton, VA 22651	Quarry and plant	Warren.
Clays:			
Brick and Tile Corp	Box 45 Lawrenceville, VA 23868	Pits and plant	Brunswick and Greensville.
General Shale Products Corp	Box 3547 Johnson City, TN 37601	do	Rockbridge, Smyth, Tazewell.
Webster Brick Co. Inc	Box 12887 Roanoke, VA 24029	do	Botetourt and Orange.
Gypsum:			
United States Gypsum Co., a subsidiary of USG Corp.	Box 4686 Norfolk, VA 23523	Plant	Norfolk (city).
Do	Route 1 Saltville, VA 24370	Mine and plant	Smyth and Washington.
Iron oxide pigments (crude):			
Hoover Color Corp	Box 218 Hiwassee, VA 24347	do	Pulaski.
Kyanite:			
Kyanite Mining Corp	Dillwyn, VA 23936	Mines and plant Plant	Buckingham. Prince Edward.
Lime:			
W. S. Frey Co. Inc	Box 65 Clear Brook, VA 22624	do	Frederick.
National Gypsum Co	Route 635 Ripplemead, VA 24150	do	Giles.
Shenvalley Lime Corp	Box 6 Stephens City, VA 22655	do	Frederick.
Virginia Lime Co	Route 635 Ripplemead, VA 24150	do	Do.
Perlite (expanded):			
Manville Building Materials Corp	Box 442 Woodstock, VA 22644	do	Shenandoah.
Sand and gravel (Construction, 1984):			
Lone Star Cement 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 15480 Richmond, VA 23227	do	Henrico.
Stone:			
W. W. Boxley Co	Box 13527 Roanoke, VA 24034	Quarries	Bland, Botetourt, Campbell, Henry, Richmond (city), Tazewell.
Luck Stone Corp	Box 29682 Richmond, VA 23229	do	Albemarle, Augusta, Fairfax, Goochland, Halifax, Mecklenburg, Pittsylvania, Prince William, Rockingham, Washington.
Vulcan Materials Co., Midsouth Div	Box 7 Knoxville, TN 37901	do	Washington.
Talc:			
Blue Ridge Talc Co. Inc.[3]	Box 39 Henry, VA 24102	Quarry and plant	Franklin.

[1]Also stone.
[2]Masonry cement only; also produces limestone and lime.
[3]Also finished iron oxide pigments.

The Mineral Industry of Washington

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

By Leon E. Esparza[1] and Nancy L. Joseph[2]

Washington's nonfuel mineral production value in 1985 was $244 million, an increase of 20% from the $203 million recorded in 1984. Industrial minerals accounted for 81% of the total nonfuel value for the year; gold and silver made up the remainder. Sand and gravel was the leading commodity produced in terms of value, followed by cement, gold, stone, lime, and diatomite. Washington ranked 31st in the Nation in the value of its nonfuel minerals production for 1985, up from its 33d ranking in 1984.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	292	r [2]$1,598	243	$1,402
Gem stones	NA	200	NA	200
Peat thousand short tons	W	W	12	292
Sand and gravel:				
Construction do	23,369	61,070	e22,700	e62,300
Industrial do	356	5,201	322	5,589
Stone:				
Crushed do	e10,400	e31,700	9,543	31,052
Dimension do	--	--	1	53
Combined value of barite, calcium chloride (natural, 1985), cement, clays (fire clay, 1984), diatomite, gold, gypsum, lime, olivine, silver, talc (1984), and value indicated by symbol W	XX	r102,855	XX	142,782
Total	XX	202,624	XX	243,670

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

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

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

Table 2.—Nonfuel minerals produced in Washington in 1984, by county[1]

County	Minerals produced in order of value
Asotin	Sand and gravel.
Benton	Do.
Chelan	Do.
Clallam	Clays, sand and gravel.
Clark	Do.
Douglas	Sand and gravel.
Ferry	Gold, silver.
Franklin	Sand and gravel.
Grant	Diatomite, sand and gravel.
Grays Harbor	Sand and gravel.
Island	Do.
Jefferson	Do.
King	Cement, sand and gravel, clays, peat.
Kitsap	Sand and gravel, peat.
Kittitas	Sand and gravel.
Klickitat	Do.
Lewis	Do.
Lincoln	Do.
Mason	Do.
Okanogan	Sand and gravel, peat, gypsum.
Pend Oreille	Cement, sand and gravel.
Pierce	Sand and gravel, lime, clays, peat.
San Juan	Sand and gravel.
Skagit	Olivine, sand and gravel, talc.
Skamania	Sand and gravel.
Snohomish	Do.
Spokane	Do.
Stevens	Lime, sand and gravel, barite, clays.
Thurston	Sand and gravel.
Walla Walla	Do.
Whatcom	Cement, sand and gravel.
Yakima	Sand and gravel.
Undistributed[2]	Stone (crushed), sand and gravel, gem stones.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Trends and Developments.—Total private expenditures for exploration and development in the State for 1985, by about 90 companies, was at least $29.3 million. Thirty-one companies reported exploring and developing industrial minerals in 1985, an increase of five over that of 1984. Industrial minerals expenditures in 1985 increased to at least $1.3 million or more than tripled those of 1984. The increase was attributed mostly to exploration for clays, diatomite, limestone, olivine, sand and gravel, silica, and stone. Development work began at the Cannon Mine, a joint venture of Asamera Minerals (U.S.) Inc. and Breakwater Resources Ltd. in Chelan County, which accounted for at least $25 million. Metals exploration and development expenditures, mostly for gold and silver, by about 60 other companies were $3 million, down about 33% from those of 1984. The decrease likely reflected the downturn in metals prices, which reduced the number of companies working in the State by about 35%. Most of the decrease in company activity was in the Wenatchee area, in the general vicinity of the Cannon Mine.

Total revenue from prospecting, mining, and quarrying on State lands was $652,096 for the fiscal year ending June 30, 1985. This figure, down sharply from what was realized in 1984, reflected a decrease of nearly $250,000 from sales of sand and gravel and other material removed from State lands.

Employment.—Employment in mining and quarrying in 1985 remained at a comparable level with that of 1984. In general, statewide unemployment by yearend had decreased to a rate of about 8.1%, the lowest level since 1979.

Exploration Activities.—Industrial minerals exploration expenditures in Washington increased severalfold over that of 1984. In Stevens County, Washington Resources Partnership explored for commercial-grade limestone in the Metaline Formation. Mine Tech Corp. explored the Silver Star Dolomite Mine for barite, dolomite, and silver, also in Stevens County. In Skagit County, International Minerals & Chemical Corp. explored for olivine. Other companies also exploring for industrial minerals were Boise Cascade Corp., Meridian Minerals Inc., and Genstar Stone Products Co.

The exploration division of Asamera spent $1 million in the Wenatchee area of Chelan County in 1985. This included exploration on the 5,000 acres that the Asamera-Breakwater joint venture holds in the State. Asamera also conducted drilling on the Amahawk Resources Corp. property southeast of the Cannon Mine. In the Blewett mining district, Chelan County, Tillicum Gold Mining Co. reported geophysical and geochemical surveys were done on its properties. Welcome North Mines (U.S.) Inc. performed geological mapping and conducted geochemical surveys on its KP and Woodworth properties; Montana de Oro Inc. explored its claims using similar methods. Sunshine Valley Minerals Inc. reported exploring its Holden property using geochemical methods. Wenatchee Resources Ltd. collected rock samples and began geophysical exploration on its Jack's Family claims, Chelan County. Silver Lake Resources Inc. drilled the Horse Lake Prospect and returned it to the lessor.

Table 3.—Indicators of Washington business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	4,305	4,349	4,409
Total civilian labor force	do.	2,068	2,054	2,105
Unemployment	percent	11.2	9.5	8.1
Employment (nonagricultural):				
Mining total[1]	thousands	2.7	2.6	2.7
Metal mining[2]	do.	.5	.4	.4
Nonmetallic minerals except fuels[2]	do.	1.3	1.4	1.4
Manufacturing total	do.	278.4	288.1	294.1
Primary metal industries	do.	12.6	13.4	12.8
Stone, clay, and glass products	do.	6.0	6.5	6.5
Chemicals and allied products	do.	10.1	10.5	11.3
Petroleum and coal products[2]	do.	1.8	1.7	1.8
Construction	do.	74.2	79.6	79.9
Transportation and public utilities	do.	87.9	90.9	93.7
Wholesale and retail trade	do.	393.9	411.6	421.6
Finance, insurance, real estate	do.	92.3	95.7	99.2
Services	do.	332.8	356.6	373.4
Government and government enterprises	do.	324.0	334.5	343.0
Total	do.	[3]1,586.1	1,659.6	1,707.6
Personal income:				
Total	millions	$54,502	$57,862	$61,185
Per capita		$12,661	$13,306	$13,876
Hours and earnings:				
Total average weekly hours, production workers		38.9	NA	NA
Total average hourly earnings, production workers		$11.41	NA	NA
Earnings by industry:				
Farm income	millions	$1,183	$1,120	$899
Nonfarm	do.	$37,185	$39,599	$42,206
Mining total	do.	$143	$162	$157
Metal mining	do.	$13	$11	$12
Nonmetallic minerals except fuels	do.	$35	$39	$38
Coal mining	do.	$29	$31	$34
Oil and gas extraction	do.	$67	$82	$73
Manufacturing total	do.	$8,092	$8,669	$9,195
Primary metal industries	do.	$475	$506	$478
Stone, clay, and glass products	do.	$162	$173	$171
Chemicals and allied products	do.	$348	$379	$424
Petroleum and coal products	do.	$85	$84	$96
Construction	do.	$2,647	$2,823	$2,808
Transportation and public utilities	do.	$2,770	$2,945	$3,087
Wholesale and retail trade	do.	$6,553	$6,864	$7,179
Finance, insurance, real estate	do.	$2,051	$2,140	$2,431
Services	do.	$6,997	$7,657	$8,374
Government and government enterprises	do.	$7,494	$7,970	$8,591
Construction activity:				
Number of private and public residential units authorized[4]		27,481	30,400	35,474
Value of nonresidential construction[4]	millions	$1,027.3	$1,217.4	$1,309.3
Value of State road contract awards	do.	$122.0	$212.0	$417.0
Shipments of portland and masonry cement to and within the State	thousand short tons	1,083	1,163	1,214
Nonfuel mineral production value:				
Total crude mineral value	millions	$187.5	$202.6	$243.7
Value per capita		$44	$47	$55

[p]Preliminary. [r]Revised. NA Not available.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

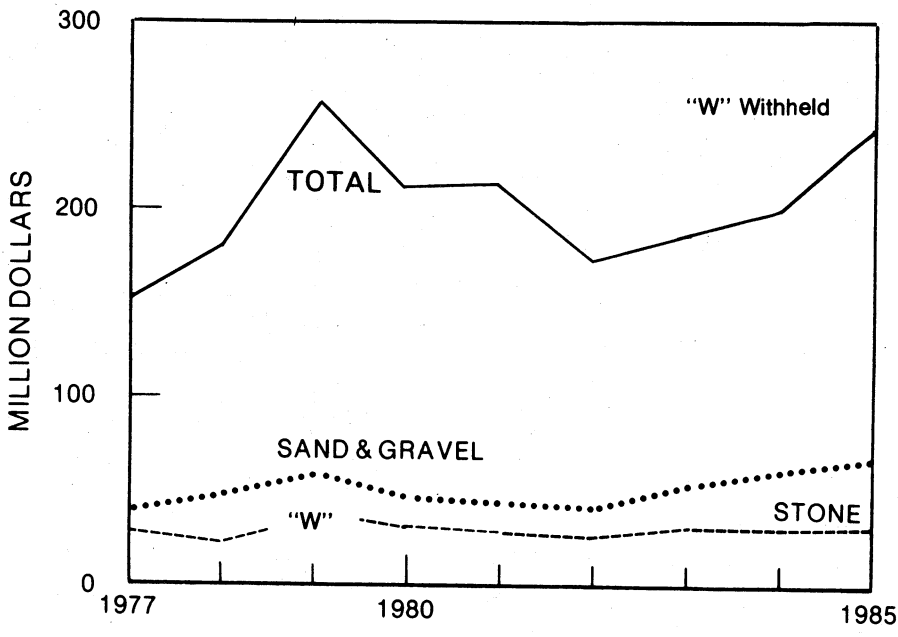

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Washington.

Hecla Mining Co. continued exploration in the vicinity of its Knob Hill Mine (Republic Unit), near Republic in Ferry County. Crown Resources Corp., in a joint venture with Gold Capital Corp. and Gold Texas Resources Ltd., explored the Granny and Key properties, also near Republic. The Granny property has disseminated gold and silver mineralization in Eocene volcanic rocks. The joint venture drilled over 4,400 feet of core and rotary holes and conducted metallurgical tests. Exploration continued at the Seattle-Flag Hill Mine, a joint venture of Crown Resources and Sutton Resources Ltd. Azure Resources Ltd. drilled its Lone Star property, Ferry County, and reported a 30-foot intercept of 0.2 troy ounce of gold per short ton and 4.5% copper in massive sulfides at a flat-lying contact of volcanics and serpentinites. Newmont Mining Corp. acquired ground south and east of the Lone Star property and conducted geophysical surveys and geological mapping.

Rexcon Inc. explored its Junction Reef property in Lincoln County for gold and silver in an epithermal environment reportedly associated in Precambrian metasedimentary rocks.

In Stevens County, Rochester Minerals Inc. reported drilling a total of 3,700 feet at the First Thought Mine near Orient. Rockmaster Resources Ltd. entered into an option agreement to acquire 100% interest in the property from Rochester. Western Land and Resources Inc. did reconnaissance exploration for gold and silver on its McNally property in the Rossland Volcanics. Minexco Inc. tested for gold and silver, using geochemical methods, on the Huckleberry Mountain claims, Stevens County. In the northern part of the county, Billiton Exploration USA Inc. explored for gold, lead, silver, and zinc in Devonian argillites and Ordovician slates. Terra Alta Mining Co. explored a massive quartz vein with silver sulfides in argillites and graphitic phyllites at the Lake View property. Van Horn and Watson Mining Co. explored the Rossland Volcanics on its Gold Nugget claims for gold and silver.

Lead, silver, and zinc mineralization in lower Paleozoic rocks was the target of several companies in Stevens County. Companies involved in this exploration, on their respective claims, included Canorex International Inc., Leadpoint Consolidated Mines Co., Challin-Ore Mining, Syracuse Minerals Ltd., and Mines Management Inc.

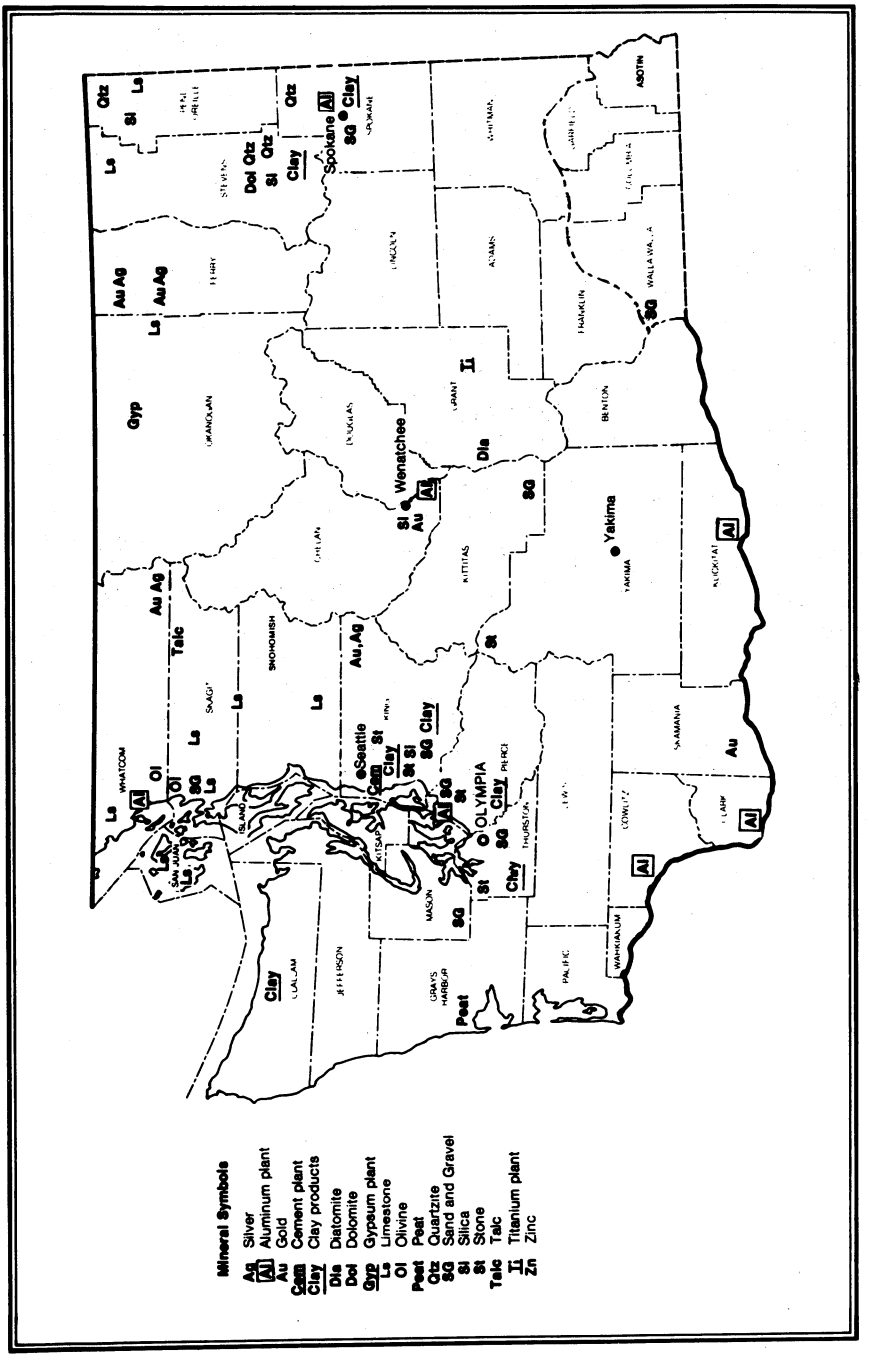

Figure 2.—Principal mineral producing localities in Washington.

In Okanogan County, Sunshine Valley Minerals explored its Billy Goat claims, and Keystone Gold Inc. prospected its Crystal Butte and Grey Eagle properties. Others exploring for gold in Okanogan County included Callahan Mining Corp., Nord Resources Corp., Silver Bell Inc., Sundance Mining-Development Inc., and Western Land and Resources.

Plexus Inc. drill tested for copper on its Silver Star claims in Skamania County and completed a mining feasibility study. In Whatcom County, Western Gold Mining Inc. reported RD Resources Ltd. of Vancouver, British Columbia, Canada, did surface and underground mapping at the New Light Mine. Seattle-St. Louis Mining Co. collected samples from the Minnesota Mine. Other companies active in precious or base metals exploration in the State included United States Borax & Chemical Corp., Kennecott, Rio Algom Exploration Inc., Noranda Exploration Inc., ASARCO Incorporated, Boise Cascade, Cominco American Incorporated, and Mine Tech.

Legislation and Government Programs.—During the 1985 regular session of the 49th Legislature, two measures were enacted that affect Washington's mining industry. The first requires the Department of Emergency Management to develop a State mine rescue plan that coordinates with Federal officials and private mine owners to ensure prompt sealing of open holes and mine shafts that constitute a threat to safety. It further requires the Department of Natural Resources to establish the scale and content of maps of surface features of all active mines. The other law introduces taxation of commissions on sales of precious metal bullion or monetized bullion and removes sales taxes on bullion transactions.

Work by the Washington Division of Geology and Earth Resources (DGER) continued on the new State geologic map. During the year, geologic mapping of the southwestern quadrant was near completion, and compilation of the northeastern quadrant continued. DGER published a report identifying mines and prospects in parts of Stevens and Spokane Counties that have anomalously high metal values for molybdenum, tin, and tungsten.

The Tacoma-Pierce County Health Department proposed a comprehensive study of the potential health effects of arsenic-laden slag derived from the Asarco smelter; the slag has been used as landscaping rock, parking lot fill, and road ballast. The smelter terminated operations in late March 1985. The department's Solid Waste Disposal Division requested a $25,000 to $50,000 grant from the Federal Environmental Protection Agency to implement the proposed study.

Early in 1985, the U.S. Forest Service and U.S. Bureau of Land Management (BLM) proposed a land exchange that would involve about 310,000 acres in Washington. Administration of these lands would be transferred from the BLM to the Forest Service. No enabling legislation had been passed by yearend.

Legislation introduced in Congress would increase the amount of wilderness included in the Hells Canyon National Recreation area along the Snake River. Under the proposal, nearly 300,000 acres would be added, bringing the total area under protection to about 517,000 acres. Most of the addition, however, will be in Oregon.

Washington received $99,014 in 1985 from the BLM as receipts from the Mineral Leasing Act.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Barite.—C-E Minerals Inc., a wholly owned subsidiary of Combustion Engineering Inc., shipped barite flotation concentrates from its mill at Leadpoint in northern Stevens County. Production and value increased significantly compared with that of 1984.

Calcium Chloride (Natural).—Tacoma Chemical Co. Inc. and Occidental Chemical Corp. were the sole producers of natural calcium chloride.

Cement.—Ash Grove Cement West Inc., Columbia Northwest Corp., Ideal Basic Industries Inc., and Lehigh Portland Cement Co. reported production of portland cement from three counties. About 80% of the portland cement produced was used by ready-mixed concrete companies, 9% by highway contractors, 7% by concrete product manufacturers, and 4% by other users.

Ash Grove and Lehigh also produced masonry cement. Production for the year was up slightly over that of 1984; however, value remained about the same.

Clays.—Clay production decreased 17%

in quantity and 12% in value in 1985 from that recorded in 1984. Three companies reported clay production from seven pits. All of the production was classified as common clay. Interpace Industries Inc. continued operation of its mine and brick plant in Spokane County.

Diatomite.—Witco Corp., Inorganic Specialties Div., processed diatomite at its Quincy plant in Grant County. The firm continued to be the State's only diatomite producer. Production and value during 1985 were up when compared with 1984 figures.

Gypsum.—Crude gypsum was mined by Agro Minerals Inc. at Poison Lake, Okanogan County. This was the only gypsum mine in the State. The product was used as a soil conditioner. Production and value decreased significantly during 1985.

Calcined gypsum was produced by Norwest Gypsum Inc. in King County and Domtar Gypsum America Inc. in Pierce County. Production and value were essentially unchanged from those of 1984.

Lime.—Continental Lime Co. produced quicklime and hydrated lime at its Tacoma plant in Pierce County. Continental also began production of precipitated calcium carbonate at a pilot plant in Tacoma. Northwest Alloys Inc., Stevens County, produced quicklime. Total value and quantity increased slightly over that reported in 1984.

Olivine.—IMC Olivine, Imcore Div., produced olivine from its stockpile at the Twin Sisters Mine in Skagit County. In Whatcom County, Olivine Corp. mined and milled olivine from its Swen Larsen quarry. Production increased significantly but value decreased during 1985. The changes were attributed, at least in part, to increased imports.

Peat.—Peat was mined by Ocean Farms Inc., Maple Valley Humus, and Bonaparte Peat in Grays Harbor, King, and Okanogan Counties, respectively. Production increased in quantity and value.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Industrial sand production in the State decreased 10% in quantity but increased 7% in value during 1985 compared with 1984 figures. Production was from Chelan, King, and Stevens Counties, and major uses were for glass containers, ferrosilicon, sandblasting, fluxes, filtration, and cement manufacture.

PPG Industries Inc. announced plans to construct a float glass manufacturing plant in Lewis County, near Chehalis. This would be the first such plant in the Pacific Northwest. The company plans to have the facility in production by early 1986 for the manufacture of clear, tinted, and coated glass.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—The 1985 production of crushed stone was down 8% in quantity and 2% in value from the estimates made for 1984. Major uses were for graded road base or subbase, unpaved road surfacing, and riprap and jetty stone. Columbia River Carbonates, a limited partnership of Bleeck Management Inc., and Genstar Stone Products began the mining of marble at their Wauconda Whitestone Mine in Okanogan County. The marble is shipped for processing to Woodland via rail. Northwest Alloys continued to mine dolomite and quartzite in Stevens County for use in magnesium metal production.

Table 4.—Washington: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	22	60
Riprap and jetty stone	1,118	5,444
Coarse aggregate, graded:		
Bituminous aggregate, coarse	197	586
Bituminous surface-treatment aggregate	299	1,057
Railroad ballast	180	676
Fine aggregate (-3/8 inch): Screening, undesignated	183	505
Combined coarse and fine aggregates:		
Graded road base or subbase	2,879	9,851
Unpaved road surfacing	1,188	3,585
Terrazzo and exposed aggregate	90	430
Crusher run or fill or waste	280	727
Other construction materials[2]	266	631
Agricultural: Agricultural purposes[3]	61	230
Special:		
Whiting or whiting substitute	45	116
Other miscellaneous[4]	726	1,710
Other unspecified[5]	2,008	5,444
Total	[6]9,543	31,052

[1]Includes dolomite, granite, limestone, quartzite, sandstone, traprock, volcanic cinder and scoria, and miscellaneous stone.
[2]Includes stone used in concrete aggregate (coarse), filter stone, stone sand (concrete and bituminous mix or seal), coarse aggregate (large), coarse aggregate (graded), combined coarse and fine aggregates, stone used for other construction and maintenance purposes, and other unspecified uses.
[3]Includes agricultural limestone and poultry grit and mineral food.
[4]Includes stone used for cement manufacture and flux stone.
[5]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[6]Data do not add to total shown because of independent rounding.

Dimension.—Dimension stone was produced in Skagit, Stevens, and Yakima Counties from four quarries.

Sulfur (Recovered).—Atlantic Richfield Co. and Mobil Oil Corp. continued to produce sulfur as a byproduct from petroleum refining in Whatcom County, while Texaco Inc. recovered byproduct sulfur at its Puget Sound facility in Skagit County. Production and value were up significantly in 1985 compared with that of 1984.

METALS

Aluminum.—The State's aluminum smelters, in aggregate, operated at about 79% of rated capacity near yearend, compared with about 67% for all smelters nationwide. This compared with about 90% statewide and 75% nationally near the beginning of 1985. Production cutbacks affected all seven of the State's smelters. Total production of primary aluminum in Washington was down 13% in quantity and value during 1985, compared with that of 1984, but the State again ranked first in the Nation. The decreases were attributed to increased electrical power costs and declining worldwide prices.

Aluminum producers were generally in favor of a Bonneville Power Administration (BPA) proposal for variable power rates. The proposed plan would link the cost of power sold to the producers to the market price of the metal. Northwestern aluminum producers purchase about one-third of all BPA-generated power.

Table 5.—Washington: Estimated primary aluminum plant production data

Year	Quantity (thousand metric tons)	Percent of national total	Value (thousands)
1981	1,097	24	$1,837,630
1982	877	27	1,470,074
1983	981	29	1,682,233
1984	1,126	27	2,010,971
1985	979	28	1,747,502

Copper.—Asarco permanently closed its Tacoma copper smelter in March after having announced plans for the closure in June 1984. The smelter was the only domestic processor of high-arsenic concentrates. The plant was the last remaining copper smelter on the west coast with deep-water port access and was the last remaining smelter available for Northwest copper producers. The company cited poor market prospects, shortage of feed material, and increasingly stringent environmental regulations as reasons for the shutdown. Asarco was considering the continued operation of an arsenic trioxide production plant at the site, using technology under test by the Colorado School of Mines. Most arsenic is used in industrial chemicals as wood preservatives, with lesser amounts utilized in the manufacture of herbicides, desiccants, and other miscellaneous applications.

Gold.—The 1985 gold production and value in the State increased compared with that of 1984. The increases were due mainly to the July startup of the Cannon Mine near Wenatchee, Chelan County.

The Cannon Mine is a joint venture between Asamera Minerals and Breakwater Resources. Asamera is the operator and 51% owner, with Breakwater holding the remainder. The Asamera-Breakwater joint venture acquired interests in the Central B Reef, Day-Lovitt Mine D Reef, and Canyon No. 2 properties from United Mining Corp. and the B-North and Lovitt Mine (Gold King Mine) from Tenneco Minerals Co. These properties are near the B Reef properties; the joint venture began mining in July. Reserves for the Cannon Mine are reported to be 5.25 million short tons grading 0.214 troy ounce of gold per ton. Production contained in concentrate form from the 2,000-ton-per-day mill was sold to J. Aron and Co. The concentrate was shipped by rail to Vancouver, WA, and then loaded on ships bound for smelters in the Federal Republic of Germany or in Japan.

Hecla continued operations at its Republic Unit near Republic, Ferry County. The company announced discovery of two veins on the 1100 level, which it named the Golden Promise Nos. 1 and 2. One of the veins reportedly contains 2.4 ounces of gold and 12 ounces of silver per ton over a thickness of 12.7 feet. The other vein is 5.7 feet thick with 0.3 ounce of gold per ton. At the time of discovery, the mine reportedly was producing ore, mostly from the Bailey vein, with grades of 0.5 ounce of gold per ton and 1.5 to 2.0 ounces of silver per ton. Company officials stated that the new discoveries should add several years to mine operations.

Heap leaching operations continued at the Minnie Mine in Okanogan County by Cordilleran Development Inc. and at the Gold Dike Mine in Ferry County by Vulcan Mountain Inc. Glamis Gold Ltd. continued heap leach testing at the South Penn property under an agreement with Crown Resources and Gold Capital. Reported results indicated that 2,300 short tons of crushed ore grading 0.05 ounce of gold per ton and leached for 27 days recovered 53% of the gold.

Lead.—The Pend Oreille lead-zinc mine in northern Pend Oreille County remained on standby; mine maintenance and pumping continued. The mine, owned by Pintlar Corp., a subsidiary of Gulf Resources & Chemical Corp., was under option early in 1985 to a group of Canadian investors. That option was subsequently terminated.

Magnesium.—Northwest Alloys, a wholly owned subsidiary of Aluminum Co. of America, operated its magnesium metal plant at Addy in Stevens County, but at a reduced level from that of 1984. The reduction was due mainly to industrywide declines in aluminum production, the principal consumer of magnesium. Northwest Alloys sells the waste material from its operation to Industrial Mineral Products Inc., which reprocesses the material to recover magnesium salts and metals.

Silicon.—Union Carbide Corp. began construction of an $85 million addition to double the size of its polycrystalline silicon plant at Moses Lake in Grant County. The Moses Lake facility refines metallurgical-grade silicon, which is converted to a silane and sprayed across glowing hot rods about 0.25 inch in diameter. The 5-foot-long rods are coated to a diameter of about 3.0 inches and shipped to computer chip manufacturers for additional refinements that include forming single, uniform crystals through a remelting of the rods. The resulting cylinders are then sliced into smooth wafers and further processed into silicon chips.

M. A. Hanna Co. continued production of silicon and ferrosilicon at its Rock Island smelter in Douglas County, near Wenatchee. The company received most of the raw material from its quartzite mine near Golden, British Columbia, Canada; the remainder is shipped from Rockland, CA, by an independent supplier. The metals are sold to aluminum, steel, and electronics manufacturers, and to Union Carbide for use in its polycrystalline silica plant at Moses Lake. Northwest Alloys continued production of ferrosilicon from quartzite mined at its Blue Creek quarry in Stevens County.

Steel.—Leckenby Co. of Seattle sold its steel fabrication plant and machinery, closing an operation that began in 1946. The plant had employed 260 people. The company reportedly blamed its demise on the collapse of major markets and low-price foreign competition. Leckenby's major markets were in fabricating pollution control facilities for nuclear and coal powerplants and aluminum plants, super structures for local shipyards, and machines for the particle board industry.

Seattle Steel Inc. ordered and installed a new $10.5 million continuous casting mill that allows the plant to produce small bars and shapes at lower costs. The equipment will increase annual production capacity from 350,000 to 540,000 short tons and

increase employment from about 500 to about 700 people.

Titanium.—International Titanium Inc. (ITI) of Moses Lake was taken over by Wyman-Gordon Co. (WGC) of Worcester, MA. ITI supplies WGC with most of its titanium sponge, used to manufacture titanium forgings supplied to the aerospace industry. The ITI plant has a rated annual capacity of 5 million pounds but reportedly has been operating below that rate because of market conditions. WGC has announced plans to become an integrated titanium producer and to later expand into titanium mill products. ITI continued to defend itself against lawsuits claiming damages to local residents from a spill of titanium tetrachloride that occurred in May 1982.

[1]State Mineral Officer, Bureau of Mines, Spokane, WA.
[2]Geologist, Washington Division of Geology and Earth Resources, Spokane, WA.

Table 6.—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.
Comalco Pty. Ltd	95 Collins St. Melbourne, Victoria 3000 Australia	do	Klickitat.
Intalco Aluminum Corp	Box 937 Ferndale, WA 98248	do	Whatcom.
Kaiser Aluminum & Chemical Corp.	Box 6217 Spokane, WA 99207	do	Spokane.
Do	3400 Taylor Way Tacoma, WA 98421	do	Pierce.
Reynolds Metals Co	Box 999 Longview, WA 98632	do	Cowlitz.
Cement:			
Ash Grove Cement West Inc	5550 SW. Macadam Ave. Suite 300 Portland, OR 97201	do	King.
Columbia Northwest Corp.[1]	Box 37, Marietta Rd. Bellingham, WA 98227	do	Whatcom.
Ideal Basic Industries Inc	Box 8789 Denver, CO 80201	do	King.
Lehigh Portland Cement Co	718 Hamilton Mall Box 1882 Allentown, PA 18105	do	Pend Oreille.
Clays:			
Ideal Basic Industries Inc	Box 8789 Denver, CO 80201	Pit	Clallam.
Mutual Materials Co	Box 2009 Bellevue, WA 98009	Pits and plant	King and Pierce.
Diatomite:			
Inorganic Specialties, a division of Witco Corp.	520 Madison Ave. New York, NY 10072	Mine and plant	Grant.
Gold:			
Asamera Minerals (U.S.) Inc	2100, 144 4th Ave. SW. Calgary, AB T2P 3N4 Canada	Mine and mill	Chelan.
Hecla Mining Co	6500 Mineral Dr. Box 8000 Coeur d'Alene, ID 83814-1931	do	Ferry.
Lime:			
Continental Lime Co	1220 Alexander Ave. Tacoma, WA 98421	Plant	Pierce.
Northwest Alloys Inc.[2]	Box 138A, Route 1 Addy, WA 99101	Plant and mine	Stevens.
Peat:			
Bonaparte Peat	Aeneas Route, Box 5 Tonasket, WA 98855	Bog	Okanogan.
Maple Valley Humus	18805 SE. 170th St. Renton, WA 98055	Bog	King.
Sand and gravel (industrial):			
Industrial Mineral Products Inc.	Box 95 Ravensdale, WA 98051	Quarry and plant	Do.
Lane Mountain Silica Co	Box 236 Valley, WA 99181	do	Stevens.
Wenatchee Silica Products Inc.	610 Doneen Bldg., Box 1668 Wenatchee, WA 98801	Quarry	Chelan.
Stone:			
Burlington Northern Railroad Co	1310 American Bank Bldg. Portland, OR 97205	Quarries	Various.
Columbia River Carbonates	Box D Woodland, WA 98674	Mine and plant	Okanogan.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
DeAtley Corp	Box 648 Lewiston, ID 83501	Quarries and plant	Okanogan.
U.S. Forest Service, Region 6	319 SW. Pine St. Box 3623 Portland, OR 97208	Quarries	Do.
Woodworth & Co. Inc	1200 East D St. Tacoma, WA 98421	Quarries and plant	Pierce.
Titanium:			
International Titanium Inc	1320 Wheeler Rd. Moses Lake, WA 98837	Sponge metal plant.	Grant.

[1]Also stone.
[2]Also magnesium, industrial sand, and stone.

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 1985 was $105.4 million, a $6.8 million decrease compared with that of 1984. Leading mineral commodities produced, in descending order of value, were crushed stone, cement, salt, common clay and shale, fire clay, construction sand and gravel, and industrial sand. Crushed stone, the leading commodity, accounted for more than one-third of the State's total nonfuel mineral value. Mineral commodities processed or manufactured but not listed in table 1 included aluminum, ferroalloys, fluorspar, synthetic graphite, finished iron oxide pigments, pig iron, steel, nickel, iron and steel slag, zinc, and zirconium.

Nationally, West Virginia ranked 39th in the value of nonfuel minerals produced. The State ranked second in ferroalloy shipments; third in finished iron oxide pigments; fourth in fire clay production; and sixth in iron and steel slag sales.

Table 1.—Nonfuel mineral production in West Virginia[1]

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	381	$3,410	331	$3,342
Salt do	1,004	W	895	W
Sand and gravel (construction) do	976	3,198	e900	e3,000
Stone (crushed) do	e9,100	e37,300	9,393	38,348
Combined value of cement, lime, sand and gravel (industrial), and values indicated by symbol W	XX	68,279	XX	60,719
Total	XX	112,187	XX	105,409

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

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

Table 2.—Nonfuel minerals produced in West Virginia in 1984, by county[1]

County	Minerals produced in order of value
Berkeley	Cement, clays.
Hancock	Clays, sand and gravel.
Lincoln	Clays.
Marshall	Salt.
Mason	Sand and gravel.
Morgan	Do.
Pendleton	Lime.
Tyler	Salt.
Wetzel	Sand and gravel.
Wyoming	Do.
Undistributed[2]	Stone (crushed).

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of West Virginia business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	1,963	1,952	1,936
Total civilian labor force	do	771	768	765
Unemployment	percent	18.0	15.0	13.0
Employment (nonagricultural):				
Mining total[1]	thousands	48.6	48.8	44.5
Nonmetallic minerals except fuels[2]	do	.9	1.0	NA
Coal mining	do	41.8	41.8	38.1
Oil and gas extraction	do	5.9	6.1	5.5
Manufacturing total	do	89.8	91.5	89.6
Primary metal industries	do	14.4	15.6	15.2
Stone, clay, and glass products	do	10.4	10.3	9.9
Chemicals and allied products	do	21.6	20.6	20.1
Petroleum and coal products[2]	do	.7	.6	.6
Construction	do	21.6	22.0	23.4
Transportation and public utilities	do	39.4	39.3	38.0
Wholesale and retail trade	do	127.4	131.9	133.7
Finance, insurance, real estate	do	22.2	23.2	23.6
Services	do	105.5	109.2	115.8
Government and government enterprises	do	127.8	130.7	127.5
Total	do	582.3	596.6	596.1
Personal income:				
Total	millions	$18,105	$19,127	$19,736
Per capita		$9,225	$9,803	$10,193
Hours and earnings:				
Total average weekly hours, production workers		39.6	40.3	39.9
Mining (bituminous coal)		40.9	40.7	40.7
Total average hourly earnings, production workers		$9.7	$9.9	$10.2
Mining (bituminous coal)		$14.3	$15.4	$15.3
Earnings by industry:				
Farm income	millions	-$13	$7	-$16
Nonfarm	do	$12,101	$12,853	$13,265
Mining total	do	$1,751	$1,912	$1,796
Nonmetallic minerals except fuels	do	$21	$23	$24
Coal mining	do	$1,576	$1,725	$1,621
Oil and gas extraction	do	$154	$164	$151
Manufacturing total	do	$2,363	$2,470	$2,516
Primary metal industries	do	$561	$570	$489
Stone, clay, and glass products	do	$226	$234	$232
Chemicals and allied products	do	$755	$768	$785
Petroleum and coal products	do	$24	$23	$23
Construction	do	$597	$625	$653
Transportation and public utilities	do	$1,136	$1,213	$1,220
Wholesale and retail trade	do	$1,802	$1,882	$1,952
Finance, insurance, real estate	do	$415	$441	$494
Services	do	$2,015	$2,170	$2,326
Government and government enterprises	do	$1,989	$2,108	$2,279

See footnotes at end of table.

Table 3.—Indicators of West Virginia business activity —Continued

		1983[r]	1984	1985[p]
Construction activity:				
Number of private and public residential units authorized[3]		1,834	2,139	1,477
Value of nonresidential construction[3]	millions	$141.3	$136.7	$141.9
Value of State road contract awards	do	$325.0	$290.0	$280.0
Shipments of portland and masonry cement to and within the State	thousand short tons	473	474	416
Nonfuel mineral production value:				
Total crude mineral value	millions	$104.0	$112.2	$105.4
Value per capita		$53	$58	$54

[p]Preliminary. [r]Revised. NA Not available.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

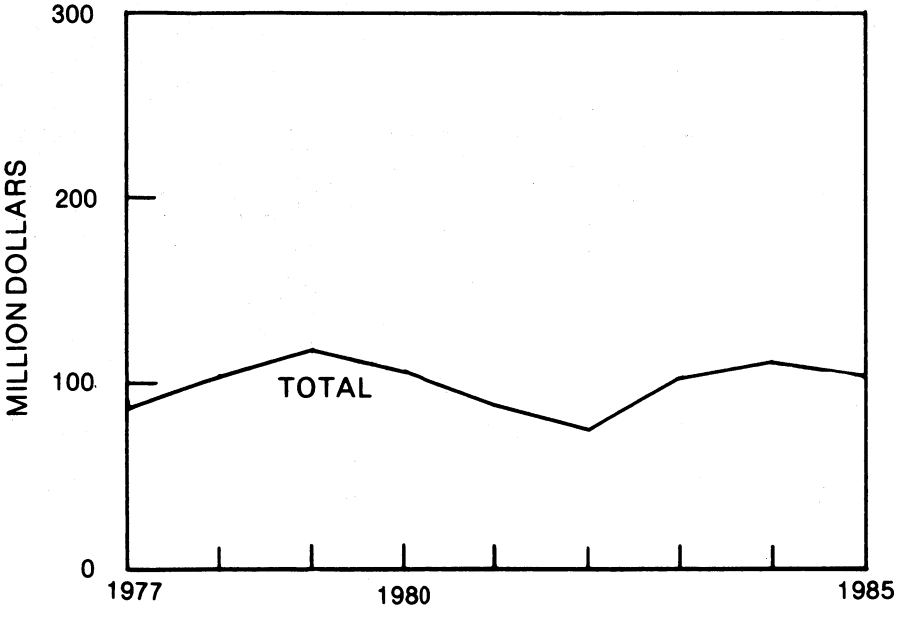

Figure 1.—Total value of nonfuel mineral production in West Virginia.

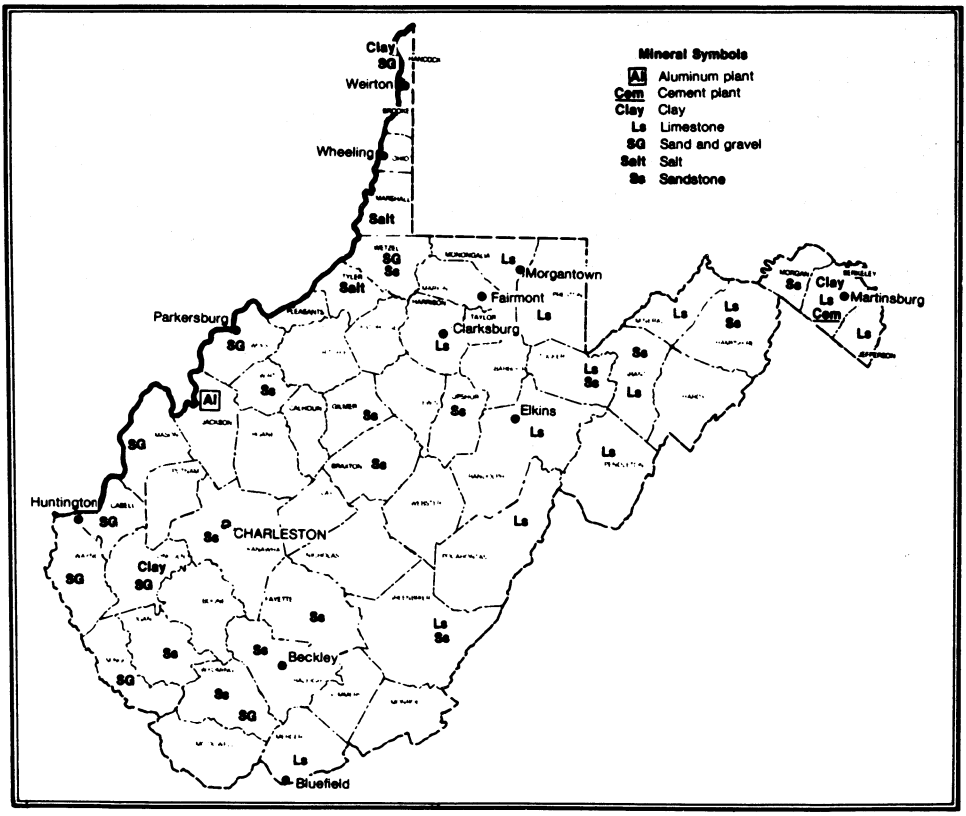

Figure 2.—Principal mineral producing localities in West Virginia.

Trends and Developments.—In an effort to expand the use of the State's coal and limestone resources, the West Virginia Geological and Economic Survey (WVGES), U.S. Department of Energy's Morgantown Energy Technology Center, West Virginia University (WVU), and several coal companies conducted research to develop combustion technologies to more effectively burn the State's high-sulfur coals. In 1984, more than one-half of the 131 million short tons of coal mined in the State were used for power generation. Of the total used for power generation (73.5 million tons), 43 million tons was sold to other States and 30.5 million tons was used in the State. One of the more promising "developing" combustion technologies is Atmospheric Fluidized Bed Combustion (AFBC).[3] In an AFBC boiler, crushed coal is mixed with limestone and burned while suspended by air forced through the bed of the boiler. The limestone absorbs most of the sulfur dioxide and other pollutants from the flue gas before it leaves the boiler. Development of AFBC technology could stimulate the use of the State's high-sulfur coals and would greatly expand the use of the State's limestone resources.

Legislation and Government Programs.—Several West Virginia laws affecting the State's mineral industry were enacted in 1985. House bill 1850, the West Virginia Energy Act, became effective on July 11 and created the new State Department of Energy by combining the Department of Mines with the Reclamation Division of the Department of Natural Resources. The new Department of Energy was given jurisdiction over every coal, oil, or gas regulatory program. It received the authority to issue permits and regulate in areas such as dams, water pollution, waste disposal, reclamation, and conservation. The Department of Energy is to be headed by a Commissioner and Deputy Commissioner and divided into two sections—the Mines and Minerals Division, and the Oil and Gas Division.

Senate bill 1, passed in March, provided for public response to applications for surface mining permits. Under this act, any person having an interest that may be adversely affected, or an officer or the head of a Federal, State, or local governmental agency, was given the right to file a written objection to a proposed initial or revised permit application for a surface mining operation within 30 days after publication notice of the last required advertisement of that permit.

House bill 1334, effective July 1, changed mine subsidence insurance coverage for State residents. The definition of "structures" covered by the insurance was amended, and the maximum coverage was raised from $50,000 to $75,000.

House bill 1693, which became effective on July 7, did away with the State's Business and Occupation tax, although it kept and changed the gross receipts tax (severance tax) for public utilities, electrical power generators, telecommunications, and natural resources industries. Under the new law, the severance tax for coal, beginning in 1987, increases from 3.85% to 4% in 1992. The tax on natural gas of 8.63%, drops to 6.5% in 1987 and then decreases to 4% by 1992. Any new gas wells would be taxed at 4% beginning in 1987. During the same 5-year period, the tax on limestone will increase from 2.2% to 4%, while the rate for sand and gravel would dip from 4.3% to 4%.

The Economic Section of the WVGES continued to collect data and conduct ongoing research toward expanding the growth and development of the State's nonfuel mineral industry. Studies on sources of raw materials used in construction near high growth areas continued. The sand and gravel resources of the Ohio River, along with its two lower terraces, continued to be examined, mapped, and studied. Information from the study, which embraced an area extending from Chester to Parkersburg, will be used in conjunction with other sand and gravel data already obtained for the determination of its resource potential to the State's construction industry.

As of yearend, the Economic Section collected samples from most of the State's sand and gravel and stone producers for chemical and mineral analyses. This information was added to the State's computer data base for limestone and sandstone.

The Economic Section also updated its 1958 Mineral Resource and Mineral Industries Map using results of recent geologic mapping and mining activity. The map, in the process of being published, will be color coded to show the geologic occurrence or production of coal, oil and gas, limestone, sandstone, clay and shale, salt, and sand and gravel.[4] Another publication nearing completion was the West Virginia Gazetteer of Physical and Cultural Place Names, a directory of over 31,000 place names that includes towns, institutions, airports, parks, schools, streams, lakes, etc. Reports published during 1985 included a State Mineral Producers and Processors Directory, a min-

eral industry status report, a generalized description of the rocks beneath the State, and an article on the State's salt resources, one of the area's first industries.[5]

During the year, the WVU College of Law received a grant from the Eastern Mineral Law Foundation to implement a law school seminar on Surface Mining Law and Regulation. The seminar will examine the Federal Surface Mining Control and Reclamation Act of 1977, and will emphasize procedural and substantive requirements of Federal law, implementation of the law by coal mining States, and oversight by the Federal Office of Surface Mining.[6]

In order to encourage State support for basic research in the mineral sciences and engineering, the U.S. Bureau of Mines awarded an allotment grant of $147,000 to the Mining and Mineral Research Institute at WVU, Morgantown. The allotment was part of the Mineral Institute program created by Public Law 98-409, the State Mining and Mineral Resources Research Program Act. The new act, signed into law in 1984, increased the required matching ratio from one State dollar to one and one-half dollars for each Federal dollar in fiscal years (FY) 1985 and 1986. Thereafter, through expiration of authority in 1989, matching must be on a 2-to-1 basis. Additional research grants were also jointly made to WVU and the Pennsylvania State University for research on respirable dusts under the Generic Center Research Program.

During FY 1985, the U.S. Bureau of Mines funded five contracts and grants in the State valued at $879,570 to WVU and two engineering firms. The largest contract—valued at nearly $500,000—was awarded to the Frick Construction Co. to test the Bureau of Mines-developed Burnout Control System in Albright. Although controlled burnout had been used experimentally with some success on underground coal mine fires, the Albright project was the first test on a waste-bank fire. The system involved completely burning out the combustible waste material while maintaining control of the fumes and heat produced. Controlled burnout promised a way to eliminate a serious environmental problem, and at the same time, convert a coal waste to a coal resource.

In FY 1985, several West Virginia counties received $430,300 from the Federal Government as their share of royalties from various activities in Monongahela National Forest. Nearly one-fifth of the moneys were attributed to mineral leasing and mining royalties. Meanwhile, the U.S. Forest Service was drafting a 50-year plan for the Monongahela National Forest that would substantially increase commercial activity in the forest. The plan called for an increase in timbering, tripling the road mileage in the forest, and leasing of up to 46,000 acres for mineral exploration.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Cement.—Capital Cement Corp., a subsidiary of Riverton Corp., operated the State's only cement plant in Martinsburg in Berkeley County in the State's eastern panhandle. The wet-process plant, with an annual grinding capacity of 780,000 short tons, produced both portland and masonry cement. Production and value of portland cement decreased 15% and 10%, respectively, from 1984 levels; masonry cement output and value were both about 18% higher than that of 1984.

In June, the Berkeley County Commission approved a $5-million, low-interest loan to Capital Cement to modernize its crushing operation and reduce dust emissions. The basic changes planned included more efficient primary grinders, improvements to a secondary finishing mill, computerization of control rooms to allow better monitoring, and enclosures to trap excess dust.

Clays.—Both common clay and fire clay were produced in 1985. Common clay and shale was mined by Continental Brick Co. and Capital Cement in Berkeley County and Sanders Dummy Co. in Lincoln County. Continental used the clay for the manufacture of face brick while Capital Cement's use was for portland cement manufacture. Common clay mined by Sanders was sold for "dummy clay" used by the mining industry for explosive stemming. Production and value of common clay decreased 18% and 11%, respectively, compared with that of 1984.

In August, the Appalachian Regional Commission awarded a $450,000 grant to Continental for a fuel conversion project at the Martinsburg plant. The grant nearly matched money put up by the company, which included $400,000 in industrial reve-

nue bonds and $100,000 of corporate equity. Total cost of the project will be $950,000. The plant, which had the capacity to produce 65 million bricks per year, will convert its energy system from natural gas to a coal-fired kiln.

Fire clay was mined by one company, Globe Refractories Inc., a subsidiary of Combustion Engineering Inc., Hancock County. Output again decreased in 1985 compared with that of 1984 because of poor sales of refractory specialties utilized by the steel industry. In November, Globe ceased production at the plant citing a lack of demand for the clay-ladle brick produced. At yearend, the plant was put up for sale.

Fluorspar.—Although fluorspar was not mined in the State, 1,633 short tons was consumed by various industries in the State. Fluorspar was used by the ceramic industry as a flux and opacifier in the manufacture of glass products, as a flux in steelmaking, in the manufacture of hydrofluoric acid, and in other manufacturing processes.

Gem Stones.—Several varieties of gem materials were found in the State's predominantly sedimentary rocks. Specimens include coral, opal, various quartz varieties, and two types of coal (bone and cannel). The commercial production of these gem materials is insignificant.

Graphite (Synthetic).—West Virginia ranked seventh of 14 States that produced synthetic graphite. One company, Union Carbide Corp.'s Carbon Productions Div., continued to produce graphite specialties at its Clarksburg plant, Harrison County. Graphite specialties produced included graphite electrodes and molds and dies used in producing crucibles for metals.

Iron Oxide Pigments (Finished).—West Virginia ranked third in the Nation behind Illinois and Pennsylvania in shipments of finished iron oxide pigments. Mobay Chemical Corp., a subsidiary of Bayer AG of the Federal Republic of Germany, operated the State's only synthetic iron oxide plant in New Martinsville, Wetzel County. In 1985, shipments and value increased 10% and 12% over that of 1984 primarily because of the continuing strong performances of the paint and construction industries, the largest consumers of the pigments.

Regenerator iron oxides continued to be recovered from steel plant wastes by Weirton Steel Corp.

Lime.—Lime was produced by one company in 1985. Both quicklime and hydrated lime were produced by Germany Valley Limestone Co. in Pendleton County. In 1985, both production and value of quicklime declined compared with that of 1984. However, output and value of hydrated lime increased over 1984 levels. The lime was used principally for acid mine water neutralization, paper pulp, water purification, and sewage treatment.

As part of a research program to study acid water abatement, the U.S. Department of the Interior awarded a $526,000 grant to the West Virginia Department of Natural Resources (DNR). The grant will furnish 85% of the total project cost of $619,200 to install and operate an acid water neutralization station on the Cranberry River in the Monongahela National Forest. The system, developed under a cooperative research program involving DNR and WVU, feeds finely ground limestone from rotary drums using river flow as a natural source of power.

Salt.—Salt, the first mineral developed in the State, was produced by three companies. PPG Industries Inc. and LCP Chemicals-West Virginia Inc. produced salt brine in Marshall County and FMC Corp. operated brine wells in Tyler County. In 1985, output and value decreased nearly 11% and 30%, respectively, compared with that of 1984. All of the salt produced was used in the manufacture of chlorine and caustic soda. Chlorine and caustic soda had a wide variety of uses including production of plastics, pulp and paper, and metal and petroleum refining, reclaiming rubber, and other products.

Near midyear, PPG completed a $100 million-plus program to modernize the chlorine and caustic soda production facilities at its chemical plant in southern Marshall County. The program, begun in 1982, replaced outmoded production components with high-efficiency units and upgraded support facilities. Modernization at the plant reduced energy demand by 10%.

FMC's Tyler County salt brine plant was closed near yearend 1985 after shutdown of the company's South Charleston chlorine and caustic soda plant. The company cited high energy costs and equipment obsolescence as the reasons for the closure. About 400 FMC workers were laid off at the South Charleston plant; 7 workers lost their jobs at the company's Bens Run, Tyler County, salt brine plant.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is

surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend. Based on these estimates, output and value of construction sand and gravel decreased 8% and 6%, respectively, compared with that of 1984.

Industrial.—Industrial sand was produced by two companies—Pennsylvania Glass Sand Corp. (PGS) in Morgan County and Tolers Sand Co. in Wyoming County. In August, the Tolers Sand operation was closed. PGS' operations in Morgan County continued to account for the majority of the State's production. Average value per ton in 1985 was $21.35 compared with $18.72 in 1984. Leading end uses were for glass sand, flat glass, and specialty glass.

PGS, headquartered in Berkeley Springs, was sold to United States Borax & Chemical Corp., a subsidiary of The Rio Tinto Zinc Corp. PLC, United Kingdom, for $80 million. The purchase of PGS' nine producing facilities in the United States included the industrial sand operation in Berkeley County, the State's largest producer. Acquisition of the sand company will provide an important expansion for U.S. Borax into the industrial minerals area.

Slag—Iron and Steel.—In 1985, two companies, both in Weirton, processed slag produced by the State's steel industry. Standard Slag Co. processed blast furnace slag, and International Slag Co. processed basic oxygen furnace slag.

Sales and value of iron and steel slag increased 19% and 10%, respectively, compared with that of 1984. These increases were the result of the continuing strong construction industry, the major user of slag. Blast furnace slag was used mainly for road base and coverings, fill, concrete aggregate, and asphaltic concrete aggregate. Basic oxygen furnace slag was used for road base and fill.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

In 1985, crushed stone accounted for about 36% of the State's total nonfuel mineral production. Both crushed limestone and sandstone were produced, with limestone accounting for nearly 88% of the State's total output. A total of 40 companies operated 49 quarries; 36 of these were crushed limestone operations and 13 were crushed sandstone operations. Leading counties in order of output were Greenbrier, Randolph, Jefferson, and Berkeley.

Although most of the stone was shipped by truck, a small amount was transported by barge and rail.

Table 4.—West Virginia: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Riprap and jetty stone	295	1,377
Filter stone	156	1,371
Coarse aggregate, graded:		
Concrete aggregate, coarse	618	2,262
Bituminous aggregate, coarse	119	563
Bituminous surface treatment aggregate	351	3,747
Fine aggregate (-3/8 inch)	29	143
Stone sand, concrete	91	453
Stone sand, bituminous mix or seal	180	761
Screening, undesignated	119	483
Combined coarse and fine aggregates:		
Graded road base or subbase	1,545	6,424
Unpaved road surfacing	190	935
Crusher run or fill or waste	385	1,539
Other construction[2]	287	1,523
Agricultural: Agricultural limestone	50	431
Chemical and metallurgical: Cement manufacture	1,530	3,169
Special:		
Other miscellaneous[3]	112	703
Other unspecified[4]	3,338	12,464
Total	[5]9,393	38,348

[1]Includes limestone and sandstone.
[2]Includes poultry grit and mineral food, macadam, railroad ballast, other construction and maintenance uses, and other uses not listed.
[3]Includes lime manufacture, flux stone, and lightweight aggregate.
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data do not add to total shown because of independent rounding.

METALS

Aluminum.—In August, Kaiser Aluminum & Chemical Corp. shut down one of three operating potlines, bringing the facility to one-half (81,500 short tons) of its 163,000-ton operating capacity. Shutdown of the potline, which was reactivated in 1984, was due to lower prices and poorer demand for the metal. The closing, which affected approximately 195 workers, had no effect on the facility's fabrication plant.

In August, Kaiser announced the signing of a "significant" agreement with General Motors Corp. (GM) to supply the automaker with a substantial portion of the estimated 117-million-pound fabricated aluminum requirements for model year 1986. Kaiser will produce the bulk of the volume at the Ravenswood sheet and plate plant and the remaining requirements will be supplied by its plants in Newark, OH, and Trentwood, WA. Under the new contract, Kaiser will supply GM with brazing sheet, body sheet, bumper reinforcement stock, common alloy, fin stock, and rod. Another major contract awarded during the year was a multiyear contract with the General Dynamics Corp. for the production of aluminum parts for F-16 fighter jets. Parts for the planes will be made at both Ravenswood and Trentwood.

Iron and Steel.—Two integrated companies produced both pig iron and steel in the State. Weirton Steel, the Nation's largest employee-owned company, operated a plant in Weirton, and Wheeling-Pittsburgh Steel Corp. (W-P) operated plants in Wheeling, Follansbee, and Beach Bottom. A steel minimill was operated by Steel of West Virginia Inc. in Huntington.

During the year, Weirton Steel completed a new $19 million emissions control project, which involved installing air cleaning devices on two high-pressure boilers that were modified to regularly burn coal and oil, if necessary. Another major capital expenditure in 1985 was a $30 million project to rebuild the No. 1 blast furnace. Also during the year, the company began producing a new galvanized product. Being marketed as WeirKote Plus, the product was claimed to offer superior resistance to corrosion. Typically, galvanized coating was 100% zinc, WeirKote Plus combined 95% zinc with 5% aluminum-mischmetal. Weirton Steel was the first U.S. steel producer to produce the new coated metal.

In August, the U.S. Environmental Protection Agency (EPA) struck down Weirton Steel's proposal for a "bubble plan" to measure and control air pollution at its Weirton plant. Although the plan was approved by the West Virginia Air Pollution Control Commission, it was rejected by the EPA. Under the bubble plan, instead of measuring the emissions from each source, the air quality for the entire area was measured as if a huge bubble contained the air over that plant or area. Weirton Steel first proposed the bubble plan several years ago in response to a settlement between EPA and National Steel Corp., then the parent of Weirton Steel.

In April, W-P, the Nation's seventh largest steel producer, filed for protection from its creditors under chapter 11 of the Federal bankruptcy laws. In turn, workers at the plants began a work stoppage in July. By early November, however, a settlement was reached with the workers and the plants resumed operations.

Although preliminary work began early in the year on a proposed new $50 million steel coating mill in Follansbee, work was halted shortly afterward when W-P filed for bankruptcy under chapter 11. The proposed new mill, a joint venture between W-P and Nisshin Steel Co. Ltd. of Japan, would be able to coat 150,000 tons of steel and would create 400 new jobs. In December, however, officials of both W-P and Nisshin signed a shareholders agreement to proceed with the joint venture. Under terms of the new agreement, Nisshin will own 67% of the new mill and W-P will own 33%. Originally, the venture was to be a 50-50 arrangement. Final approval, however, was still contingent on the decision of the U.S. Bankruptcy Court.

United Steelworkers of America officials began undertaking a study on the feasibility of an employee stock ownership plan at W-P's Benwood plant. The plant, which manufactured pipe used mainly in oil drilling and gas transmission, had been idle since 1983. Total cost of the study is expected to be between $120,000 and $140,000. Two-thirds of the funding will be provided by the Governor's Office of Economic and Community Development; the Steelworkers International will provide the remaining third.

Steel of West Virginia operated the State's only steel minimill. The plant, in Huntington, employed 480 workers and is 1 of only about 6 specialty hot-rolling mills in the world capable of turning out small orders of hot-rolled steel bars in complex

shapes. Annual capacity of the plant is 250,000 tons of continuous billets and 150,000 tons of rolled products.

Ferroalloys.—In 1985, three companies produced ferroalloys in the State; Elkem Metals Co. at its Alloy plant in Graham County; the Foote Mineral Co. at its Graham plant in Mason County; and Chemetals Corp., a subsidiary of SEDEMA S.A. at Kingwood in Preston County. Shipments in 1985 decreased 30% compared with those of 1984.

In December, Foote, a subsidiary of Newmont Mining Corp., closed its Graham ferroalloy plant affecting nearly 300 workers. The company decided to close the plant, which began operating in 1952, because of declining market conditions caused primarily by large volumes of imported ferroalloys. The closing was estimated to have cost the company about $5 million, mainly for severance pay. Foote also announced that it was selling its rights to produce a proprietary line of ferroalloys produced at the plant to SKW Alloys Inc., Niagara Falls, NY. Under the agreement, Foote will supply technical assistance in 1986 and 1987, receiving as compensation a portion of the profit generated by those products over a 6-year period. Foote could receive payments totaling between $6 and $8 million during that period. SKW will produce the proprietary ferroalloys at its Calvert City, KY, plant.

Also, near yearend, a Government-funded retraining program was under way at Elkem's ferroalloy plant in Alloy. The company was awarded a $69,050 contract by the Governor's Office under the Federal Job Training Partnership Act to retrain about 450 of its workers. The project, expected to be completed by March 1986, will train the workers in statistical process control procedures.

Nickel.—Inco Alloys International Inc. continued to produce wrought high-nickel alloys at its Huntington plant in Cabell County. During the year, the welding products operations were moved from Huntington to Newton, NC, in order to accommodate the relocation of its research pilot plant from New York to the Huntington complex. The company decided to place the research plant adjacent to its nickel alloy production facilities in Huntington because the research center was concentrating on developing products that can be quickly commercialized. Research projects included work on low-coefficient expansion alloys and other alloy systems for the aerospace industry.

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.

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[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2]Economic geologist and head, Economic Section, West Virginia Geological and Economic Survey, Morgantown, WV.

[3]Erwin, R. B., C. J. Smith, G. H. McColloch, K. C. Ashton. Coal Fired Power Plants: The Geological Survey's Role. WV Geol. and Econ. Surv., Mountain State Geol. Mag., 1986, pp. 1-8.

[4]West Virginia Geologic and Economic Survey. Map WV24.

[5]Kirstein, D. S., and H. M. King. Mineral Producers and Processors Directory. WV Geol. and Econ. Surv., Min. Res. Series 1, 1985, 23 pp.

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Kirstein, D. S. Salt, West Virginia's Hidden Resources. WV Geol. and Econ. Surv., Mountain State Geol. Mag., 1986, pp. 44-47.

[6]Eastern Mineral Law Foundation Newsletter. WVU College of Law Awarded Grant. V. 6, No. 7, Sept. 1985, p. 3.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Kaiser Aluminum & Chemical Corp.	Box 98 Ravenswood, WV 26164	Smelter and fabricating plant.	Jackson.
Cement:			
Capital Cement Corp.[1]	Box 885 Martinsburg, WV 25401	Quarry and plant	Berkeley.
Clays:			
Continental Brick Co	Box 1111 Martinsburg, WV 25401	Pit and plant	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.
Lime:			
Germany Valley Limestone Co	Box 302 Riverton, WV 26814	Quarry and plant	Pendleton.
Salt:			
FMC Corp	Box 8127 South Charleston, WV 25303	Brine wells	Tyler.
LCP Chemicals-West Virginia Inc.	Drawer J Moundsville, WV 26041	Brine wells and plant	Marshall.
PPG Industries Inc	1 Gateway Center Pittsburgh, PA 15222	do	Do.
Sand and gravel (1984):			
Construction:			
Dravo Corp	1 Oliver Plaza Pittsburgh, PA 15222	Dredges	Various.
ET&S Inc	Route 1 Cheshire, OH 45620	Quarry and plant	Mason.
Shippingport Sand & Gravel Co.	Drawer A Newell, WV 26050	do	Hancock.
Standard Slag Co.[2]	Box 448 Weirton, WV 26062	Plant	Do.
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:			
Acme Limestone Co	Box 27 Fort Spring, WV 24936	Mine and quarry	Greenbrier.
Fairfax Sand & Crushed Stone Co.	Box 98 Thomas, WV 26292	Quarries	Grant, Mineral, Randolph.
Greer Limestone Co., a division of Greer Steel Co.	Greer Bldg. Morgantown, WV 26505	Mine and quarries	Monongalia and Pendleton.
Lone Star Industries Inc	Route 3, Box 489 Morgantown, WV 26505	Mine	Monongalia.
Millville Quarry Inc.	Box 166 Milleville, WV 25434	Quarry	Jefferson.

[1]Also clays and crushed stone.
[2]Also iron slag.

The Mineral Industry of Wisconsin

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

By James J. Hill,[1] Thomas J. Evans,[2] and Wanda J. West[3]

The value of nonfuel mineral production in Wisconsin was $125.1 million in 1985. This was about 3% less than the 1984 figure. On the national level, the State ranked 37th in the value of nonfuel mineral output. Diminished sales of portland cement (16%), lime (8%), construction sand and gravel (10%), crushed stone (8%), and dimension stone (9%), contributed to the decline in overall State mineral value. Sales improved for peat and industrial sand. About 63% of the State's mineral value was accounted for by sales of crushed stone and construction sand and gravel. Another 15% was attributed to sales of lime.

Mineral commodities processed within the State from out-of-State sources included iron oxide pigments, perlite, and vermiculite. Sulfur was recovered as a refinery byproduct. No metallic minerals have been produced in the State since 1982.

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

Mineral		1984		1985	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Lime	thousand short tons	373	$19,892	341	$19,001
Peat	do	9	W	10	W
Sand and gravel:					
Construction	do	17,785	38,245	e16,000	e36,000
Industrial	do	1,060	11,821	1,197	14,624
Stone:					
Crushed	do	e15,800	e45,000	14,496	42,380
Dimension	do	e24	e2,863	22	2,733
Combined value of abrasive stone, cement, and values indicated by symbol W		XX	11,527	XX	10,372
Total		XX	129,348	XX	125,110

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

Table 2.—Nonfuel minerals produced in Wisconsin in 1984, by county[1]

County	Minerals produced in order of value
Adams	Sand and gravel (construction).
Ashland	Do.
Barron	Do.
Bayfield	Do.
Brown	Lime, sand and gravel (construction).
Buffalo	Sand and gravel (construction).
Burnett	Do.
Calumet	Do.
Chippewa	Do.
Clark	Do.
Columbia	Sand (industrial), sand and gravel (construction).
Crawford	Sand and gravel (construction).
Dane	Do.
Dodge	Lime, sand and gravel (construction).
Door	Sand and gravel (construction).
Douglas	Lime, cement, sand and gravel (construction).
Dunn	Sand and gravel (construction).
Eau Claire	Do.
Florence	Do.
Fond du Lac	Lime, sand and gravel (construction).
Forest	Sand and gravel (construction).
Green Lake	Sand (industrial), sand and gravel (construction).
Iron	Sand and gravel (construction).
Jackson	Sand (industrial), sand and gravel (construction).
Jefferson	Sand and gravel (construction).
Kenosha	Do.
Kewaunee	Do.
La Crosse	Do.
Langlade	Do.
Lincoln	Do.
Manitowoc	Lime, sand and gravel (construction).
Marathon	Sand and gravel (construction).
Marinette	Sand and gravel (construction), sand (industrial).
Milwaukee	Cement.
Oconto	Sand and gravel (construction).
Oneida	Do.
Outagamie	Do.
Ozaukee	Do.
Pepin	Do.
Pierce	Sand and gravel (construction), sand (industrial).
Polk	Sand and gravel (construction).
Portage	Do.
Price	Do.
Racine	Do.
Richland	Do.
Rock	Do.
Rusk	Do.
St. Croix	Do.
Sauk	Sand and gravel (construction), abrasive stone.
Sawyer	Sand and gravel (construction).
Shawano	Do.
Sheboygan	Do.
Taylor	Do.
Vilas	Do.
Walworth	Do.
Washburn	Do.
Washington	Do.
Waukesha	Sand and gravel (construction), peat.
Waupaca	Sand and gravel (construction), sand (industrial).
Waushara	Sand and gravel (construction).
Winnebago	Sand and gravel (construction), sand (industrial).
Undistributed[2]	Stone (crushed and dimension).

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Table 3.—Indicators of Wisconsin business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	4,747	4,762	4,775
Total civilian labor force	do.	2,426	2,390	2,374
Unemployment	percent	10.4	7.3	7.2
Employment (nonagricultural):				
Mining total[1]	thousands	1.9	1.9	2.2
Nonmetallic minerals[2]	do.	1.8	1.8	1.8
Manufacturing total	do.	484.1	518.9	514.8
Primary metal industries	do.	17.6	19.9	19.3
Stone, clay, and glass products	do.	7.8	8.1	7.8
Chemicals and allied products	do.	9.3	9.7	10.0
Construction	do.	57.7	63.2	62.8
Transportation and public utilities	do.	88.1	91.9	93.7
Wholesale and retail trade	do.	433.3	452.8	462.5
Finance, insurance, real estate	do.	98.6	101.3	104.2
Services	do.	388.6	404.4	415.2
Government and government enterprises	do.	312.5	314.7	321.6
Total[3]	do.	1,864.6	1,949.2	1,976.8
Personal income:				
Total	millions	$54,868	$59,987	$62,815
Per capita		$11,558	$12,597	$13,154
Hours and earnings:				
Total average weekly hours, production workers		40.7	41.1	41.1
Total average hourly earnings, production workers		$9.8	$10.0	$10.3
Earnings by industry:				
Farm income	millions	$713	$1,325	$1,130
Nonfarm	do.	$37,288	$40,825	$42,970
Mining total	do.	$117	$136	$125
Nonmetallic minerals	do.	$43	$44	$45
Manufacturing total	do.	$12,122	$13,518	$13,855
Primary metal industries	do.	$459	$553	$526
Stone, clay, and glass products	do.	$181	$198	$198
Chemicals and allied products	do.	$293	$317	$340
Petroleum and coal products	do.	$16	$17	$14
Construction	do.	$1,858	$2,131	$2,193
Transportation and public utilities	do.	$2,481	$2,716	$2,833
Wholesale and retail trade	do.	$5,941	$6,309	$6,632
Finance, insurance, real estate	do.	$1,973	$2,090	$2,373
Services	do.	$6,992	$7,731	$8,359
Government and government enterprises	do.	$5,587	$5,970	$6,373
Construction activity:				
Number of private and public residential units authorized[4]		16,962	17,771	20,151
Value of nonresidential construction	millions	$730.9	$830.9	$945.1
Value of State road contract awards	do.	$293.2	$235.9	$250.2
Shipments of portland and masonry cement to and within the State	thousand short tons	1,283	1,458	1,279
Nonfuel mineral production value:				
Total crude mineral value	millions	$101.2	$129.3	$125.1
Value per capita		$21	$27	$26

[p]Preliminary. [r]Revised.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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 Wisconsin Department of Natural Resources (DNR) continued assessing the impact of Exxon Minerals Co. proposed zinc-copper mine near Crandon in Forest County during 1985 and began preparing a draft Environmental Impact Statement (EIS) on the mining project. Exxon had submitted an environmental impact report (EIR) to the DNR in late 1982. The EIR is the principal environmental assessment document used by DNR to prepare a draft EIS as required by the Wisconsin Environmental Policy Act.

In May, Exxon notified the DNR that it planned to modify its construction and operating plan for the Crandon Project. Citing significant changes in the world metal markets and the economic outlook, Exxon proposed to mine the zinc-rich portion of the deposit (sphalerite-dominated massive ore) and leave the copper-rich portion (chalcopyrite-dominated stringer ore) available for mining at later stages of the operation. Production would be reduced from the originally proposed 9,100 metric tons per day to 7,000 tons and may be reached in stages.

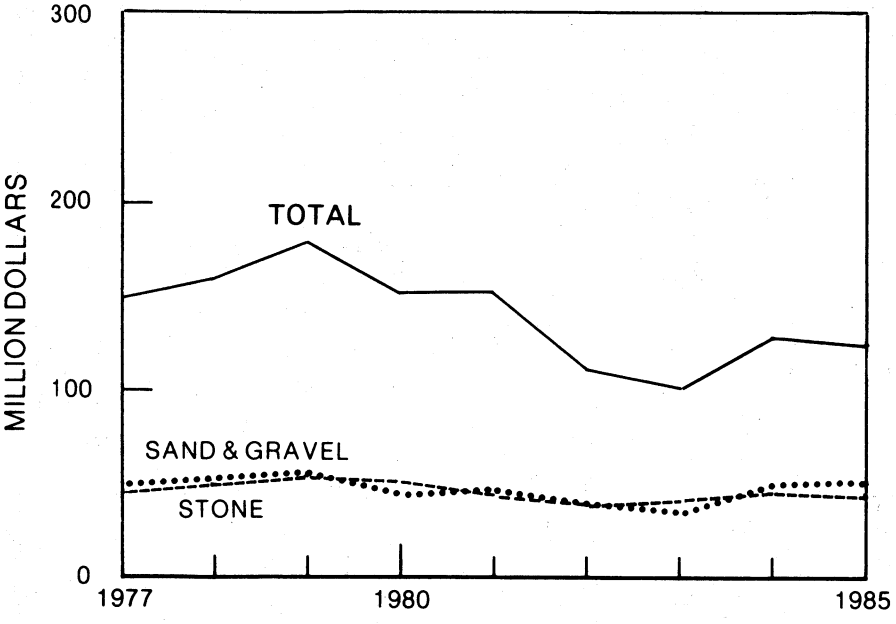

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Wisconsin.

Work force requirements would drop to 600 from the approximately 700 employees originally proposed. The tailings ponds and mill water facilities would be downsized to accommodate the lower production rate, and the mine construction period would be reduced from 42 months to about 30 months. With the downsizing of the project, the mine life would also be extended.

The change in mining plans interrupted the DNR's progress on the draft EIS, and the document was rescheduled for public review and hearings in mid-1986.

Several other developments occurred in the State's mineral industry. In the nonmetallic sector, Pfizer Inc. announced that it would build a precipitated calcium carbonate (PCC) plant in Wisconsin Rapids adjacent to Consolidated Paper Inc.'s pulp mill. Startup of the multimillion-dollar facility was scheduled for the first quarter of 1986. Lime obtained from regional sources would be reacted with carbon dioxide recovered from the pulp mill to produce the desired grades of PCC that would be used as a high-brightness and high-opacifying pigment in premium quality coated and uncoated papers.

The Kalium Chemicals unit of PPG Industries Inc. began construction of a 20,000-short-ton-capacity potash terminal at Madison that was to cost more than $2 million. Consisting of two storage domes, railcar unloading equipment, conveyors, and reclaimer systems to reload trucks, the terminal will be operated by Royester-Madison Inc., a fertilizer manufacturer, for Kalium. Potash will be supplied by Kalium's Belle Plaine, Saskatchewan, Canada, plant in unit trains of up to 100 cars.

In the metallic sector of the State's economy, Mercury Stainless Corp., headquartered in Wheeling, IL, announced plans to build a $50 million mill to produce cold-roll stainless steel near Kenosha that could create about 200 jobs by the end of 1987. Reasons cited by the company for favoring that location included lower power rates, proximity to Mercury's markets, availability of skilled labor, and Kenosha's deepwater port. After the announcement was issued in July, several other States submitted packages of financial incentives to the company to try to entice them to relocate in their States. By yearend, the company had not decided where it would locate the plant.

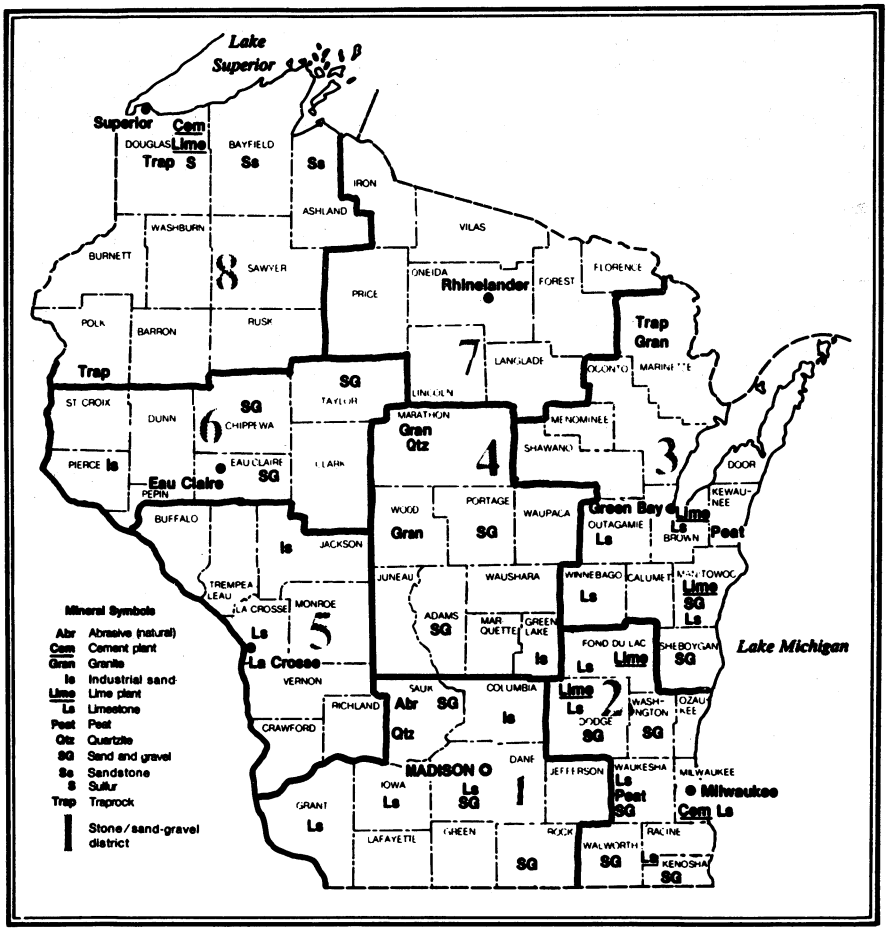

Figure 2.—Principal mineral producing localities in Wisconsin.

Several metals processing, fabricating, and manufacturing facilities were put up for sale during 1985. Armco Inc., based in Middletown, OH, announced that it would seek a buyer for its Ladish Co. of Cudahy and other operations in its Aerospace and Strategic Materials Group. Ladish's plant in Cudahy did forging, diemaking, heat treating, and machining. Another plant in Kenosha, Ladish's Tri Clover Div., made valves and pumps and sanitary fittings for the dairy, food-processing, brewing, and pharmaceutical industries. Combined employment at the plants was about 3,250 persons. No announcement of a sale had been made by yearend.

Inland Steel Co. of Chicago hired the Merrill Lynch investment banking firm to sell its subsidiary INRYCO Inc. that had a plant with 700 employees in Milwaukee. INRYCO designed and built commercial steel buildings and manufactured components for steel buildings, such as floor, roof, and wall systems, doors, and drainage systems. Although the company was headquartered in Deerfield, IL, the Milwaukee factory was its largest operation. About 1,700 people were employed by the company in 10 plants nationwide. A sale of the company had not been consummated by the end of 1985.

Beatrice Companies Inc. sold its Brillion Iron Works Inc. in Brillion early in the year to the Robins Group for $32.5 million. The Brillion operation made gray iron, ductile iron, and compacted graphite iron castings, along with farm equipment.

Arco Metals Co. of Rolling Meadows, IL, a subsidiary of Atlantic Richfield Co., divested two operations in Wisconsin during the year. Wisconsin Centrifugal Inc., based in Waukesha, was sold to Southern Centrifugal of Chattanooga, TN, in June. The company produced centrifugal cast bronze and steel castings. In October, Arco Metals sold its American Brass Co. unit to Buffalo Brass Co. Inc. of Buffalo, NY. The sale included American Brass's plant in Kenosha as well as five other plants that produced copper and copper alloy products as rod, sheet, strip, tube, and wire.

Employment.—Wisconsin's employment picture continued to show signs of improvement in 1985. The State Department of Industry, Labor, and Human Relations (DILHR) reported annual average unemployment at 171,000 persons, or about 7.2% of the work force, a slight improvement over the 1984 rate. Employment in the mining sector also showed gains, rising nearly 16% over 1984 figures. Average annual earnings in the mining sector were $22,510 in 1985 compared with $22,520 in 1984. No strikes were reported in the mining industry in 1985.

Exploration Activities.—In 1985, drilling for metallic minerals reached its lowest level of activity in 8 years. Only 24 holes were drilled, compared with 54 holes in 1984. Total footage drilled, however, increased 17% over that of 1984. Drill records for 1985 included four holes completed by Exxon on its Crandon Project property in support of refinements to its mining plan, which was revised in May 1985. Drilling occurred in seven counties, all in northern Wisconsin. Lincoln County had the greatest number of holes drilled, followed by Forest County. Drilling also took place in Chippewa, Florence, Iron, Oconto, and Price Counties. Five companies were active out of a total of 16 companies that held exploration licenses at some time during the year. A summary of drilling activity is presented in table 4.

Table 4.—Wisconsin: Metallic mineral exploration in 1985

Licensed exploration companies	Number of drill holes	Total footage drilled
AMAX Exploration Inc	2	1,278
American Copper & Nickel Co. Inc	1	363
Exxon Minerals Co	4	4,753
Kerr-McGee Corp	5	3,631
Ernest K. Lehmann & Associates of Wisconsin Inc	12	9,419
Total	24	19,444

Source: Wisconsin Geological and Natural History Survey. Metallic Mineral Exploration in Wisconsin, Summary of 1985 Activity.

Exploration for diamonds during 1985 focused on areas in southeastern and northwestern Wisconsin. Targets included suspected kimberlitic rocks buried beneath glacial and Paleozoic cover in the southeast and unusual near-surface structures in the Pierce County area. At yearend, the southeastern Wisconsin activity had been abandoned with some activity in the northwestern Wisconsin holdings scheduled for 1986.

The press reported several accounts of exploration activity in the State. Mineralco, an Illinois company, and InteResources Inc. of San Antonio, TX, reportedly were investigating a disseminated gold prospect near Rhinelander at Hixon Lake. Plans were to drill several holes on the prospect in 1986.[4]

GEOEX Inc. of Iron Mountain, MI, received a prospecting permit from the Bureau of Land Management to explore for copper, gold, nickel, and zinc on 360 acres in the Nicolet National Forest in the vicinity of Perch and Hemlock Lakes, about 10 miles west of Florence. The firm planned to conduct geophysical studies in the area before its prospecting permit expired in November 1986.[5]

Leasing activity for the purpose of metallic mineral exploration was at a low level during 1985. County records indicated that only two companies leased land totaling 1,110 acres in Lincoln and Oneida Counties. This represented a 60% drop in leased acreage compared with that of 1984, which in itself had declined over 80% from 1983 leasing activity.[6]

Several reasons could be given for the decline in leasing activity: (1) The price of metals was low on the world market, (2) prime target areas have already been leased, evaluated, and the acreage retained or dropped, and (3) a "wait-and-see" attitude was taken by the mining industry as to whether Exxon could obtain a mining permit for its Crandon Project.

Leasing for oil and gas, however, rose sharply in 1985, reflecting major acquisitions of leases on public land holdings in northwestern Wisconsin. Oil and gas leasing for 1985 was 478,000 acres, up from approximately 220,000 acres leased in 1983 and 1984 combined. The leases with the largest block of acreage were signed on county forest lands in Burnett and Douglas Counties.[7]

During the year, Amoco Production Co. announced plans to drill a 12,000-foot exploration borehole to evaluate petroleum potential along the Wisconsin portion of the Keweenawan-Age Midcontinent Rift. The proposed drillsite, termed a rank wildcat, was located in Bayfield County on privately held lands near the Chequamegon National Forest. In the latter part of May, Amoco informed the Wisconsin DNR of its decision to defer drilling in Wisconsin until it gathered more geological information. By yearend, no petroleum drilling by Amoco or other leaseholders in northwestern Wisconsin had occurred. Declining oil prices in late 1985 made it unlikely that petroleum exploration would occur in the near future.

In another action related to the potential of finding oil in the Midcontinent Rift, Grant-Norpac Inc., a Houston, TX-based oil exploration company, probed the depths of Lake Superior using a sophisticated seismic survey ship to record the underlying rock structure. Results indicated several interesting features that could attract wildcat petroleum exploration.

As a result of the oil exploration activity, several Great Lakes States governors banded together to propose a ban on drilling for oil or gas in the Great Lakes, a primary source of water for the surrounding States and Canadian Provinces. A formal resolution to ban drilling was expected to be signed in 1986.

Shipping.—The 1985 shipping season at the Port of Duluth-Superior began on April 2 with the first shipment of iron ore from the Duluth, Missabe & Iron Range Railway Co. (DM&IR) docks in Duluth and ended on December 22 when the last lake carrier departed. The Seaway Port Authority of Duluth reported total waterborne commerce passing through the Port of Duluth-Superior at 25.8 million metric tons, down 20.6% from the 32.5 million tons reported in 1984. Iron ore and concentrates shipped to domestic ports dropped 23.6% from the 17.4 million metric tons reported in 1984. Iron ore and concentrates shipped to Canada totaled 1.6 million metric tons, down 11.1% from 1984 figures. The American Iron Ore Association reported iron ore and concentrates of 8.5 million gross tons (railroad weight) handled through the Burlington Northern Railroad facility on Allouez Bay, compared with 11.1 million gross tons handled in 1984. The DM&IR docks handled 6.1 million gross tons of iron ore and concentrate in 1985 compared with 7.8 million gross tons in 1984.

The port experienced declines in shipments of grain, grain byproducts, iron ore

and concentrate, and oilseed. Declines were also recorded for receipts of limestone, limestone products, fertilizer, calcium chloride, and sodium chlorides from domestic and Canadian sources, and general cargo. Shipments of Western coal and petroleum coke recorded slight increases over 1984 figures.

Problems on the Great Lakes also added to the port's troubles in 1985. The St. Lawrence Seaway, which links the Great Lakes to the Atlantic Ocean, was closed for 24 days beginning October 14 when a wall collapsed in a navigation lock on the Welland Canal. On November 29, the Seaway closed for another 3 days when a freighter rammed a bridge on the St. Lawrence River near Montreal.

During 1985, Burlington Northern filed suit against the City of Superior, claiming that the city's collection of taxes on taconite shipped through its facility in Superior was unconstitutional. The firm had lost a similar suit the previous year in the Douglas County Circuit Court, but the decision was under appeal to the State Supreme Court. Superior had collected about $2.5 million in taxes since the law went into effect. About 30% of the tax receipts were passed on to the State. Results of the suit were expected in 1986.

The Midwest Energy Terminal in Superior established a new record in 10 seasons of shipping Western coal to electric generating facilities in Michigan. Nearly 7 million short tons of coal was transshipped in 1985 compared with 6.7 million short tons shipped in 1984, the previous record year.

The Port of Green Bay on the western shore of Lake Michigan reported a total of 2.2 million short tons of cargo through the port in 1985, compared with 2.5 million tons in 1984. Major mineral commodities entering the port, in decreasing order of tonnage, were coal, cement, limestone, and salt.

Total tonnage through the Port of Milwaukee was down about 18% during 1985, reaching only about 2.5 million short tons. No imports were reported for clinker, concrete aggregate, gypsum, or limestone, and large drops were reported for, in order of percent decline, sand, pig iron, grain, and steel. The shutdown of the St. Lawrence Seaway for several weeks also adversely affected the port's business. Table 5 lists selected nonfuel mineral commodities imported during the year.

Table 5.—Port of Milwaukee: Selected nonfuel mineral commodity imports[1]

(Short tons)

Commodity	1984	1985
Cement	388,796	366,776
Clinker	81,219	--
Concrete aggregate	11,067	--
Gypsum	6,110	--
Limestone	129,295	--
Pig iron	67,445	33,368
Salt	524,393	493,062
Sand	44,985	22,799
Total	1,253,310	916,005

[1]Includes Canadian imports and domestic receipts.

Source: 1985 Annual Report, Port of Milwaukee, U.S.A.

Legislation and Government Programs.—In 1985, a section within Wisconsin Act 29, the 1985 Executive Budget Bill, amended existing statute 70.40 to read that "Every person operating an iron ore concentrates dock in this state, shall on or before December 15 of each year pay an annual occupational tax equal to 5 cents per ton upon all iron ore concentrates handled by or over the dock during the year ending on the preceding December 31. In this section "dock" means a wharf or platform for the loading or unloading of materials to or from ships." Previously, iron ore companies operating in Wisconsin and paying a net proceeds tax were exempt from this tax.

The Wisconsin DNR promulgated an administrative rule (NR 134) that regulated oil and gas exploration in the State. The action was taken because of the high degree of interest shown in the Midcontinent Rift Zone, the accelerated levels of oil leasing activity, and the plan of one company to drill a deep exploration hole, which was later rescinded. The rules set licensing and bonding requirements for oil and gas exploration, provided for notification of intent to drill, and established procedures for the abandonment of drill holes.

Wisconsin's attorney general issued an opinion (OAG 12-85) in April stating that, in tax delinquency proceedings, a county acquires fee simple title to land, including mineral interests therein, whether severed or not. The opinion had been sought by the Legislative Council Mining Committee to clarify the legal position of tax deed lands that are common in the extensive county forest holdings in northern Wisconsin. County governments had requested a determination to clarify their right to lease the minerals they had obtained through tax

deeds, as much of the county forest land was of interest to exploration firms.

In 1985, the Mining Investment and Local Impact Fund Board disbursed almost $462,000, most to local governmental units near Exxon's Crandon Project in Forest County, to mitigate impacts due to metallic mineral development. Permit-period payments totaling $431,600 were disbursed to two towns and two tribal governments near the Exxon property. Discretionary payments of $30,300 were disbursed to fund local mining impact committees, comprehensive planning and zoning in the Town of Elcho, fencing and ground-filling near subsidence zones in Iron County, and continued monitoring of sulfate-impacted wells near Shullsburg in southwestern Wisconsin. Revenues supporting Impact Fund Board disbursements included a $350,000 loan from the State to the Board and $80,000 in revenues from the iron ore concentrates tax. Net proceeds tax revenues, another source of Board funding in past years, were not received in 1985. Although specific grant funds were not issued in 1985, the Impact Fund Board maintained an active interest in funding local economic development near the closed taconite mine formerly operated by Jackson County Iron Co. at Black River Falls.

Statutory changes affecting the Impact Fund Board in 1985 included (1) revised accounting and fiscal procedures mandated by the legislature following the 1984 Legislative Audit Bureau report, (2) the addition of counties to the construction-period payment program, so counties can receive up to $300,000 per year for mine-related expenses, and (3) legislatively mandated limitations on Impact Fund Board funding of legal expenses.

Two Wisconsin counties actively pursued development of nonmetallic mining ordinances in 1985. Marathon County began to draft a new ordinance after State legislation passed in 1984 gave counties clear authority to adopt nonmetallic mining reclamation ordinances. Sawyer County also began to revise its existing mining ordinance to encompass nonmetallic mineral operations. At yearend, neither ordinance had been formally adopted by the respective county boards.

In another action, Marinette County, in cooperation with the Wisconsin Geological and Natural History Survey, University of Wisconsin—Extension, began to formulate a competitive leasing system for metallic minerals on county forest lands. Development of the lease policy was expected to be completed in 1986.

In June, the Wisconsin Geological and Natural History Survey moved from its home of 22 years on University Avenue to a new location at 3817 Mineral Point Road in Madison. The new offices provided the Survey with needed space for its expanding programs.

The Survey's special efforts were directed toward geologic mapping and ground water studies during the year. Three 1:250,000-scale bedrock geologic maps covering about 30% of the State's land area were completed as were two county bedrock geologic maps at a scale of 1:100,000. Pleistocene geologic mapping was under way in 11 counties in support of ground water studies. The county maps were to be part of a comprehensive county atlas mapping program that will include geologic, hydrologic, and soils maps, plus derivative maps, for land use planning.

Among the publications released by the Survey during 1985 were Special Report No. 8, "Groundwater Protection Principles and Alternatives for Rock County, Wisconsin;" Bibliography and Index No. 21, "An Annotated Bibliography of Local Groundwater Management Publications;" and "Educational Series No. 28, Major Groundwater Units of Wisconsin." Information Circular No. 47, "A New Subsurface Study of the St. Peter Sandstone," was also released in 1985.

The Bureau of Land Management (BLM) released its final plan for surface and split-estate minerals of public lands in Wisconsin. The plan called for the disposal of all remaining BLM-administered surface tracts in the State, following resolution of title conflicts and site specific land reports. All Federal mineral ownership remained available for exploration and development, except where legal restrictions, intergovernmental consistency requirements, administrative or Congressional designations, or surface resource sensitivity prohibit such activities.

For Federal mineral estate holdings under State or local government or private surface, the plan defined management objectives based on mineral production potential. Management classes were defined for high, moderate, and low mineral production potential and for common variety mineral commodities.

The U.S. Forest Service released its draft 10-year management plan and EIS for the Chequamegon National Forest during the

year. The plan allowed for mineral exploration with surface-disturbing activities to be evaluated and permits granted or refused on a site-specific basis. Surface mining would be prohibited on threatened or endangered species breeding areas, fish spawning areas, or DNR scientific areas, although alternate mining methods might be approved. The report stated that 66% of the mineral rights in the forest were Federally owned. The remaining 34% of the mineral ownership was divided among private owners, counties, or the State.

The Federal Government distributed $620,250 to Wisconsin for its share of funds generated by activities (timbering, mineral leasing, recreation, user fees, etc.) on national forest lands in fiscal year 1985. This compared with $728,750 in funds the State received in fiscal year 1984. Wisconsin's local governments received $554,541 in fiscal year 1985 funds as "payments in lieu of taxes" for Federal tax-exempt lands within their boundaries.

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Abrasive Stone.—Quartzite continued to be mined by Baraboo Quartzite Co. Inc. at its small quarry east of Baraboo in Sauk County. Extremely hard, the stone was used as a deburring and burnishing media at metal stamping plants in several States and foreign countries. The material was marketed in about 20 different sizes, ranging from 4 inches to sand size and was shipped to consumers in 100-pound bags. Only one other producer in the United States processed stone for this use. Shipments declined about 7% during the year, but value increased about 6%.

Cement.—Two companies operated clinker-grinding facilities during 1985. Clinker and raw materials were obtained from out-of-State sources and stockpiled at the plantsites until used. National Gypsum Co., Huron Cement Div., produced portland cement at its facility at Superior, Douglas County, and St. Marys Wisconsin Cement Inc., a subsidiary of St. Marys Cement Ltd., produced portland and masonry cement at its facility in Milwaukee. Shipments and value for portland cement dropped nearly 16% and about 15%, respectively, during the year, whereas masonry shipments and value remained the same as that of 1984. Most sales were to ready-mixed concrete companies and concrete product manufacturers. Sales to building material dealers, highway and other contractors, government agencies, and miscellaneous customers were also reported.

Most of the cement produced was shipped in bulk (93%); the rest, in packaged form. All shipments were by truck. Shipments to and within the State were 1,240,000 tons of portland cement and 39,000 tons of masonry cement.

Near midyear, National Gypsum announced that it was negotiating the sale of its Great Lakes network of Huron Cement distribution terminals to LaFarge Coppee, a France-based conglomerate in the building products industry whose United States-Canadian subsidiary was LaFarge Corp. Transfer of ownership of the distribution facilities was not consummated by yearend.

Iron Oxide Pigments (Finished).—DCS Color & Supply Co. Inc., in Milwaukee County, processed and sold natural iron oxide pigments for colorant in animal food, cement and construction materials, foundry use, and paint and coatings. Sales and value increased modestly in 1985.

Lime.—Wisconsin ranked 14th of 36 States in the production of lime, which was the third highest valued mineral commodity produced in the State. Plants were operated by CLM Corp. at Superior, Douglas County; Rockwell Lime Co. at Manitowoc, Manitowoc County; and Western Lime & Cement Co. in Brown, Dodge, and Fond du Lac Counties. Both quicklime and hydrated lime were produced at the plants, with quicklime accounting for 71% of the total. Production dropped about 8% during the year and value about 4%. Sales were adversely affected by declines in steel and agricultural demand. Average value per ton increased $2.39. Lime consumed in Wisconsin was 145,000 short tons (99,000 tons of quicklime and 46,000 tons of hydrated lime.)

Rockwell Lime Co. announced plans during 1985 to modify the old Medusa Cement Co. plant in Manitowoc and to convert it to high calcium lime production. Adverse public reaction to the proposal and discrepancies in air quality data caused the company to abandon the project for the near term.

Western Lime brought its new 250-ton-per-day rotary kiln at Eden into production during the year. With the new kiln on-stream, the company phased out production

from its shaft kiln at the site while adding a substantial increase in capacity.

Peat.—Four companies produced peat in 1985. One company operated in Kewaunee County, and the other three companies had operations in Waukesha County. Sales and value increased 11% and 39%, respectively. Sales were for general soil improvement and for use as seed inoculant. About 66% of the peat was sold in bulk, the rest in packaged form. Types of peat harvested were reed-sedge, humus, and hypnum.

Perlite (Expanded).—Midwest Perlite Co., the State's only producer, expanded crude perlite obtained from western sources at its plant in Outagamie County. The company's product, used mainly for horticultural purposes, was bagged and shipped to consumers in Iowa, Minnesota, and Wisconsin. Sales and value of the product increased modestly in 1985.

Sand and Gravel.—*Construction.*—Construction sand and gravel is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

Industrial.—Sand used for industrial purposes was produced by three companies in six counties. Production and value increased nearly 13% and 24%, respectively, in 1985 compared with 1984 figures. Average value per ton increased $1.07. Major sales of industrial sand were for foundry applications, glass manufacturing, hydraulic fracturing, and sandblasting. Wisconsin's industrial sand was marketed throughout the Nation and in several foreign countries. Approximately three-fourths of the State's sand sales was distributed to consumers by truck. The rest was transported by rail.

Stone.—Stone production was surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed.—Nationally, Wisconsin ranked 25th in crushed stone production, which in terms of value, was the leading mineral commodity produced in the State. Crushed stone was mined in 46 of the State's 72 counties at 175 quarries. Limestone generated the greatest value of sales, followed by sandstone, granite, and traprock.

In 1985, the U.S. Bureau of Mines began compiling crushed stone production statistics by districts for some States. Table 7 presents end-use data for crushed stone produced in the eight Wisconsin districts that are outlined in figure 2.

Table 6.—Wisconsin: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+1-1/2 inch):		
Macadam	107	(2)
Riprap and jetty stone	137	768
Filter stone	379	967
Coarse aggregate, graded:		
Concrete aggregate, coarse	878	2,746
Bituminous aggregate, coarse	257	906
Bituminous surface-treatment aggregate	369	856
Railroad ballast	109	228
Fine aggregate (-3/8 inch): Screening, undesignated	202	377
Combined coarse and fine aggregates:		
Graded road base or subbase	4,527	12,597
Unpaved road surfacing	734	2,095
Crusher run or fill or waste	326	676
Other construction[3]	107	636
Agricultural:		
Agricultural limestone	573	3,397
Agricultural marl and soil conditioners	W	21
Chemical and metallurgical: Flux stone	1	W
Special:		
Other fillers or extenders	3	W
Roofing granules	1	W
Other miscellaneous[4]	1,080	3,294
Other unspecified[5]	4,707	12,819
Total[6]	14,496	42,380

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

[1]Includes limestone, dolomite, granite, sandstone, and traprock.

[2]Withheld to avoid disclosing company proprietary data; included with "Other construction."

[3]Includes stone sand (concrete), coarse aggregate (large), and stone used for other construction and maintenance purposes.

[4]Includes stone used in cement and lime manufacture, chemical stone, stone used in chemicals, and data indicated by symbol W.

[5]Includes production reported without a breakdown by end use and estimates for nonrespondents.

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

Table 7.—Wisconsin: Crushed stone sold or used by producers in 1985, by use and district

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3		District 4	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	(1)	(1)	313	1,195	28	77	--	--
Coarse aggregate, graded	110	179	865	2,866	494	1,257	--	--
Fine aggregate (-3/8 inch)	--	--	71	166	136	225	--	--
Combined coarse and fine aggregates	938	2,188	2,081	5,448	1,105	2,619	359	1,075
Other construction	341	981	--	--	--	--	--	--
Agricultural limestone	183	764	(2)	(2)	(2)	(2)	(2)	(2)
Cement manufacture	--	--	(2)	(2)	(2)	(2)	--	--
Lime manufacture	--	--	(2)	(2)	(2)	(2)	--	--
Chemical stone	--	--	--	--	(2)	(2)	--	--
Flux stone	--	--	(2)	(2)	--	--	--	--
Roofing granules	--	--	(2)	(2)	--	--	--	--
Other fillers or extenders	--	--	--	--	(2)	(2)	--	--
Other miscellaneous	--	--	212	1,515	967	3,072	--	--
Other unspecified[4]	1,953	5,542	717	2,059	1,050	2,579	(2)	(2)
Total[5]	3,526	9,653	4,259	13,249	3,779	9,828	1,295	3,606

Use	District 5		District 6		District 7		District 8	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Coarse aggregate (+1-1/2 inch)	8	36	(2)	(2)	--	--	15	37
Coarse aggregate, graded	52	228	68	168	--	--	(1)	(1)
Fine aggregate (-3/8 inch)	2	4	--	--	--	--	(1)	(1)
Combined coarse and fine aggregates	879	3,312	169	610	--	--	(1)	(1)
Other construction	--	--	--	--	--	--	94	176
Agricultural limestone	81	404	123	594	--	--	25	160
Other chemical and metallurgical	--	--	(2)	(2)	--	--	--	--
Other unspecified[4]	56	156	(2)	(2)	--	--	--	--
Total[5]	1,078	4,140	426	1,530	--	--	134	373

[1]Withheld to avoid disclosing company proprietary data; included with "Other construction."
[2]Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."
[3]Withheld to avoid disclosing company proprietary data; included in "Total."
[4]Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5]Data may not add to totals shown because of independent rounding.

Dimension.—Nationally, Wisconsin ranked 13th of 36 States in dimension stone production. Production was by 10 companies in 6 counties at 13 quarries. Uses of dimension stone produced in Wisconsin during 1985 are shown in table 8. Granite accounted for most of the monumental stone value and for a small amount of the ashlar and/or veneer sales. The remainder was limestone.

Table 8.—Wisconsin: Dimension stone[1] sold or used in 1985, by use

Use	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:			
Irregular-shaped stone	2,886	36	$85
Monumental	1,771	21	314
Dressed stone:			
Ashlars and partially squared pieces	6,588	82	381
Monumental	4,042	50	1,772
Curbing	532	7	18
Flagging	2,767	35	106
Other[2]	3,333	42	57
Total[3]	21,920	272	2,733

[1]Includes granite and limestone.
[2]Includes rough blocks and dressed slabs and blocks for building and construction.
[3]Data may not add to totals shown because of independent rounding.

Granite, commanding 69% of dimension stone sales, was the most valued rock type mined with production occurring in Marathon and Marinette Counties by four companies at six quarries.

Six companies quarried limestone at seven quarries in Calumet, Fond du Lac, Manitowoc, and Waukesha Counties. The greatest number of quarries were operated in Waukesha County.

Sulfur (Recovered).—Murphy Oil Corp. continued to recover byproduct sulfur at its oil refinery in Superior, Douglas County. Sales dropped 18% during the year to about 1,500 metric tons. Average value increased $4.92 per tons.

Vermiculite (Exfoliated).—Crude vermiculite from out-of-State sources was exfoliated by Koos Inc. at its plant in Kenosha. Sales dropped about 6% during 1985, and average value per ton dropped about 16%. Major sales were for agricultural purposes. Lesser quantities were used for loose fill and packing insulation, and as concrete, plaster, and roofing aggregates.

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[1]State Mineral Officer, Bureau of Mines, Minneapolis, MN.

[2]Associate professor, Minerals Information, Wisconsin Geological and Natural History Survey, Madison, WI.

[3]Editorial assistant, Bureau of Mines, Minneapolis, MN.

[4]North American Gold Mining Industry News. Assessment Completed on InteResources' Montana, Colorado Claims. Sept. 13. 1985, p. 10.

[5]Florence Mining News. GEOEX Gets Permit To Look Closer for Nickel in Nicolet. Feb. 6, 1985.

[6]Harkin, D. A. Mineral Transactions Activity and Terms in Wisconsin—1985. Univ. WI, Agri. Econ. Staff Paper No. 252, 1986, 11 pp.

[7]Work cited in footnote 6.

Table 9.—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.	4000 Town Center Suite 2000 Southfield, MI 48075	Grinding plant	Douglas.
St. Marys Wisconsin Cement Inc., a subsidiary of St. Marys Cement Ltd.	9333 Dearborn St. Detroit, MI 48209	do	Milwaukee.
Iron oxide pigments (finished):			
DCS Color & Supply Co. Inc	2011 South Allis St. Milwaukee, WI 53207	Plant	Do.
Lime:			
CLM Corp	12th Ave. West and Waterfront St. Duluth, MN 55802	do	Douglas.
Rockwell Lime Co	Route 2, Box 124 Manitowoc, WI 54220	do	Manitowoc.
Western Lime & Cement Co	Box 57 West Bend, WI 53095	Plants	Brown, Dodge, Fond du Lac.
Peat:			
Bogda's Top Soil & Excavating Co.	12600 West Cleveland Ave. New Berlin, WI 53151	Bog and plant	Waukesha.
Certified Peat & Sod Inc	19000 West Lincoln Ave. New Berlin, WI 53151	do	Do.
Demilco Inc., a division of Nitragin Sales Corp.	3101 West Custer Ave. Milwaukee, WI 53209	do	Do.
Honest To Peat Inc	Route 2 Algoma, WI 54201	Bog	Kewaunee.
Perlite (expanded):			
Midwest Perlite Co	4280 Parkway Blvd. Appleton, WI 54911	Plant	Outagamie.
Sand and gravel:			
Construction (1984):			
American Materials Corp	Box 388 Eau Claire, WI 54701	Pits and plants	Barron, Chippewa, Dunn, Eau Claire.
Janesville Sand & Gravel Co., Lycon Inc.	Box 427 Janesville, WI 53545	do	Columbia, Dane, Rock.
Johnson Sand & Gravel Inc	N8 W22590 Johnson Dr. Waukesha, WI 53186	do	Waukesha.
Arthur Overgaard Inc	Box 87 Elroy, WI 53929	do	Adams, Columbia, Jackson, Washburn.
Valley Sand & Gravel Corp	S63 W19750 Luckow Dr. Muskego, WI 53150	Pit and plant	Waukesha.
Wissota Sand & Gravel Co	Box 1268 Eau Claire, WI 54702	Pits and plants	Barron, Rusk, Washington.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Industrial:			
Badger Mining Corp	Box 97 Fairwater, WI 53931	Pits and plants	Green Lake and Jackson.
A. F. Gelhar Co. Inc	Box 209 Berlin, WI 54923	do	Waupaca and Winnebago.
Treco Sales Inc	Box 38 Bay City, WI 54723	Underground mine and plant.	Pierce.
Unimin Corp	258 Elm St. New Canaan, CT 06840	Pit and plant	Columbia.
Stone:			
Crushed:			
Granite:			
Boon Construction Inc	Route 3, Box 61-H Neillsville, WI 54456	Quarry and plant	Wood.
Gary Charneski Excavating Co.	626 Highway B Mosinee, WI 54455	do	Marathon.
Limestone and dolomite:			
Daanen & Janssen	Box 127 De Pere, WI 54115	do	Brown.
4X Corp	Box 509 Neenah, WI 53929	Quarries and plants.	Calumet, Fond du Lac, Winnebago.
C. C. Linck Inc	1226 West Center St. Beaver Dam, WI 53916	do	Various.
Arthur Overgaard Inc	Box 87 Elroy, WI 53929	do	Buffalo, Juneau, La Crosse, Monroe, St. Croix.
Vulcan Materials Co., Midwest Div.	Box 6 Countryside, IL 60525	do	Milwaukee, Racine, Waukesha, Winnebago.
Sandstone and quartzite:			
Minnesota Mining & Manufacturing Co.	3M Center St. Paul, MN 55101	Quarry and plant	Marathon.
Weaver Construction Co	Box 177 Rock Springs, WI 53961	do	Sauk.
Traprock (basalt):			
GAF Corp	Box 630 Pembine, WI 54156	do	Marinette.
TCI Traprock Inc	Box 517 Dresser, WI 54009	do	Polk.
Dimension:			
Granite:			
Anderson Bros. & Johnson Co.	Box 26 Wausau, WI 54401	Quarries and plant	Marathon and Marinette.
Cold Spring Granite Co	202 South 3d Ave. Cold Spring, MN 56320	Quarry	Marathon.
Lake Wausau Granite Co.	Box 397 Wausau, WI 54401	Quarry and plant	Do.
Monumental Sales and Manufacturing Co. Inc.	5019 Ross Ave. Schofield, WI 54476	do	Do.
Limestone:			
Buechel Stone Center Inc	Box 907 Fond du Lac, WI 54935	Quarries and plant	Calumet and Fond du Lac.
R. & T. Quality Stone Inc.[1]	Box 182 Lannon, WI 53046	Quarry and plant	Waukesha.
Valders Lime & Stone Co. Inc.	Box 35 Valders, WI 54245	do	Manitowoc.
Wislanco Stone Co. Inc	Box 312 Lannon, WI 53046	do	Waukesha.
Sulfur (recovered):			
Murphy Oil Corp	Box 2066 Superior, WI 54880	Byproduct sulfur recovery plant.	Douglas.
Vermiculite (exfoliated):			
Koos Inc	4500 13th Ct. Kenosha, WI 53140	Plant	Kenosha.

[1]Also crushed limestone.

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 1985 was $552.5 million, a very slight increase over the 1984 value. It was the first year since 1981 that had not registered a decline in value from the preceding year. The 1985 figure was more than 28% below the 1981 peak year.

Trends and Developments.—During 1980-85, the national and international economy had changed in ways that seriously affected demand for Wyoming mineral products. A trend away from glass containers to plastic, metals, and paper, and more limited demand for window glass reduced demand for soda ash; drastically reduced drilling for oil and gas and reduced mining and pelletizing of iron ore lessened demand for bentonite clay; and production of iron ore in the State ceased entirely as output of the U.S. iron and steel industry declined.

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

Mineral	1984		1985	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	r2,628	$67,921	2,302	$64,146
Gem stones	NA	225	NA	225
Gypsum thousand short tons	376	2,618	576	4,488
Sand and gravel (construction) do.	4,586	13,372	e3,500	e11,000
Stone (crushed) do.	e1,900	e7,600	2,030	2,329
Combined value of cement (portland), lime, sodium carbonate, and stone (crushed granite, 1985)	XX	458,187	XX	465,275
Total	XX	r549,923	XX	552,463

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

Table 2.—Nonfuel minerals produced in Wyoming in 1984, by county

County	Minerals produced in order of value
Albany	Cement (portland), clays, sand and gravel, gypsum.
Big Horn	Clays, gypsum, sand and gravel, lime.
Campbell	Sand and gravel.
Carbon	Do.
Converse	Do.
Crook	Clays, sand and gravel.
Fremont	Sand and gravel.
Goshen	Lime, sand and gravel.
Hot Springs	Sand and gravel.
Johnson	Clays, sand and gravel.
Laramie	Sand and gravel.
Lincoln	Do.
Natrona	Sand and gravel, clays.
Niobrara	Sand and gravel.
Park	Gypsum, sand and gravel.
Platte	Sand and gravel.
Sheridan	Do.
Sublette	Do.
Sweetwater	Sodium carbonate, sand and gravel.
Teton	Sand and gravel.
Uinta	Sand and gravel, clays.
Washakie	Clays, lime, sand and gravel.
Weston	Clays.
Undistributed[2]	Stone (crushed), gem stones, sand and gravel.

[1]No production of nonfuel mineral commodities was reported for counties not listed.
[2]Data not available by county for minerals listed.

Eight industrial minerals were produced in Wyoming in 1985; no metals were produced. Wyoming again ranked 14th among nonfuel mineral producing States as it had in 1984. Value of nonfuel minerals per capita was about $1,085 in 1985, compared with $1,615 in 1980, but still dramatically above the national average of $98, indicating the continuing importance of mineral production to Wyoming's economy.

In 1985, output of sodium carbonate (soda ash), still the dominant nonfuel mineral product of the State, increased very slightly over 1984 output. Production of bentonite clay, second in importance, declined approximately 12% in output from the 1984 level. Change in output of other minerals was mixed: construction sand and gravel output was estimated to have fallen substantially, crushed stone output was up substantially, as was output of gypsum and lime; cement production increased slightly.

Total tax valuation of property in the State of Wyoming was $8.4 billion in 1985, up 5% from that of 1984. Minerals accounted for 71% of this total: oil, 37%; natural gas, 18%; coal, 15%; and trona (soda ash) and other minerals, 1.7%. Minerals paid $393.7 million in ad valorem taxes on production, of which trona and other nonfuel minerals contributed $10.5 million. Severance taxes collected on mineral production were $191.4 million, $0.9 million from trona and other nonfuel minerals. Sales and use taxes on minerals amounted to $22.8 million. All mineral income, taxes, rents, and royalties, accruing to the State of Wyoming in 1985 was about $905 million, by far the most important source of income to the State.

Another indicator of the state of the economy in Wyoming in 1985 was its home foreclosure rate, the highest in the Nation with nearly 4% of all home mortgages in foreclosure at the end of the year, most related to mining layoffs.

About 25,900 people were employed in mining in Wyoming in 1985, compared with about 27,900 in 1984, about 56% of whom were employed by the oil and gas industry. Total labor force of the State declined from about 255,000 in 1984 to 253,000 in 1985. The unemployment rate increased from 6.3% to 7.1% over the same period.

Exploration Activities.—Exploration for gold continued in the granite-greenstone of the South Pass-Atlantic City and Lewiston mining districts along the southern tip of the Wind River Mountains of western Wyoming, in the iron formation of the Bradley Peak area of the Seminoe Mountains District, in the northern Medicine Bow and Sierra Madre Mountains of central Wyoming, and in the Hartville Uplift and Black Hills of eastern Wyoming. Although major mining companies have been exploring Wyoming for both large-tonnage, low-grade stratiform gold deposits and low-grade "Carlin-type" micrometer gold deposits associated with black shales, only minor exploration activity for micron gold occurred during the year. That activity was centered in the Overthrust Belt of western Wyoming.

At the Carissa Mine near South Pass City, historically one of the two largest gold producers in the district, a Salt Lake City company cleared the primary shaft of debris and began dewatering the drifts and stopes on the five levels. The Geological Survey of Wyoming (GSW) prepared preliminary mine maps of a dozen old mines in the district as part of a project to map the greenstone belt and to categorize the gold

Table 3.—Indicators of Wyoming business activity

		1983[r]	1984	1985[p]
Employment and labor force, annual average:				
Population	thousands	516	511	509
Total civilian labor force	do.	263	255	253
Unemployment	percent	8.4	6.3	7.1
Employment (nonagricultural):				
Mining total[1]	thousands	28.5	27.9	25.9
Metal mining	do.	2.1	1.3	.9
Nonmetallic minerals except fuels[2]	do.	4.4	4.0	3.9
Coal mining[2]	do.	5.6	5.7	5.7
Oil and gas extraction[2]	do.	16.3	16.9	14.6
Manufacturing total	do.	8.2	8.0	7.9
Primary metal industries[2]	do.	1	.1	W
Stone, clay, and glass products[2]	do.	1.1	1.1	1.0
Chemicals and allied products[2]	do.	.3	.3	.3
Petroleum and coal products	do.	1.3	1.1	1.0
Construction	do.	14.4	14.1	14.7
Transportation and public utilities	do.	16.3	15.8	15.2
Wholesale and retail trade	do.	45.9	46.4	45.8
Finance, insurance, real estate	do.	7.9	8.0	8.0
Services	do.	32.4	33.1	34.4
Government and government enterprises	do.	48.9	50.9	53.1
Total[3]	do.	202.5	204.3	204.9
Personal income:				
Total	millions	$6,215	$6,410	$6,734
Per capita		$12,040	$12,506	$13,228
Hours and earnings:				
Total average weekly hours, production workers		36.9	39.5	41.2
Mining		40.6	43.4	43.0
Total average hourly earnings, production workers		$8.7	$9.1	$9.9
Mining		$12.6	$13.3	$13.6
Earnings by industry:				
Farm income	millions	$42	$28	$29
Nonfarm	do.	$4,649	$4,823	$5,070
Mining total	do.	$1,055	$1,057	$1,016
Metal mining	do.	$74	$49	$39
Nonmetallic minerals except fuels	do.	$164	$158	$161
Coal mining	do.	$276	$305	$332
Oil and gas extraction	do.	$542	$546	$486
Manufacturing total	do.	$199	$198	$199
Primary metal industries	do.	$2	$6	$6
Stone, clay, and glass products	do.	$28	$27	$26
Chemicals and allied products	do.	$9	$9	$12
Petroleum and coal products	do.	$61	$48	$44
Construction	do.	$419	$443	$576
Transportation and public utilities	do.	$511	$537	$547
Wholesale and retail trade	do.	$673	$685	$707
Finance, insurance, real estate	do.	$161	$168	$186
Services	do.	$611	$656	$696
Government and government enterprises	do.	$966	$1,058	$1,121
Construction activity:				
Number of private and public residential units authorized[4]		2,872	1,649	1,167
Value of nonresidential construction	millions	$79.6	$88.6	$83.3
Value of State road contract awards	do.	$144.9	$171.1	$174.5
Shipments of portland and masonry cement to and within the State	thousand short tons	382	396	415
Nonfuel mineral production value:				
Total crude mineral value	millions	$629.9	$549.9	$552.5
Value per capita		$1,221	$1,075	$1,085

[p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

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

[4]1983 data based upon 16,000-place sample; 1984 and 1985 data based upon 17,000-place sample.

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

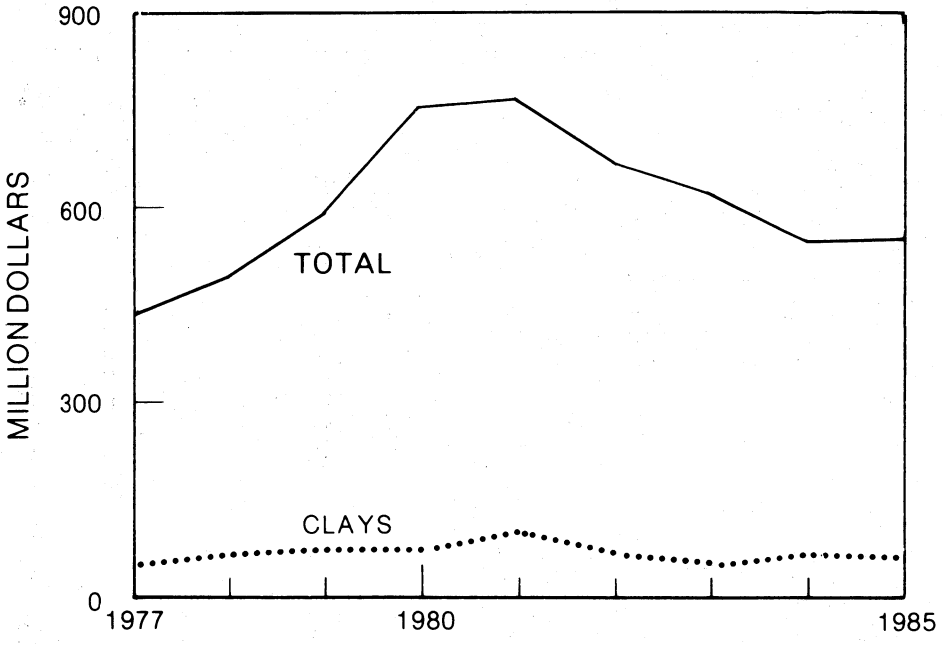

Figure 1.—Value of clays and total value of nonfuel mineral production in Wyoming.

deposits. Exploration by at least two companies focused on the Ferris-Haggerty Mine; copper, gold, and silver were known to exist at that mine.

The GSW continued searching the Laramie Range for diamondiferous kimberlite. The Leucite Hills in southwestern Wyoming was also the site of exploration for diamonds.

Exploration for industrial minerals included natural sulfur deposits in the Auburn, Cody, and Thermopolis areas in western Wyoming; local sources of durable rock suitable for railroad ballast to replace rock imported from out of State; and limestone for use as highway construction aggregate and in the production of cement.

Legislation and Government Programs.—Enrolled Act No. 38, signed by the Governor February 14, stated the liability of mineral lessors and leasers for property taxes due for mineral production under the lease and provided for payment date.

An act passed by the legislature and signed by the Governor, Chapter 235, Wyoming Session Law, created a State Economic Development and Stabilization Board to replace the Department of Economic Planning and Development. Duties of the new agency included: "considering new plans and, if necessary, draft legislation to reduce the adverse effect of the monopoly railroad power on the coal and trona industries."

The Governor vetoed an interim mine stabilization act passed by the legislature that would have allowed noncoal surface mines to suspend operations when mineral markets were adverse without having to begin irreversible reclamation of the mined area. The bentonite industry would have been the major beneficiary.

A bill raising truck weight limits on interstate highways was also vetoed. The current interstate weight was 80,000 pounds, while on other primary and secondary highways, the limit was 117,000 pounds. The effect of the bill would have been to make more feasible movement of soda ash by truck to railheads other than the Union Pacific Railroad, whose lines provided nearly sole access to markets for the soda ash producers in southwest Wyoming.

The Office of Surface Mining (OSM), U.S. Department of the Interior, awarded Wyoming $5.4 million to reclaim 18 abandoned bentonite, gold, and uranium mines and a

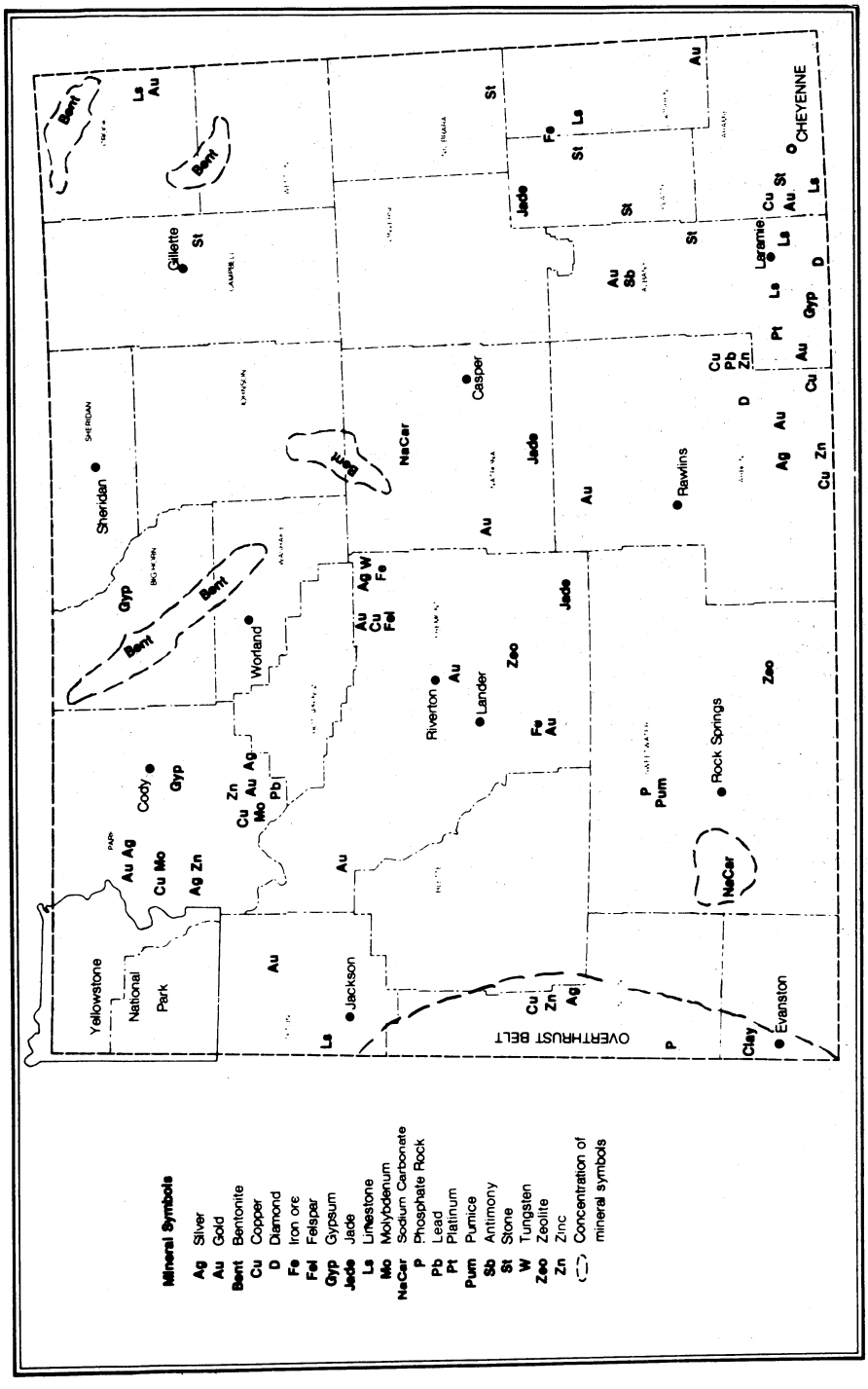

Figure 2.—Principal mineral producing localities in Wyoming.

limestone quarry, mostly in northeastern Wyoming. An additional $7.4 million was granted for reclamation of 19 abandoned copper, feldspar, gold, graphite, iron, and limestone mines in southeastern Wyoming. Strong local opposition was expressed to plans to reclaim old gold mines in the South Pass-Atlantic City area. The State had been awarded $92.6 million for reclamation work by OSM since the State's abandoned mine lands program was approved in February 1983. The State also received $7.6 million in lieu of taxes for tax-exempt Federal land.

The Mine and Mineral Resource Research Institute at the University of Wyoming received a grant of $147,000 through the U.S. Bureau of Mines. The nonprofit Western Research Institute, which deals with hydrocarbon development and also is affiliated with the University of Wyoming, was the second largest employer in Laramie, after the Union Pacific Railroad, with a payroll of $10 million.

The U.S. Bureau of Land Management made plans to correct survey errors affecting more than 2.5 million acres in the Powder River Basin. The incorrect surveys made in the 1880's and 1890's could create a legal tangle for Wyoming's mineral industry in the area, which is mainly oil and gas and coal.

Among its many activities in 1985, the GSW completed an investigation and report on strategic metal deposits at Copper Mountain in central Wyoming, continued investigating for diamondiferous kimberlites at various locations in the State, and published a "Metallic and Industrial Minerals Map of Wyoming."

REVIEW BY NONFUEL MINERAL COMMODITIES

INDUSTRIAL MINERALS

Cement.—Wyoming's one cement plant, operated by Monolith Portland Cement Co. at Laramie, increased production slightly in 1985, reflecting an increase in highway building and construction. The last unfinished segment of Wyoming's 914-mile interstate highway system was completed on I-90 north of Sheridan.

Most cement produced at the company's two wet-process kilns was general use and moderate heat Types I and II gray portland cement. A small amount of oil well cement was also produced, but no masonry cement. Ready-mixed concrete companies provided the market for more than three-fourths of the cement produced in the State, followed by other contractors, concrete product manufacturers, and building material dealers.

In December, the Monolith plant was purchased by Centex Cement Enterprises to be operated as Mountain Cement Inc. The plant was closed for modernization with plans to reopen sometime in 1986. Mountain Cement began development of new sources of limestone and gypsum for future plant operations.

Clays.—Clays ranked second in importance among Wyoming's nonfuel mineral products, with about 12% of the total. About 92% of the State's clay production was sodium bentonite, sometimes called swelling bentonite or Wyoming bentonite, a montmorillonite material formed by the alteration of volcanic ash that has swelling characteristics that increase its volume as much as 15 times when wet. Wyoming was first of the 13 States in the Nation producing bentonite, with about 66% of the total. With about 5% of the total, Wyoming ranked fourth among 44 States in production of all types of clay.

Bentonite production was relatively stable in 1985, with little change from the 1984 level. Output, however, remained well below capacity at about two-thirds the 1979 peak. The drastic decline in oil well and gas well drilling and iron and steel production limited the major markets for bentonite, i.e., for well drilling mud and as a binder for iron ore pelletizing.

Bentonite production was reported by 7 companies at 107 pits in 7 counties, mostly along the eastern flank of the Big Horn Basin in north-central Wyoming, the southern Powder River Basin, and the northern and western edge of the Black Hills in northeastern Wyoming. Eighty-five percent of State production, in descending order of output, was in Crook, Big Horn, and Weston Counties. Two companies produced common clay at three pits in Albany and Uinta Counties. Employment in bentonite production fell about 107 during 1985, to about 655 people. In 1981, nearly 1,200 people had been employed.

Bentonite producers, in descending order of output, were the Baroid Div. of NL Industries Inc., American Colloid Co., Federal Ore and Chemicals Inc., Kaycee Bentonite Corp. (Black Hills Bentonite), Dres-

ser Minerals (Magcobar), Wyo-Ben Inc., and International Minerals & Chemical Corp. The top three producers accounted for more than 50% of total output.

Bentonite has been described as the mineral with 1,000 uses—the U.S. Bureau of Mines canvass listed 38. In 1985, about 56% of Wyoming bentonite production was used in oil well and gas well drilling mud, 26% in foundry sand, 15% in iron ore pelletizing, and 2% each in animal feed and waterproof seals. Other uses included adhesives, chemical manufacturing, medical and pharmaceutical, paint, paper coating and filling, portland cement, asphalt tile, and pet litter box absorbent material.

Estimates of remaining Wyoming bentonite reserves ranged from 200 million short tons (Bureau of Mines) to 1,149 million short tons (American Institute of Mining, Metallurgical and Petroleum Engineers). It was mined only by surface methods and generally only those deposits with 30 feet or less overburden were considered commercial.

OSM granted the State of Wyoming $30 million in 1985 to reclaim 100 bentonite mines on about 5,000 acres in Crook County.

Of the two producers of common clay, Interstate Brick Co.'s output went into manufacturing face brick, and the output of the largest producer, Lone Star Industries Inc., was used in manufacturing portland cement.

The outlook for bentonite production was relatively stable. As drilling footage remained low, the future demand and price for bentonite also would remain low.

Gem Stones.—Wyoming was the largest source of semiprecious nephrite jade in the United States. Southern Fremont and southwestern Natrona Counties were the center of the jade collecting area. The possibility of exporting jade to China was being investigated by people in the industry.

The GSW continued searching the Laramie Range for diamondiferous kimberlite. Anomalous stream sediment samples were located in the Pole Mountain-Happy Jack area east of Laramie and the Sheep Rock District northeast of Laramie. Interest in the Leucite Hills area northeast of Rock Springs was prompted by discovery of rich diamond deposits in identical rock strata in Australia. There was, apparently, still some industry interest in the Colorado-Wyoming State Line diamond-bearing districts where Superior Minerals Inc. had been testing for commercial deposits.

Gypsum.—Reported production of gypsum showed a substantial rise in 1985 as demand for building materials increased. Crude gypsum was produced by three companies in three counties. Wyoming Construction Co. mined gypsum in Albany County for use in cement manufacture at Monolith's (Mountain Cement) Laramie plant. Georgia-Pacific Corp., Gypsum Div., at Lovell, Big Horn County, and Celotex Corp., a subsidiary of Jim Walter Corp., at Cody, Park County, mined and calcined gypsum for production of wallboard. The value of gypsum produced rose at a faster pace than output.

Helium.—The U.S. Department of the Interior announced in June that it had agreed to the sale of helium from the Riley Ridge Gasfield. Under the agreement, Exxon Co. USA would extract the helium as part of its natural gas operations in the field, due to start in mid-1986, and then sell the helium to private industry, paying a royalty to the Federal Government from the proceeds of the sale. The 20-year agreement could produce $60 million in royalties to the Federal Government. The U.S. Bureau of Mines estimated that the Riley Ridge Gasfield, east of the Overthrust Belt in southwestern Wyoming, contained more than 100 billion cubic feet of helium in association with natural gas.

Exxon Corp. leased tracts of Federal land for oil and gas development, but the Mineral Lands Leasing Act of 1920 reserved helium rights to the Federal Government. Terms of the agreement provided that helium in the ground remained property of the Federal Government, but Exxon attained ownership as the gas entered the company's production facilities. The Government royalty will be one-eighth the gross proceeds from the sale of crude helium, or not less than $3 per thousand cubic feet (Mcf), and one-twelfth the gross proceeds from the sale of refined helium, or not less than $3.12 per Mcf for gaseous refined helium and $3.33 per Mcf for liquid helium. Exxon expected to produce about 800 million cubic feet of helium per year.

Lime.—Quicklime was produced by two companies in three counties in 1985: The Great Western Sugar Co. at Lovell, Big Horn County, and Holly Sugar Corp. at Torrington, Goshen County, and Worland, Washakie County. Despite closure of a site in Laramie County and only intermittent production from Holly Sugar's Lost Day Quarry near Fort Laramie, Goshen County,

reported output of lime in 1985 increased more than 50% over that of 1984. Quicklime was used in processing sugar beets, a declining market as consumption of sugar in the United States fell. Limestone also was shipped from the Lost Day Quarry to the Laramie River Station powerplant for use in emissions control.

Perlite (Expanded).—Wyoming had two perlite processing operations: a packaging operation, Western Perlite Corp. in Green River, and a processing plant operated by Harborlite Corp., west of Green River, which supplied perlite to the trona industry for use in filters at the trona refining plants. Perlite, a glassy volcanic rock containing 2% to 5% water, expands rapidly when heated, yielding a material with low density, high silica content, and a large surface area, which has a variety of industrial applications.

There were no known occurrences of perlite in Wyoming; perlite processed in Wyoming was mined in Arizona and Idaho.

Phosphate Rock.—No phosphate rock was reported mined in Wyoming in 1985. Phosphate rock mined in Idaho was beneficiated at Stauffer Chemical Co.'s Leefe plant in Lincoln County. Chevron U.S.A. Inc. continued plans to pump phosphate rock mined near Vernal, UT, to a plant at Rock Springs in a slurry pipeline for processing with sulfur from Wyoming gas processing plants to produce phosphoric acid. The plant was scheduled for completion in mid-1986.

FMC Corp. used elemental phosphorus from Pocatello, ID, to produce, at its plant near Green River, sodium tripolyphosphate. Plans were made during the year to double the capacity of sodium tripolyphosphate, a detergent builder, at Green River.

Sand and Gravel (Construction).—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1985. Data for odd-numbered years are based on annual company estimates made before yearend.

It was estimated that construction sand and gravel output declined 24% in 1985 from the 1984 level. In 1984, 55 companies produced sand and gravel in 22 of Wyoming's 23 counties.

Sodium Carbonate.—Wyoming was again the source of about 85% of the Nation's output of soda ash. Output was virtually unchanged from 1984 as the industry's problem of excess capacity remained unresolved. Production continued to be by five trona mine-soda ash processing plants near Green River, Sweetwater County. According to the annual report of the State Inspector of Mines of Wyoming, 1985 output of the five producing companies was: FMC Corp., 1.9 million short tons of soda ash; Allied Chemical Co., 1.5 million tons; Stauffer Chemical Co. of Wyoming, 1.3 million tons; Texasgulf Inc., 1.0 million tons; and Tenneco Minerals Co., about 0.8 million tons. These levels of output represented about 75% of capacity.

The only U.S. soda ash producers outside southwestern Wyoming were Kerr-McGee Chemical Corp.'s 150,000-short-ton-per-year facility at Searles Lake, CA, which was scheduled for closing by 1987, and Allied Chemical's 700,000-short-ton-per-year Solvay process synthetic soda ash plant at Syracuse, NY, scheduled for closure in early 1986. Closure of these facilities should benefit Wyoming soda ash producers.

With overall production and sales of soda ash "flat" because of declining use of glass containers, companies concentrated on cost-cutting production techniques, expanding exports, and developing new uses for soda ash.

After investing nearly $30 million over 5 years, FMC began commercial production of soda ash from a solution mine near its conventional soda ash facility. Two pairs of wells were in operation in September. One well in each pair was used to inject a solvent into a 30-foot-thick trona bed 2,000 feet below the surface, the other to pump the trona solution to the surface where it was piped to FMC's soda ash processing plant. A total of 22 wells were drilled in a 1-square-mile area overlaying 100 million tons of trona. When all wells are producing, they could account for 10% to 15% of FMC's annual plant capacity of 2.5 million short tons of soda ash. A cost savings of 25% per year over traditional mining methods was anticipated, but several years of operation will be required before estimates can be confirmed. Allied Chemical also was experimenting with solution mining. Other mining systems used in the five mines were conventional drill-blast-haul, continuous miner, and longwall cutting systems.

The soda ash export market reached an estimated 1.8 million short tons per year, with exports to 43 nations, of which Asian nations received 60% of the total. A large contract with China, perhaps as much as

600,000 short tons per year, was the major export event of the year. All six U.S. soda ash producers export as a single company through the American Natural Soda Ash Corp.

The University of Wyoming studied use of trona in enhanced oil recovery through horizontal injection. The Public Service Co. of Colorado experimented with dry sodium as a pollution control agent in powerplant smokestacks.

Transportation costs were critical in marketing soda ash. All five southwestern Wyoming mines were served by the Union Pacific Railroad. Shipping cost to eastern markets was about $60 per ton. Sale price of soda ash was about $69 (1984) to $79 (1985) per short ton, f.o.b. Green River (down from $92 in 1981). In April, a new company, Bonneville Transloaders Inc. began trial runs trucking soda ash 220 miles from Green River to a Burlington Northern Railroad railhead at Shoshoni, north of Riverton, to take advantage of lower freight rates offered by Burlington Northern. The company claimed transportation cost savings of $4 to $15 per short ton to eastern markets and aimed at capturing 5% of soda ash shipments, 300,000 to 500,000 short tons per year. Industrial development revenue bonds issued by the city of Riverton helped finance facilities at Shoshoni.

Allied Chemical, FMC, and Stauffer Chemical laid off 73, 76, and 7 workers, respectively. Overall employment at the five mines fell by 1,000 workers in 4 years, to about 3,000 at the end of 1985.

Church & Dwight Co., which processed soda ash into various products, invested $12 million in expanding its production facilities at Green River by 50%, or 60,000 square feet, to increase output of a dry laundry detergent.

Chesebrough-Ponds Inc. acquired Stauffer Chemical Co. for $1.25 billion, and with it, its subsidiary Stauffer Chemical of Wyoming's trona-soda ash facility owned jointly with Rocky Mountain Energy Co., a subsidiary of Union Pacific Corp. In November, Allied Chemical merged with Signal Corp. to become Allied-Signal Corp. Allied-Signal later spun off Allied's Green River soda ash operation as General Chemical Co., part of the Henley Group, a group of 30 former Signal companies. Neither corporate change appeared to affect the soda ash facilities involved.

The Wyoming trona-soda ash resource, formed by deposits in an ancient lake, is the largest known such resource in the world, with 42 individual beds underlying 1,300 square miles and estimated to contain as much as 81.7 billion tons of trona and 52 billion tons of mixed trona and halite. Mining was started by Westvaco, later acquired by FMC, in 1946, production began in 1950, Stauffer Chemical entered the field in 1962, Allied Chemical in 1968, Texasgulf in 1975, and Tenneco Minerals in 1982. About 55% of soda ash production normally has been consumed in glassmaking, 23% by the chemical industry, 5% in soaps and detergents, 4% in pulp and paper manufacture, 3% in water treatment, and the balance in metallurgy, petroleum refinery, pharmaceuticals, photography, and other uses.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; the 1984 chapter gave estimates. Data for even-numbered years are based on annual company estimates made before yearend.

Among plans announced for development of aggregate resources in Wyoming were L. C. Holding Inc., Boulder, CO, plans to reopen the old Idealite lightweight aggregate plant near Laramie under the name Wyolite; Carbon Energy Corp. plans to mine scoria from the Alkali Buttes Coalfield to be marketed as decorative stone in handy-sized sacks through convenience stores; and Peter Lien & Sons plans to quarry limestone at the Shamrock Hills and Point of Rocks areas of Carbon County for use as scrubber stone for electrical generators and as concrete aggregate.

Reported production of crushed stone in Wyoming increased substantially in 1985. The largest single use for this stone was as railroad ballast. Unpaved road surface, cement manufacture, and fine aggregate tied for second major use, followed by dense road base. Highway construction was at a high level in 1985, with $178.7 million in construction contracts, a new record high, adding to demand for construction aggregates. Upgrading access roads to Peacekeeper missle silos provided additional demand for aggregates. Limestone and dolomite provided the largest amount of stone. Granite and volcanic cinder were also used. A small amount of marble was produced by Basins Engineering Co. for decorative use.

Six companies operated eight quarries in six counties. Platte County was the major source of crushed stone, with 40% of the total, followed, in descending order of

output, by Laramie, Albany, Sheridan, Fremont, and Crook Counties.

Peter Kiewit & Sons Co., Gilbert Central Corp., and Morrison-Knudsen Co. Inc. accounted for 77% of total output.

Table 4.—Wyoming: Crushed stone[1] sold or used by producers in 1985, by use

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate, graded:		
Bituminous aggregate, coarse	W	W
Bituminous surface-treatment aggregate	10	W
Combined coarse and fine aggregates:		
Graded road base or subbase	246	W
Unpaved road surfacing	305	W
Terrazzo and exposed aggregate	14	60
Other construction[2]	872	5,331
Chemical and metallurgical: Cement manufacture	304	1,064
Special:		
Other fillers or extenders	24	102
Lightweight aggregate	16	68
Other unspecified[3]	W	W
Total	2,030	7,329

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1]Includes limestone, dolomite, marble, volcanic cinder and scoria, excludes a minor amount of granite withheld to avoid disclosing company proprietary data.

[2]Includes stone used in concrete aggregate (coarse), riprap and jetty stone, railroad ballast, and fine aggregate screen.

[3]Includes production reported without a breakdown by end use and estimates for nonrespondents.

Sulfur (Recovered).—Wyoming was second of 26 States producing recovered elemental sulfur. Production increased 12% over that of 1984. Almost all of Wyoming's sulfur production was by energy companies as a byproduct of processing natural gas produced in the Overthrust Belt of southwestern Wyoming. Six companies reported sulfur production in seven counties. Most of the production was in Uinta County by Amoco Production Co. at its Whitney Canyon natural gas processing facility and by Chevron at Carter Creek. The Amoco plant was capable of producing 1,200 short tons per day of byproduct sulfur; Chevron's plant, 1,000 tons. Exxon planned a third large natural gas processing plant at Shute Creek in Lincoln County capable of producing 2,000 short tons per day of byproduct sulfur from 600 million cubic feet of gas.

Chevron completed construction of its $250 million phosphate fertilizer plant at Rock Springs, which will combine sulfuric acid with phosphate from Vernal, UT, to produce 200,000 short tons per year of phosphoric acid. The phosphate rock will be pumped 96 miles in a slurry pipeline from the phosphate rock mine near Vernal, UT, to the fertilizer plant at Rock Springs. The plant is expected to employ 225 workers when production begins in mid-1986.

Burza International Ltd. of Calgary, Alberta, Canada, began trucking 12,000 short tons per year of liquid sulfur from Amoco's plant at Whitney Canyon to the Burlington Northern Railway transfer station at Bonneville, near Shoshoni, for shipment to Galveston, TX.

Continental Sulfur Co. of Nevada negotiated with the Hot Springs County Commission to establish a sulfur mine near Thermopolis. If plans materialize, up to 100,000 tons of sulfur per month could be produced.

METALS

Universal Equipment Co. of Fremont, OH, purchased the Atlantic City iron ore mine near Lander from United States Steel Corp. in March. The sale included iron ore processing facilities, mining equipment, water rights, and a 76-mile railroad line from the mine to Winton Junction near Rock Springs. The sale price was not disclosed. The iron ore reserves continued to be owned by J. R. Simplot Co. of Idaho. Universal Equipment assumed U.S. Steel's obligations under Wyoming law for reclamation. Universal Equipment's plans for the site included mining and road construction materials. U.S. Steel ceased mining iron ore at Atlantic City in October 1983. No iron ore was produced in Wyoming in 1985.

[1]State Mineral Officer, Bureau of Mines, Denver, CO.

[2]State geologist and executive director, Geological Survey of Wyoming, Laramie, WY.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Mountain Cement Inc.[1]	Box 40 Laramie, WY 82070	Plant	Albany.
Clays:			
American Colloid Co	5100 Suffield Ct. Skokie, IL 60076	Pits and plants	Big Horn, Crook, Weston.
Dresser Minerals, a division of Dresser Industries Inc.	Box 832 Greybull, WY 82426	do	Big Horn.
Federal Ore and Chemicals Inc	117 5th Ave. Belle Fourche, SD 57717	do	Crook and Weston.
International Minerals & Chemical Corp.	Box 460 Belle Fourche, SD 57717	do	Crook.
Kaycee Bentonite Corp	Box 1 Mills, WY 82644	do	Johnson, Natrona, Washakie.
NL Industries Inc., Baroid Div	Box 1675 Houston, TX 77001	do	Big Horn and Crook.
Wyo-Ben Inc	Box 1979 Billings, MT 59103	do	Big Horn and Hot Springs.
Gypsum:			
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.
Lime:			
The Great Western Sugar Co.[2]	Box 5308 Denver, CO 80217	Plant	Big Horn.
Holly Sugar Corp	Holly Sugar Bldg. Colorado Springs, CO 80902	Plants	Goshen and Washakie.
Sodium carbonate:			
General Chemical Co	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 (Chesebrough-Ponds Inc.).	Box 513 Green River, WY 82935	do	Do.
Tenneco Minerals Co	Box 1167 Green River, WY 82935	do	Do.
Texasgulf Inc	Box 100 Granger, WY 82934	do	Do.
Stone:			
Gilbert Central Corp	Box 6206 Sheridan, WY 82801	Quarries	Fremont, Platte, Sheridan.
Guernsey Stone Co. (Peter Kiewit & Sons Co.).	Box 337 Guernsey, WY 82214	do	Platte.
Morrison-Knudsen Co. Inc	Box 1028 Cheyenne, WY 82001	do	Laramie.
Summit Materials Co	Box 1716 Rapid City, SD 57709	do	Crook.

[1]Also clays and crushed stone.
[2]Also crushed stone.

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