

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.

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The value of nonfuel mineral production in 1980 in Florida was \$1.5 billion, an increase of \$239.2 million over that of 1979. Florida ranked first nationally in total value of nonmetallic minerals produced, and nonmetals accounted for over 95% of the State's total nonfuel mineral production value. The State ranked first in the production of phosphate rock and titanium concentrates, and was second in crushed stone,

fuller's earth, and peat. Staurolite and zircon concentrates were produced only in Florida. Principal nonmetals, in order of value, were phosphate rock, stone, cement, sand and gravel, and clays.

Although mineral output in 1980 increased compared with the 1970 level, and in some cases doubled in the 10-year period, total value during this period increased nearly 500%.

Table 1.—Nonfuel mineral production in Florida¹

Mineral	1979		1980		
	Quantity	Value (thousands)	Quantity	Value (thousands)	
Cement:					
Masonry	thousand short tons	255	\$13,098	285	\$22,074
Portland	do	2,957	126,562	3,574	182,590
Clays	do	681	231,308	614	224,164
Gem stones		NA	4	NA	5
Lime	thousand short tons	210	11,440	195	12,434
Peat	do	153	2,190	154	2,398
Sand and gravel	do	21,708	39,520	314,464	328,831
Stone (crushed)	do	63,787	188,896	66,209	215,972
Combined value of clays (kaolin), magnesium compounds, phosphate rock, rare-earth concentrate, industrial sand (1980), staurolite, titanium concentrate (ilmenite and rutile), zircon concentrate		XX	856,589	XX	1,020,286
Total		XX	1,269,607	XX	1,508,754

¹Revised. NA Not available. XX Not applicable.

²Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

²Excludes value of kaolin; value included in "Combined value" figure.

²Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Florida, by county¹

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Aiachua	\$3,074	\$2,789	Stone.
Bay	663	1,040	Sand and gravel.
Brevard	W	W	Clays, stone, sand and gravel.
Broward	12,408	20,607	Stone, sand and gravel.
Calhoun	75	52	Sand and gravel.
Charlotte	W	W	
Citrus	2,445	6,002	Stone, phosphate rock.
Clay	23,838	26,526	Titanium, zirconium, staurolite, sand and gravel, monazite, clays.
Collier	3,521	6,236	Stone.
Dade	W	W	Stone, cement, sand and gravel.
Dixie	W	W	
Escambia	680	605	Sand and gravel.
Gadsden	W	W	Clays, sand and gravel.
Glades	W	W	Sand and gravel.
Gulf	W	W	Magnesium, lime.
Hamilton	W	W	Phosphate rock.
Hardee	W	W	Do.
Hendry	W	W	Stone, sand and gravel.
Hernando	W	W	Stone, cement, lime, clays.
Highlands	W	W	Peat.
Hillsborough	W	W	Phosphate rock, cement, stone, peat.
Jackson	1,594	620	Stone, sand and gravel.
Lake	W	W	Sand and gravel, peat.
Lee	8,036	W	Stone.
Leon	W	W	Sand and gravel.
Levy	449	2,846	Stone.
Manatee	W	W	Cement, stone.
Marion	10,189	12,772	Stone, clays, sand and gravel, phosphate rock.
Monroe	W	2,447	Stone.
Nassau	W	W	Titanium, zirconium, monazite.
Okaloosa	33	36	Sand and gravel.
Orange	64	64	Do.
Palm Beach	90	W	Stone.
Pasco	W	W	Do.
Polk	640,981	676,298	Phosphate rock, sand and gravel, peat.
Putnam	W	W	Sand and gravel, clays, peat.
St. Lucie	307	W	Sand and gravel.
Santa Rosa	W	W	
Sarasota	W	W	Sand and gravel, stone.
Sumter	W	W	Lime, stone.
Suwannee	W	W	Stone.
Taylor	W	2,787	Do.
Walton	W	W	Sand and gravel.
Undistributed ²	390,321	507,884	
Total ³	1,098,772	1,269,607	

¹Withheld to avoid disclosing company proprietary data; included with "Undistributed."²The following counties are not listed because no nonfuel mineral production was reported: Baker, Bradford, Columbia, De Soto, Duval, Flagler, Franklin, Gilchrist, Holmes, Indian River, Jefferson, Lafayette, Liberty, Madison, Martin, Okaloosa, Oceola, Pinellas, St. Johns, Seminole, Union, Volusia, Wakulla, and Washington.³Includes gem stones and values indicated by symbol W.³Data may not add to totals shown because of independent rounding.

Of the 54.4 million metric tons of phosphate rock produced in the United States, Florida was the predominant producer, and for the 87th consecutive year supplied more than any other State. Florida and North Carolina supplied nearly 87% of the domestic phosphate rock output; Florida supplied most of the exports.

The nationwide recession did not affect the nonmetallic minerals industry in Florida as seriously as other Southeastern States. Although the housing market was stable, commercial and other nonresidential building increased. Road maintenance work decreased because of reduced Federal input.

Trends and Developments.—The Florida

Phosphate Council reported that member companies plan to spend about \$2 billion in the next 5 years in expansion programs. Of the \$2 billion, an estimated 18% will be for environmental controls. Companies plan to develop six new mines, one chemical fertilizer complex, and expand two mines and eight chemical fertilizer plants. These operations will be in Hamilton County in north Florida, and in De Soto, Hardee, Hillsborough, Manatee, and Polk Counties in the southern part of the State. The council estimates construction and operating jobs will number about 11,600 as companies build and expand plants and mines to keep pace with increasing world demand for

fertilizer. Delays involving permits governing land use and air- and water-quality standards may extend the time period for startup of operations. Companies report that it can take 5 years and cost more than \$6 million to obtain necessary permits to open a new mine.

Norsk Hydro Aluminum Inc. began production of cold-drawn aluminum tubing at Rockledge, approximately 60 miles southeast of Orlando. This is the first manufacturing plant owned entirely by Norway's Norsk Hydro to be located outside Europe. The \$6.5 million plant is expected to pro-

duce 5 million pounds of extruded shapes and tubes annually when it reaches full production in mid-1981.

The Port of Tampa, which handled over 51 million tons of cargo, shipped the major portion of exported phosphate. Phosphate exports totalled nearly 16 million tons, which included nearly 12 million tons of bulk phosphate. Phosphate accounted for about 90% of all export cargo through the Port of Tampa. About 1.2 million tons of aragonite was imported from the Bahamas for use in the manufacture of cement.

Table 3.—Indicators of Florida business activity

		1979	1980 ^P	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	3,835.0	3,925.0	+2.4
Unemployment	do	230.0	234.0	+1.7
Employment (nonagricultural):				
Mining ¹	do	10.1	10.6	+5.0
Manufacturing	do	442.6	457.2	+3.1
Contract construction	do	241.4	267.0	+10.6
Transportation and public utilities	do	208.5	219.3	+5.2
Wholesale and retail trade	do	889.5	931.7	+4.7
Finance, insurance, real estate	do	235.0	252.6	+7.5
Services	do	752.6	815.8	+8.4
Government	do	600.5	616.3	+2.6
Total nonagricultural employment ¹	do	3,381.2	3,570.5	+5.6
Personal income:				
Total	millions	\$75,631	\$86,944	+15.0
Per capita	do	\$8,521	\$8,987	+5.5
Construction activity:				
Number of private and public residential units authorized	do	175,705	178,092	+1.4
Value of nonresidential construction	millions	\$1,684.8	\$2,132.5	+26.6
Value of State road contract awards	do	\$383.6	\$316.0	-17.6
Shipments of portland and masonry cement to and within the State	thousand short tons	4,998	5,820	+16.4
Nonfuel mineral production value:				
Total crude mineral value	millions	\$1,269.6	\$1,508.8	+18.8
Value per capita, resident population	do	\$143	\$155	+8.4
Value per square mile	do	\$21,680	\$25,764	+18.8

^PPreliminary.

¹Includes oil and gas extraction.

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

Legislation and Government Programs.—The Federal Bureau of Mines and Agrico Chemical Co. conducted borehole mining research tests to recover deep phosphate ore in St. Johns County. The mining site used by Agrico and the Bureau for the borehole mining in the summer of 1980 has been completely restored. All borehole mining cavities were backfilled using a Bureau-developed technique to replace 1,800 tons of ore that was shipped to the Agrico Mill at Mulberry, Fla., and the original topography was restored. The U.S. Geological Survey, which monitored the impact on ground water hydrology of the borehole mining operations, issued a draft report stating that the mining had no significant, long-

term effect on the ground water despite two episodes of roof collapse during the mining.

As a followup to the borehole mining tests, Agrico announced plans for a pilot borehole phosphate mining and processing program in St. Johns County. The first 9 months of 1981 will be used to obtain operating permits, construct and install mining and processing equipment, and field test the components. Mining and processing will start in the first quarter of 1982 and will continue for most of 1982. The mining rate planned is 30 tons per hour on a one-shift basis, and processing the matrix will be at a rate of 15 tons per hour on a two-shift basis.

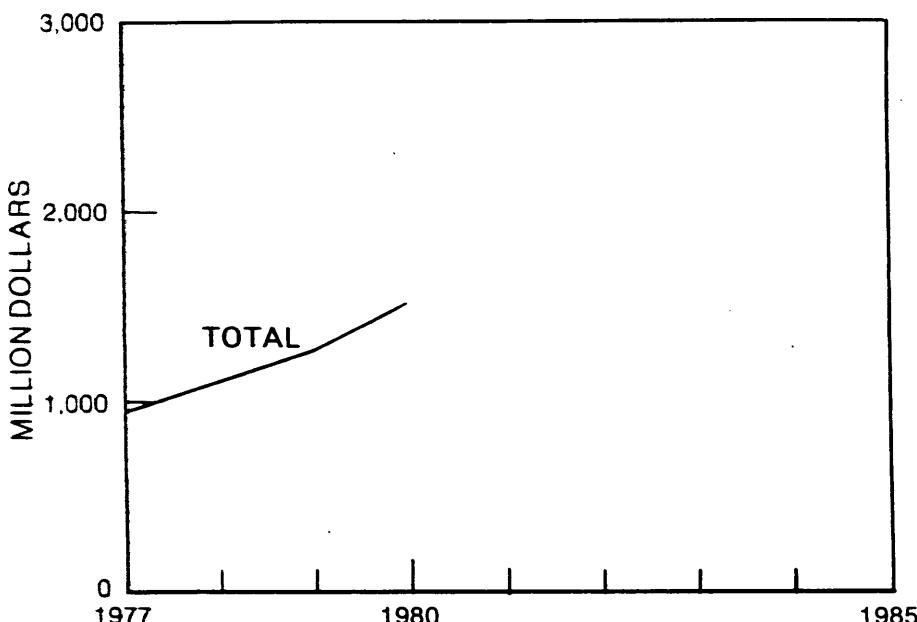


Figure 1.—Total value of nonfuel mineral production in Florida.

The Bureau approved a report, "Economic Impact of the Phosphate Rock Industry on Selected Florida Counties, Florida, and the United States," for open file status. The report was prepared by the Florida Resources and Environmental Analysis Center under Bureau contract.

The Bureau awarded a contract to Zellars-Williams, Inc., Lakeland, to obtain, estimate, and accumulate engineering and profile data from foreign phosphate mines and deposits.

The Florida Bureau of Geology had two contracts with the Bureau, one to inventory and classify reclaimed lands in the phosphate area, and the other to monitor phosphate activities in Florida using digital analyses of Landsat imagery.

Since 1972, the Bureau, at its Tuscaloosa Research Center, has been involved in a concerted research effort to develop methods that will either eliminate the retention areas of phosphate waste slimes or provide an improved waste storage system.

Inhouse Bureau project activity during 1980 included research on water recovery from phosphatic clay slimes, continuous flocculation dewatering and floc formation studies, and reuse and purification of low-

quality waters for processing.

Research programs included beneficiation of dolomitic phosphate ores, beneficiation of phosphate-bearing Hawthorn Formation limestone, recovery of phosphate from beneficiation slimes, and direct acidulation of phosphate matrix to improve recovery of P_2O_5 .

In a U.S. Environmental Protection Agency (EPA) mine waste study, EPA selected 20 copper, phosphate, uranium, gold and silver, lead and zinc, and molybdenum mine sites in 10 States for intense study. The analysis is designed to determine which mine wastes, if any, warrant specially tailored regulations in the future under EPA's hazardous waste law, Part C of the Resource Conservation & Recovery Act (RCRA). Mine and processing wastes are currently exempt from RCRA until results are presented to Congress and the law is amended. Sites being considered in Florida for study include two phosphate mine waste rock dumps and two tailings ponds. EPA will analyze solid waste, ground water, surface water, and emissions at each site. Monitoring will be completed by August 1982, with a report to Congress in October 1982.

Brownwell Engineering, Inc., was award-

ed a contract by the U.S. Geological Survey for exploratory drilling to determine the nature of the phosphatic sediments, clay, and peat of the Holocene, Bone Valley, and Hawthorn Formations in the Roadless Area Review and Evaluation (RARE) II and wilderness areas of the Ocala, Osceola, and Apalachicola National Forests.

The Geological Survey released Circular 824, "Thorium Resources of Selected Regions in the United States." The report covers thorium reserves and resources in beach placers in northern Florida. These deposits are principally mined for titanium, with thorium and other minerals recovered as byproducts.

The Florida Department of Environmental Regulations completed the publication, "Water Quality and Mining." Included in the report are the major regulations affecting mining and its environmental effects, and the report recommends the best management practices.

During the year, the Florida Bureau of Geology completed eight studies on environmental geology, stratigraphy, ground water, and clay resources in the State. Twelve

other geologic and stratigraphic studies were continued. In addition to basic geologic studies, the Bureau of Geology handled reclamation and maintained a geologic well log library and a computerized list of mineral producers and statistics.

Twelve publications were issued during the year, including "Limestone, Dolomite, and Coquina Resources of Florida," and "Sand and Gravel Resources of Florida." The staff supported a major revision of Chapter 16C-16, Florida Administrative Code, Mine Reclamation Rules. Florida's Governor and Cabinet approved these reclamation rules, which would require restoration of a mining site to as near as possible its original state. The rules include (1) restoration of environmentally sensitive areas, (2) elimination of certain tax rebates, (3) approval of premining reclamation plans, (4) stricter standards for creation of lakes, (5) retroactive compliance of future Federal standards for radiation emissions, and (6) requirements for slime storage below natural grade to the greatest extent possible. Effective date of the rules was October 1, 1980.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of both portland and masonry cement increased in 1980. Production of masonry cement in Florida ranked third nationally, while portland ranked fifth. Five companies produced portland cement at six plants; masonry was produced at four plants. Most of the shipments of both portland and masonry cement were to users within the State.

Portland cement shipments, mainly in bulk form, were made by truck and rail. Principal consumers were ready-mix dealers, building material dealers, and concrete products manufacturers, with the remaining to other contractors and Government agencies.

Most raw materials used to manufacture cement were mined within the State, and included limestone, clay, sand, and staurolite. With higher value uses developing for staurolite, a substitute may be necessary in the near future. Oolitic aragonite imported from the Bahamas was used along with small amounts of gypsum, clinker, fly ash, clay, iron ore, and slag; most were obtained from out-of-State sources.

Eleven rotary kilns were operated at five

plants. Of the 11, 10 were wet process, and 1 was dry process. About 440 million kilowatt-hours of electrical energy, in addition to natural gas, fuel oil, and coal, were consumed in the manufacture of cement.

Moore McCormack Resources, Inc., new owners of Florida Mining & Materials Corp., announced a \$68 million expansion program for cement and concrete production at the company's Brooksville plant. The plan calls for adding a second coal-fired kiln and increasing grinding and storage capabilities. The plant is expected to be operational by the third quarter of 1982, and will double the production capacity of the plant to 1.2 million tons of cement per year. The company also plans to purchase additional trucks to increase deliveries of ready-mix and concrete block.

Clays.—Clays mined in Florida included common clay, fuller's earth, and kaolin. Total clay production and value decreased.

Common clay output and value increased. Common clay was produced by four companies at four pits in Clay, Gadsden, Hernando, and Lake Counties in the northern part of the State. The clays were used in the manufacture of cement and lightweight aggregate.

Florida continued to rank second in the Nation in fuller's earth production, although production decreased. Fuller's earth was mined by four producers from nine pits in Brevard, Gadsden, and Marion Counties. Main end uses were for fertilizer fillers, pet waste absorbents, pesticides, and drilling mud.

Kaolin was produced by one company at two pits in Putnam County; production remained at about the same level as in 1979. The deposit also includes silica, with the sand recovered for glass and other industrial uses. Principal uses for kaolin were in electrical porcelain, whiteware, and wall tile. Major kaolin markets were in the Southeast, although some was exported.

Fluorine.—Fluorine, in the form of fluosilicic acid, was recovered at six plants as a byproduct of wet-process phosphoric acid manufacture. Fluosilicic acid was used to produce cryolite, aluminum fluoride, sodium silica fluoride, and was also used in water fluoridation. The value of fluorine byproducts is not included in the State's mineral value.

Gypsum.—Imported gypsum was calcined at two plants in Duval County and one plant in Hillsborough County. United States Gypsum Co., Jim Walter Corp., and National Gypsum Co. calcined gypsum in kettles, a rotary kiln, and a holoflite unit, respectively. Production in 1980 decreased to 637,000 tons, a drop of 22,000 tons from the 1979 level.

United States Gypsum announced plans to expand its north Jacksonville plant, with completion scheduled for late 1981. The \$25 million expansion will increase capacity to 600 million board feet per year, reportedly making it the largest in the world. The market area is south Georgia and Florida.

Lime.—Quicklime was produced by Basic Magnesia, Inc., Gulf County; Chemical Lime, Inc., Hernando County; and Dixie Lime & Stone Co., Sumter County. Hydrated lime was produced by Chemical Lime, Inc. Production decreased 7%, but value increased 9%. Lime was used for magnesia, water treatment, and sewage-disposal systems.

Magnesia.—Florida ranked second nationally in the recovery of magnesium compounds from seawater. Basic Magnesia, Inc., Port St. Joe, Gulf County, produced caustic calcined magnesia and refractory-grade magnesia from seawater; plant capacity is 100,000 tons of MgO equivalent. Shipments in 1980 decreased 9%; value increased 3%.

Peat.—Florida ranked second nationally in peat production in 1980. Production and value increased slightly. Ten plants produced moss, reed-sedge, and humus peat from five counties. Most of the peat, shipped in bulk, was used for general soil improvement and for potting soils.

Perlite.—Four companies produced expanded perlite from crude ore shipped into the State. Production increased to 31,700 tons; value increased to \$3.7 million. Perlite was expanded at plants in Broward, Duval, Escambia, and Indian River Counties, and was used for horticultural purposes, insulation, and fillers.

Phosphate Rock.—Florida ranked first in the Nation in the production of phosphate rock. Marketable production of phosphate rock in 1980 increased 6% in quantity and 20% in value.

The phosphate industry continued to be the principal mineral industry in the State. Nearly all phosphate companies announced development or expansion plans. Development costs of mines have increased from \$34 per ton of annual capacity in 1975 to approximately \$100 per ton in 1980; construction costs of phosphoric acid plants have increased from \$141 per ton of annual capacity in 1975 to \$440 per ton in 1980. In 1980, companies spent \$436 million for expansion, replacement, and new construction. Expansion plans announced in 1980 will be equivalent to an additional \$2 billion investment by 1985 if permits are obtained. In line with local government concerns, the Governor and Cabinet approved revised reclamation rules for phosphate producers that would require restoration of a mining site as near as possible to its original state.

Soft-rock phosphate was produced by four companies in 1980, operating five mines in Citrus and Marion Counties. The soft-rock phosphate was used for direct application to the soil and, if low in fluorine, as an animal feed supplement.

Land-pebble phosphate was produced at 22 mines by 13 companies in Hamilton, Hardee, Hillsborough, and Polk Counties. In 1980, agricultural uses accounted for 71%; industrial, 1%; and exports, 28%. Normal superphosphate, triple superphosphate, wet-process phosphoric acid, and defluorinated phosphate rock were produced for agricultural uses. Industrial chemicals were produced from the production of elemental phosphorus.

Agrico Chemical Co., with a reported annual mining capacity of 7.5 million tons,

began an expansion program at its South Pierce phosphoric acid facility. The addition to the phosphoric acid plant will reportedly increase capacity by 120,000 tons per year by 1981.

AMAX, Inc., purchased the mining operations and phosphate reserves of Borden, Inc., for \$200 million, and will spend \$44 million more to expand and improve the operation. In addition to Borden's Big Four Mine, AMAX acquired a phosphoric acid complex at Piney Point and a defluorinated feed phosphate facility at Plant City. The Big Four Mine in Hillsborough County will expand capacity from 1.6 to 2.5 million tons per year. In addition to purchasing additional reserves, a dragline and processing equipment were acquired. AMAX continued development of its proposed \$335 million, 4 million-ton-per-year mine in Manatee and De Soto Counties. A contract was awarded for the engineering, design, and construction of the facility. AMAX plans to spend a projected \$625 million in the 1980's to develop their phosphate operations.

Beker Industries Corp. started developing its \$100 million phosphate mine in eastern Manatee County. Present plans call for a 1-million-ton-per-year operation. A production level of 3 million tons per year, is scheduled by late 1982. Beker plans to build a \$5 million facility at Port Manatee to ship rock to its fertilizer plant in Louisiana.

Estech, Inc., continued in its attempts to develop its 3-million-ton-per-year Duette Mine in Manatee County. Early in the year, the Manatee County Zoning Board denied Estech a permit to mine, but this was revised by the Governor and Cabinet. However, the Florida Department of Environmental Regulation then denied Estech a permit for waste water discharge. The permit is required in order to construct slime ponds. Mining plans are thus delayed indefinitely.

Farmland Industries, Inc., planned to develop a \$200 million mine and chemical plant near Ora in Hardee County. However, the Hardee County Commission rejected Farmland's request to build the chemical plant, but gave approval to the 2-million-ton-per-year mine. Farmland did not appeal, but was considering either increasing production at its Green Bay plant or purchasing an existing plant.

Gardinier, Inc., received permission to expand its fertilizer plant adjoining Hillsborough Bay and the Alafia River. The \$67 million expansion program will convert the

plant to wet grinding, increase production capacity by 20%, and reduce emissions. The company purchased mineral rights to more than 7,000 acres in Hardee County for over \$10 million.

W. R. Grace & Co. announced plans to spend \$300 million from 1980 to 1984 for environmental controls; the 1980 budget was \$52.7 million, compared with \$38.9 million in 1979. W. R. Grace & Co. and International Minerals & Chemical Corp. (IMC) continued development of their Four Corners Mine in Hardee, Hillsborough, Manatee, and Polk Counties. The \$500 million venture will have a design capacity of 5 million tons per year. Grace, which is planning to expand its Hooker Praire Mine, is participating in a joint venture with U.S.S. Agri-Chemicals, Inc. The companies plan a \$200 million fertilizer plant at Fort Meade to include two sulfuric acid facilities.

IMC announced a planned \$400 million expansion of its Florida phosphate operations. In addition to its venture with Grace, IMC plans to spend \$58 million to expand its New Wales plant, increasing overall output by 500,000 tons per year. IMC purchased additional reserves, including a \$4 million purchase of land from Bartow Minerals near IMC's Clear Springs operation. IMC also purchased a \$13.5 million dragline capable of removing overburden in excess of 40 feet thick.

Mississippi Chemical Corp. filed a proposal to develop a 3-million-ton-per-year mine and beneficiation plant in Hardee County. Reserves are reportedly sufficient for over 30 years. A decision on when the mine will be developed has not been made by Mississippi Chemical Co.

Mobil Oil Corp. received permits from the South Florida Water Management District to develop a new mine in the Fort Meade area. The 3-million-ton-per-year mine, to be in operation by 1984, will replace Mobil's Fort Meade Mine scheduled to close in 1988. Mobil has been purchasing land east and southeast of the proposed site.

Occidental Petroleum Corp. (Oxy) continued construction of a \$3.2 million animal feed supplement plant at White Springs. Although an embargo was placed on phosphate fertilizer shipments to the Soviet Union, Oxy's major customer, the company was able to develop other markets to sustain its operations. Oxy and South Africa's Triomf Fertilizer agreed in principle to a marketing program whereby Oxy would have an alternative source of phosphoric

acid to fulfill its contracts with the Soviet Union, while Triomf would utilize Oxy as a source of phosphate rock. Oxy also was negotiating with mainland China to construct production plants in China and receive phosphoric acid in return.

Bartow Minerals and T. A. Minerals Corp. closed their phosphate rock mining operations in Polk County in 1980.

Zellars-Williams, Inc., Lakeland, was awarded a \$36,000 contract by the South Florida Water Management District to project the water needs and possible water sources for the phosphate industry over the next 20 years. The area to be studied includes land in the Alafia, Manasota, and the Peace River Basins.

Sand and Gravel.—Total sand and gravel output decreased in 1980. Lake, Polk, and Glades were the leading producing counties.

During 1980, 34 companies operated 46 mines in 19 counties. Transportation was

primarily by truck, with the balance shipped by railroad and waterway. Sand and gravel was used mainly for construction purposes, which included concrete aggregate and fill, with the balance going into industrial uses. Four companies produced over 1 million tons each; the top 14 companies, with 25 pits, mined 90% of the total sand and gravel in the State. Florida Rock Industries, Inc., opened an industrial sand operation at Interlachen in Putnam County. The sand will be used by southeastern glass manufacturers and foundries. Glass sand is shipped to Anchor Hocking Corp. in Jacksonville, with foundry sands shipped to the Alabama markets. The company also obtained permits for a \$2 million sand plant in Marion County. Construction started at the end of the year with financing through Industrial Development Revenue Bonds. The plant will serve the Daytona Beach market.

Table 4.—Florida: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thou- sands)	Value per ton	Quantity (thousand short tons)	Value (thou- sands)	Value per ton
Concrete aggregate	11,949	\$19,200	\$1.61	7,927	\$16,713	\$2.11
Plaster and granite sands	239	584	2.44	W	W	2.99
Concrete products	869	1,765	2.03	2,424	4,998	2.06
Asphaltic concrete	868	2,195	2.53	619	1,855	3.00
Roadbase and coverings	2,214	2,845	1.28	680	1,907	2.80
Fill	4,503	4,556	1.01	2,432	2,810	.95
Other	—	—	—	383	1,049	2.74
Total ¹ or average	20,642	31,145	1.51	14,464	28,831	1.99

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

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

Table 5.—Florida: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thou- sands)	Value per ton	Quantity (thousand short tons)	Value (thou- sands)	Value per ton
Construction:						
Sand	18,143	\$26,843	\$1.48	13,305	\$26,238	\$1.97
Gravel	2,500	4,302	1.72	1,159	2,592	2.24
Total ¹ or average	20,642	31,145	1.51	14,464	28,831	1.99
Industrial sand	1,066	8,375	7.86	W	W	6.32
Grand total or average	21,708	39,520	1.82	W	W	2.12

W Withheld to avoid disclosing company proprietary data.

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

Staurolite.—Florida is the only State with a recorded production of staurolite. Staurolite was recovered as a byproduct of ilmenite production at the Highland and Trail Ridge plants of E. I. du Pont de Nemours & Co., Clay County, and by Associated Minerals Ltd., Inc. (United States), also in Clay County. Production decreased in 1980. Staurolite was mainly used in sandblasting, with minor amounts used in cement and as a foundry sand.

Stone.—Florida ranked second in the Nation in crushed stone production, which included limestone, marl, and oyster shell.

Stone was produced by 89 companies at 128 quarries in 24 counties. The three leading counties were Broward, Dade, and Her-

nando, which supplied 65% of the State's total production. Sixteen companies produced over 1 million tons each from 36 quarries, and accounted for 67% of the production and 71% of the value.

Crushed stone was transported mainly by truck and railroad, and was used for dense-graded roadbase, concrete and bituminous aggregate, and cement manufacture. Two companies processed oyster shell for roadbed material.

Sulfur.—Florida ranked fifth in the Nation in the production of recovered elemental sulfur. Recovered sulfur from Exxon's desulfurization plants in Escambia and Santa Rosa Counties decreased in 1980.

Table 6.—Florida: Crushed stone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979 ¹		1980 ²	
	Quantity	Value	Quantity	Value
Agricultural limestone	1,131	6,036	1,729	8,299
Agricultural marl and other soil conditioners	52	452	115	632
Poultry grit and mineral food	490	2,837	497	3,064
Concrete aggregate	14,085	53,980	14,583	57,691
Bituminous aggregate	3,498	12,490	4,604	17,010
Dense-graded roadbase stone	17,603	37,602	16,497	40,325
Surface treatment aggregate	2,885	12,804	3,708	14,716
Other construction aggregate and roadstone	13,409	30,858	12,164	32,946
Riprap and jetty stone	58	277	59	398
Filter stone	55	233	W	W
Manufactured fine aggregate (stone sand)	5,642	19,770	5,813	23,134
Cement manufacture	2,344	5,139	2,337	5,615
Lime manufacture	367	1,007	449	1,120
Asphalt filler	21	209	20	221
Other fillers	188	1,222	184	1,288
Fill	1,580	2,919	2,288	5,068
Glass manufacture	W	W	20	191
Other ³	200	632	1,140	4,257
Total ⁴	63,609	188,467	66,209	215,972

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

¹Crushed limestone only.

²Includes limestone, shell, and marl.

³Includes stone used for macadam aggregate, railroad ballast, and filter stone (1979).

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

Vermiculite.—Exfoliated vermiculite was produced by two operators at four plants in Broward, Duval, and Hillsborough Counties from crude ore shipped into the State. Production increased 11% over that of 1979; principal uses were for lightweight aggregate, horticulture, and insulation.

METALS

Mineral Sands.—Du Pont and Associated Minerals produced concentrates from their heavy mineral operations in Clay County. In May 1980, Associated Minerals Consolidated Ltd. (AMC) of Sydney, New South Wales, Australia, acquired the properties of Titanium Enterprises at Green Cove

Springs for \$11.7 million. The properties were mined thereafter by Associated Minerals Ltd., Inc., a subsidiary of the Australian firm AMC. AMC plans to invest an additional \$6 million for working capital and improvements to bring the operation up to optimum capacity. Reserves at Green Cove Springs are projected to last 16 years at an average annual production rate of 25,000 tons of rutile, 25,000 tons of zircon, and 50,000 tons of ilmenite, plus significant quantities of leucoxene, staurolite, and monazite.

Rare-Earth Minerals.—AMC produced monazite concentrates as a byproduct from its operations in Clay County. Florida was

the only domestic producer of rare earths from mineral sands mining.

Titanium.—Du Pont and AMC, Clay County, produced titanium concentrates for use in titanium dioxide pigment manufacture.

Zircon.—Production and value of zircon concentrates from Du Pont and AMC, both

in Clay County, decreased in 1980. Florida was the only producer of zircon concentrates in the United States.

¹State mineral specialist, Bureau of Mines, Tuscaloosa, Ala.

²State geologist, Florida Bureau of Geology, Tallahassee, Fla.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Florida Mining & Materials Corp	Box 23965 Tampa, FL 33622	Plant-----	Hernando.
General Portland, Inc. -----	12700 Park Central Place Suite 2100 Dallas, TX 75251	Plants -----	Dade and Hillsborough.
Lonestar Florida, Inc. -----	Box 2035 PVS Hialeah, FL 33012	Plant-----	Dade.
Rinker Portland Cement Corp. --	Box 530679 Miami, FL 33165	---do-----	Do.
Clays:			
Florida Mining & Materials Corp	Box 6 Brooksville, FL 33512	Open pit mine --	Hernando.
Mid-Florida Mining -----	Box 68-F Lowell, FL 32663	---do-----	Marion.
Pennsylvania Glass Sand Corp. -	Berkeley Springs, WV 35411 --	---do-----	Gadsden.
Gypsum (calcined):			
Jim Walter Corp. -----	Box 135 Jacksonville, FL 32226	Plant-----	Duval.
National Gypsum Co. -----	4100 First Intl. Bldg. Dallas, TX 75270	---do-----	Hillsborough.
United States Gypsum Co. -----	101 South Wacker Dr. Chicago, IL 60606	---do-----	Duval.
Lime:			
Chemical Lime, Inc. -----	Box 250 Ocala, FL 32670	---do-----	Hernando.
Dixie Lime & Stone Co. ¹ -----	Drawer 217 Sumterville, FL 33585	---do-----	Sumter.
Magnesium compounds:			
Basic Magnesia, Inc. ² -----	Box 160 Port St. Joe, FL 32456	---do-----	Gulf.
Peat:			
F. E. Stearns Peat -----	Route 1, Box 542D Dover, FL 33527	Bog-----	Hillsborough.
Peace River Peat Co. -----	Box 1192 Bartow, FL 33830	Bog-----	Polk.
Superior Peat & Soil -----	Box 2588 Sebring, FL 33870	Bog-----	Highlands.
Perlite (expanded):			
Arlite Processing Corp. of Florida	Route 2, Box 740 Vero Beach, FL 32960	Plant-----	Indian River.
Armstrong Cork Co. -----	Box 1991 Pensacola, FL 32589	---do-----	Escambia.
Chemrock Corp. -----	End of Osage Street Nashville, TN 37208	---do-----	Duval.
W. R. Grace & Co. ³ -----	52 Whittemore Ave. Cambridge, MA 02140	---do-----	Broward.
Phosphate rock:			
Agrico Chemical Co. -----	Box 3166 Tulsa, OK 74101	Open pit mines and plants	Polk.
Borden, Inc. -----	Box 790 Plant City, FL 33566	Open pit mine and plant	Hillsborough and Polk.
Brewster Phosphates -----	Bradley, FL 33835-----	---do-----	Do.
C. F. Industries -----	Box 790 Plant City, FL 33566	---do-----	Hardee.
Estech, Inc. -----	Box 208 Bartow, FL 33830	Open pit mines --	Polk.
Gardinier, Inc. -----	Box 3269 Tampa, FL 33601	Open pit mine and plant	Do.
International Minerals & Chemical Corp.	Box 857 Bartow, FL 33830	Open pit mines --	Do.
Mobil Oil Corp. ⁴ -----	Box 311 Nichols, FL 33863	---do-----	Do.
Occidental Petroleum Corp. -----	White Springs, FL 32096-----	Open pit mine --	Hamilton.
U.S.S. Agri-Chemicals, Inc. -----	Box 867 Fort Meade, FL 33841	---do-----	Polk.
W. R. Grace & Co. -----	Box 471 Bartow, FL 33830	Open pit mine and plant	Do.

See footnotes at end of table.

Table 7.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Florida Rock Industries, Inc., Shands & Baker.	744 Riverside Ave. Jacksonville, FL 32201	Pits -----	Clay, Lake, Lee, Putnam.
General Development Corp.-----	1111 South Bayshore Dr. Miami, FL 33131	----do -----	St. Lucie, and Sarasota.
E. R. Jahna Industries, Inc., Ortona Sand Co. Div.	First & East Tillman Lake Wales, FL 33853	----do -----	Glades, Lake, Polk.
Silver Sand Co. of Clermont Inc.	Route 1, Box US 1 Clermont, FL 32711	Pit -----	Lake.
Staurolite:			
E. I. du Pont de Nemours & Co.-----	DuPont Bldg. D-10084 Wilmington, DE 19898	Mines and plants-----	Clay.
Stone:			
Florida Crushed Stone Co.-----	Box 317 Leesburg, FL 32748	Quarries-----	Hernando and Sumter.
Florida Rock Industries, Inc. ⁵ -----	Box 4467 Jacksonville, FL 32201	----do -----	Collier, Lee, Sumter, Suwannee.
Lone Star Florida, Inc.-----	Box 6097 Fort Lauderdale, FL 33310	Quarry-----	Dade.
Rinker Southeastern Materials, Inc.	Box 2634 Hialeah, FL 33012	Quarries-----	Do.
Vulcan Materials Co.-----	Box 7324-A Birmingham, AL 35223	----do -----	Broward and Dade.
Titanium concentrates:			
Associated Minerals Consolidated Ltd.	Green Cove Springs, FL 32043	Mine and plant-----	Clay.
E. I. du Pont de Nemours & Co. ⁶ -----	DuPont Bldg. D-10084 Wilmington, DE 19898	Mines and plants-----	Do.

¹Also stone.²Also lime.³Also phosphate rock and exfoliated vermiculite.⁴Also elemental phosphorus.⁵Also sand and gravel.⁶Also zircon concentrate and rare-earth oxides and thorium oxide in monazite concentrate.



FLORIDA GEOLOGICAL SURVEY

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