

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. Boyle¹ and Charles W. Hendry, Jr.²

The value of nonfuel mineral production in 1981 in Florida was \$1.7 billion, an increase of \$216.3 million over that of 1980. Florida ranked fourth nationally in total value of nonfuel minerals produced, and nonmetals accounted for over 95% of the value of the State's mineral output. The State ranked first in the production of phosphate rock and was second in crushed stone, fuller's earth, masonry cement, and peat. Staurolite and zircon concentrates were produced only in Florida. Principal

nonmetals, in order of value, were phosphate rock, stone, cement, clays, and sand and gravel.

Of the 53.6 million tons of phosphate rock produced in the United States, Florida was the predominant producer and for the 88th consecutive year supplied more than any other State. Florida and North Carolina supplied 86.3% of the domestic phosphate rock output; Florida supplied most of the exports.

Table 1.—Nonfuel mineral production in Florida¹

Mineral	1980		1981	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry ----- thousand short tons	285	\$22,074	288	\$20,757
Portland ----- do	3,574	182,590	3,518	199,064
Clays ----- do	614	24,164	731	235,319
Gem stones ----- do	NA	5	NA	6
Lime ----- thousand short tons	195	12,434	191	11,343
Peat ----- do	154	2,398	157	2,885
Sand and gravel ----- do	^r 14,412	^r 23,766	^p 14,149	^p 32,719
Stone (crushed) ----- do	66,209	215,972	65,067	226,192
Combined value of clays (kaolin), magnesium compounds, phosphate rock, rare-earth concentrate, sand and gravel (industrial, 1980), staurolite, titanium concentrates (ilmenite and rutile), and zircon concentrates ----- do	XX	^r 1,020,855	XX	1,197,304
Total ----- do	XX	^r 1,509,258	XX	1,725,589

^pPreliminary. ^rRevised. NA Not available. XX Not applicable.

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

²Excludes kaolin; value included with "Combined value" figure.

³Excludes industrial sand; value included with "Combined value" figure.

In 1981, Florida fared better economically than the Nation as a whole. Although residential construction and road maintenance programs decreased late in the year, nonresidential construction increased. The effect on individual mineral producers depended on the construction market supplied, with output mixed throughout the industry. Road maintenance programs decreased because of reduced Federal input.

Alexander Grant & Co., a Chicago-based accounting firm, conducted a study, in cooperation with the Conference of State Manufacturers' Association, on the general manufacturing business climate of the 48 contiguous States. The study concluded that in 1981, Florida had the best overall business climate for manufacturing among the 48 States. Florida ranked 12th in 1979 and 8th in 1980.

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

(Thousands)

County	1979	1980	Minerals produced in 1980 in order of value
Alachua	\$2,789	\$4,391	Stone.
Bay	1,040	1,021	Sand and gravel.
Brevard	W	W	Clays, stone, sand and gravel.
Broward	20,607	28,587	Stone, sand and gravel.
Calhoun	52	46	Sand and gravel.
Charlotte	--	717	Stone.
Citrus	6,002	7,594	Stone, phosphate rock.
Clay	26,526	27,858	Titanium, zirconium, staurolite, sand and gravel, clays, monazite.
Collier	6,236	8,339	Stone.
Dade	W	W	Cement, stone, sand and gravel.
Escambia	605	617	Sand and gravel.
Gadsden	W	20,339	Clays, sand and gravel.
Glades	W	W	Sand and gravel.
Gulf	W	W	Magnesium compounds, lime.
Hamilton	W	W	Phosphate rock.
Hardee	W	W	Do.
Hendry	W	534	Stone.
Hernando	W	W	Cement, stone, lime, clays.
Highlands	W	W	Peat.
Hillsborough	W	W	Phosphate rock, cement, stone, peat.
Jackson	620	W	Stone.
Lake	W	W	Sand and gravel, peat, clays.
Lee	W	W	Stone, sand and gravel.
Leon	W	W	Sand and gravel.
Levy	2,846	3,985	Stone.
Manatee	W	W	Cement, stone.
Marion	12,772	W	Stone, clays, phosphate rock.
Monroe	2,447	4,020	Stone.
Nassau	W	--	
Okaloosa	36	17	Sand and gravel.
Orange	64	58	Do.
Palm Beach	W	6,319	Stone.
Pasco	W	3,437	Do.
Polk	676,298	784,741	Phosphate rock, sand and gravel, peat, stone.
Putnam	W	W	Sand and gravel, clays, peat.
St. Lucie	W	W	Sand and gravel, stone.
Sarasota	W	W	Do.
Sumter	W	W	Lime, stone.
Suwannee	W	777	Stone.
Taylor	2,787	3,922	Do.
Walton	W	W	Sand and gravel.
Undistributed ²	507,884	601,938	
Total ³	1,269,607	1,509,258	

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

¹The following counties are not listed because no nonfuel mineral production was reported: Baker, Bradford, Columbia, De Soto, Dixie, Duval, Flagler, Franklin, Gilchrist, Holmes, Indian River, Jefferson, Lafayette, Liberty, Madison, Martin, Okechobee, Osceola, Pinellas, St. Johns, Santa Rosa, Seminole, Union, Volusia, Wakulla, and Washington.

²Includes gem stones and values indicated by symbol W.

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

Table 3.—Indicators of Florida business activity

	1980	1981 ^P	Change, percent
Employment and labor force, annual average:			
Total civilian labor force ----- thousands	3,986.0	4,134.8	+3.9
Unemployment ----- do -----	199.0	300.9	+51.2
Employment (nonagricultural):			
Mining ¹ ----- do -----	11.0	11.2	+1.8
Manufacturing ----- do -----	466.4	466.4	+2.2
Contract construction ----- do -----	263.9	282.5	+7.0
Transportation and public utilities ----- do -----	220.8	228.6	+3.5
Wholesale and retail trade ----- do -----	939.8	983.0	+4.6
Finance, insurance, real estate ----- do -----	254.2	271.9	+7.0
Services ----- do -----	811.3	863.4	+6.4
Government ----- do -----	618.8	614.6	-7
Total nonagricultural employment ¹ ----- do -----	3,576.2	² 3,721.7	+4.1
Personal income:			
Total ----- millions -----	\$88,693	\$102,333	+15.4
Per capita ----- do -----	\$8,993	\$10,050	+11.8
Construction activity:			
Number of private and public residential units authorized ----- do -----	174,451	149,241	-14.5
Value of nonresidential construction ----- millions -----	\$2,199.0	\$2,930.3	+33.3
Value of State road contract awards ----- do -----	\$316.0	\$416.0	+31.6
Shipments of portland and masonry cement to and within the State ----- thousand short tons -----	5,820	5,724	-1.6
Nonfuel mineral production value:			
Total crude mineral value ----- millions -----	\$1,509.3	\$1,725.6	+14.3
Value per capita, resident population ----- do -----	\$155	\$177	+14.2
Value per square mile ----- do -----	\$25,764	\$29,467	+14.4

^PPreliminary.

¹Includes oil and gas extraction.

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

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

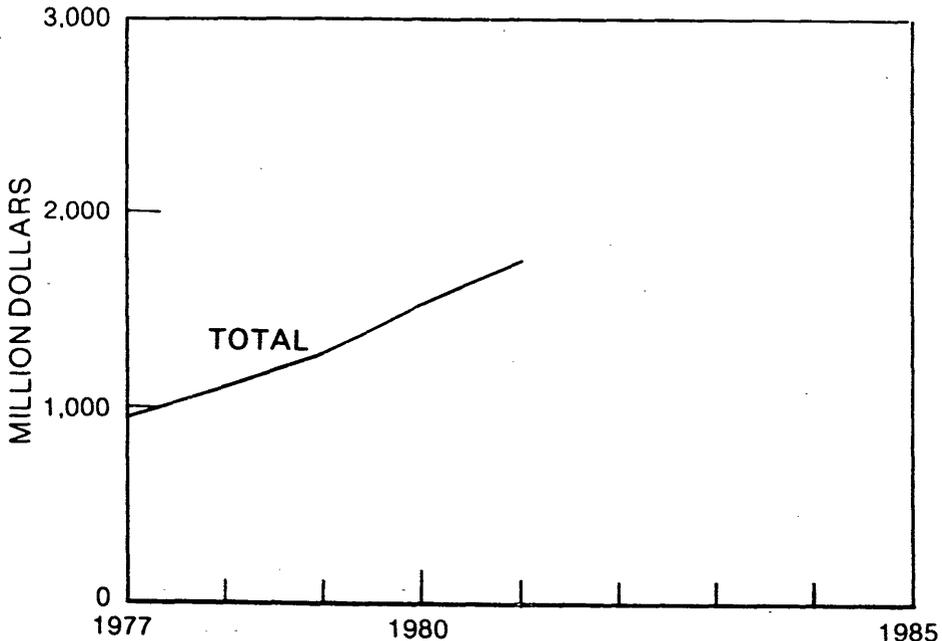


Figure 1.—Total value of nonfuel mineral production in Florida.

Trends and Developments.—The Port of Tampa, which handled over 45 million tons of cargo in 1981, shipped the major portion of exported phosphate. Phosphate rock and processed phosphate exports totaled 13 million tons, down from 16 million tons in 1980. These exports included 9 million tons of bulk phosphate, down from 12 million tons in 1980. Phosphate accounted for about 90% of all export cargo through the Port of Tampa. A new market in bagged phosphate chemicals developed in China, and nearly one-half million tons was exported through the port to that market. About 750,000 tons of aragonite was imported from the Bahamas for use in the manufacture of cement, down from 1.2 million tons in 1980.

In contrast, Port Manatee's phosphate exports increased when Beker Industries opened its new mine, with plans to export 1 million tons per year through the facility. Shipments from Beker were expected to increase up to 3 million tons per year in the next several years, according to the company.

Texasgulf, Inc., started operations at its new \$8 million sulfur terminal on Hooker's Point in Tampa. The terminal, on a 10-acre site leased from the Tampa Port Authority, can store 60,000 tons of liquid sulfur. The terminal is supplied by tankers from sulfur mines in Texas and Mexico.³

Occidental Petroleum Corp. (Oxy) resumed shipments of superphosphoric acid to the Soviet Union after the trade embargo was lifted in April. The original agreement called for Oxy to ship 1 million tons per year of superphosphoric acid to the Soviet Union in exchange for urea, potash, and anhydrous ammonia. The 20-year agreement would be worth about \$20 billion. Plans called for Oxy to ship 72,000 tons per month for the balance of 1981. The National Safety Council awarded Oxy's White Springs Mine first place in safety for achieving the lowest accident incident rate among member companies. Second place went to Oxy's Suwannee River Mine.

Legislation and Government Programs.—The Florida Coastal Management Program was approved by the U.S. Department of Commerce Office of Coastal Zone Management in September 1981. The entire State and its territorial waters were included within the Coastal Zone Boundary. The Florida Coastal Management Program is based on existing State laws. Twenty-five statutes specifically serve as the authorities for a direct State control management technique with the Department of Environ-

mental Regulation as the designated State agency. Major first-year work projects include hazard mitigation planning, port dredging and soil disposal, and technical assistance for areas designated as areas of critical State concern.

The Florida phosphate industry impacted economically within the State and nationally. The U.S. Bureau of Mines released a study in 1981 (IC 8850, "Economic Significance of the Florida Phosphate Industry") on the impact. The study assessed the economic significance of the Florida phosphate industry to selected counties in Florida, the State of Florida, and the Nation; it also included a brief survey of the industry's international impact. Based on forecasts of Florida phosphate production in 1981, and using constant 1977 dollars, estimates were given for 1981 for regional and national output, the value of this output, income, and employment created by the phosphate industry in Florida. Federal, State, and county tax revenues generated by the State's phosphate industry were also estimated for 1981. The concentrated impact of the phosphate industry on certain areas of Florida and on the State's regional industries was examined using economic base analysis complimented by an industrial complex approach. The industry's impact at the State and national levels was examined through input-output analysis.

In addition, an attempt to forecast for 1990 the effects of constraints on phosphate rock mining as a result of economic conditions and other factors was included as an appendix to the report. Also discussed was the phosphate industry's importance to the U.S. balance of trade; U.S. agricultural production, including forward linkages; the U.S. sulfur industry; and the phosphate industry's importance to the production of fluorine and uranium byproducts from fertilizer manufacturing.

Other U.S. Bureau of Mines publications on phosphate included RI 8576, "Fluorine and Uranium in Phosphate Rock Processing and Waste Materials"; RI 8609, "Beneficiation of High-Magnesium Phosphate from Southern Florida"; and RI 8611, "Large-Scale Dewatering of Phosphate Clay Waste from Central Florida."

The Bureau, in association with Agrico Chemical Co., initiated tests of borehole mining of deep phosphate ore in St. Johns County. The tests were made to determine if deep phosphate ores in St. Johns County could be mined economically and in an

environmentally compatible manner. Agro plans to start additional borehole mining experiments in 1983.

Since 1972, the Bureau's Tuscaloosa Research Center has been involved in projects to eliminate holding ponds of phosphate waste slimes or develop an improved dewatering system. In-house Bureau project activity during the year included research on water recovery from phosphate clay slimes, continuous flocculation dewatering and floc formation studies, and reuse and purification of low-quality water for processing. Research continued on devising new or improved beneficiation methods applicable to high-magnesium phosphate deposits.

The Bureau reported that the apparent consumption of industrial explosives and blasting agents in the State in quarrying and nonmetal mining was 23.2 million pounds in 1981. Of that total, the top two types, water gels and slurries and other high explosives, accounted for 87% of the explosives used.

During the year, the Florida Bureau of Geology completed six geologic projects in the State. Thirteen other projects were underway on stratigraphy, lithostratigraphy, and geomorphology of specific formations and in geographic areas; mineral deposits, such as peat and dolomite, were also investigated. In addition, the Bureau of Geology maintained a geologic well log library and a computerized list of mineral producers and statistics. Six publications were issued during the year, including RI 91, "The Hawthorn Formation of Central Florida," and several publications in the

map series were also issued. The Bureau of Geology, also involved in mined land reclamation, developed a Master Reclamation Plan, proposed Chapter 16C-17, Florida Administrative Code, addressing lands mined or disturbed by the severance of phosphate prior to July 1, 1975. The plan, scheduled for adoption in 1982, provides procedures to reclaim approximately 86,000 acres of disturbed land.

The Florida Institute of Phosphate Research funded six major projects during the year. The funded projects were a Virginia Polytechnic Institute study of a clay separation process (\$49,622), a University of South Florida investigation on the utilization of waste gypsum to produce cement (\$26,857), and a National Council on Radiation Protection and Measurements study of radiation exposure (\$34,080). Three projects were with the U.S. Bureau of Mines: (1) a comprehensive evaluation of slime treatment and storage methods (\$269,000), (2) the development of techniques for utilization of high-magnesia phosphate ore (\$12,000), and (3) the production of 12,000 ceramic tiles from phosphate slimes and fly ash to be tested at the Institute's new headquarter's sidewalks in Bartow (\$5,000).

The U.S. Geological Survey studies include the geology, geochemistry, and resources of peat; geochemistry and hydrochemistry of marine sediments, mineral resources, and ground water systems; research in geophysical data interpretation off southern Florida; and environmental geologic studies of the west Florida continental shelf.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of both portland and masonry cement remained at about the same level as those of 1980; portland cement shipments decreased slightly, while those of masonry cement increased slightly. Production of masonry cement in Florida ranked second nationally, while portland cement production ranked sixth. Four companies produced portland cement at five plants; masonry cement was also produced at five plants. A fifth company operated a grinding plant to produce portland cement from imported clinker. Most of the shipments of both portland and masonry cement were to users within the State; Florida was a net

importer of cement, with about 1 million tons being imported. Portland cement shipments, mainly in bulk form, were made by truck and rail. Principal consumers were ready-mix concrete dealers, highway contractors, building material dealers, and concrete products manufacturers, with the remainder being consumed by other contractors and government agencies.

Most raw materials used to manufacture cement were mined within the State and included limestone, clay, sand, and stauroilite; the use of stauroilite is diminishing because of higher value uses. Oolitic aragonite imported from the Bahamas was used as well as 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 447 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., continued its \$68 million expansion program at the Brooksville plant. The expansion includes a second coal-fired kiln and enlarged grinding and storage capabilities, which, when operational in 1982, would double cement output to 1.2 million tons annually. The company also purchased two cement plants in Tennessee from Penn Dixie Industries, Inc.

Lonestar Florida Pennsuco, Inc., installed a new finish mill and increased storage capacity at the 1.2-million-ton-per-year cement plant at Hialeah. Conversion to coal at its wet-process plant was also completed.

Clays.—Clays mined in Florida included common clay, fuller's earth, and kaolin. Total clay production and value increased 117,000 tons and \$11.2 million, respectively.

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 clay was used in the manufacture of cement and lightweight aggregate.

Florida continued to rank second in the Nation in fuller's earth production, with production increasing. Fuller's earth was mined by four producers from nine pits in Brevard, Gadsden, and Marion Counties. Main end uses were for pet waste and oil and grease absorbents, and in fertilizers, pesticides, and saltwater drilling muds. Pennsylvania Glass Sand Corp. completed an expansion of its processing plant at Quincy. New facilities were installed for clay extrusion, bagging, dust collection, and pneumatic bulk loading.

Kaolin was produced by one company at two pits in Putnam County; production increased slightly from that of 1980. A coproduct was silica, which was recovered for glass and other industrial uses. Principal uses for kaolin were in electrical porcelain, whiteware, and wall tile; major markets were in the Southeast.

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 silicofluoride, and was also used in water fluoridation.

Gypsum.—Imported gypsum was calcined at two plants in Duval County and one plant in Hillsborough County. United States Gypsum Co., Jim Walter Corp., and National Gypsum Co. calcined gypsum in kettles, a rotary kiln, and a holoflite unit, respectively, prior to wallboard manufacture. Production in 1981 remained at the 1980 level, with value decreasing. Florida gypsum wallboard was marketed primarily in south Georgia and Florida. Byproduct gypsum was recovered by Occidental Petroleum Corp. at its plant in Hamilton County; output remained at about the 1980 level.

Lime.—Both quicklime and dehydrated lime were produced in Florida. Quicklime was produced by Basic Magnesia, Inc., Gulf County; Chemical Lime, Inc., Hernando County; and Dixie Lime & Stone Co., Sumter County. Hydrated lime was also produced by Chemical Lime, Inc. Production and value decreased 2.1% and 8.8%, respectively, from those of 1980. 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 1981 increased 6.9%; value increased 17.7% over that of 1980.

Peat.—Florida ranked second nationally in peat production in 1981. Production increased slightly, while unit value increased nearly 18%. Eight 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 (Expanded).—Four companies produced expanded perlite from crude ore shipped into the State. Production decreased to 29,900 tons, while value increased to \$3.9 million. Perlite was expanded at plants in Broward, Duval, Escambia, and Indian River Counties and was used for construction aggregate, horticultural purposes, insulation, and fillers.

Phosphate Rock.—Florida ranked first in the Nation in the production of phosphate rock. Marketable production of phosphate rock in 1981 decreased slightly in quantity, but increased 17.6% in value. The phos-

phate industry continued to be the principal mineral industry in the State.

Phosphate production decreased gradually throughout the year. Inventories increased, resulting in reduced operating levels and temporary closure of some mines and plants. By yearend, mining output was reportedly at 47% of capacity, with chemical plants at about 59% capacity. Decreased demand and large inventories of processed phosphates resulted in prices frequently below stated production costs. The drop in sales of about 20% was attributed to high interest rates and low crop prices. Adequate phosphorus levels in the soil permitted deferments of applications. Exports, reported to be off as much as 3 to 4 million tons, were down because of increased competition and the strength of the U.S. dollar. In spite of reduced demand and increased inventories, reported expansions underway or planned for completion by 1985 exceeds \$2 billion, with expenditures in 1981 approaching \$600 million. Environmental constraints and the low demand for phosphates may cause delays in meeting planned schedules.

The Florida Phosphate Council estimated that about \$78.5 million was collected in severance taxes from phosphate producers during the year. The \$1.67-per-ton rate was to increase to \$1.84 per ton in 1982. Discussions continued over returning a portion of severance taxes to the producing counties; at present, all monies go to the State treasury.

Soft-rock phosphate was produced by four companies in 1981, 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 21 mines by 12 companies in Hamilton, Hardee, Hillsborough, Manatee, and Polk Counties. In 1981, agricultural uses accounted for 75%; industrial, 1%; and exports, 24%. 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.

AMAX Phosphate, Inc., had its first full year of operations after purchasing the mining operations and phosphate reserves of Borden, Inc., in mid-1980. The company had one active mine, the Big Four Mine, in southeast Hillsborough County, with plans

to expand capacity from 1.6 to 2.5 million tons per year by early 1982. Also planned for DeSoto County was a 4-million-ton-per-year mine near Pine Level. To guarantee environmental protection, county officials levied a tax to be used in developing a review procedure. AMAX will spend over \$3 million at its Plant City defluorination plant to control fugitive dust. Wet scrubbers were also to be redesigned for improved efficiency.

Beker Phosphate, Inc., started operating its Wingate Creek Mine and beneficiating plant late in the year, with two floating dredges removing overburden and matrix. Capacity should increase to 1 million tons per year, with output shipped through the company's new facilities at Port Manatee to the company's fertilizer plant in Louisiana. Manatee County officials questioned company transportation modes when they used trucks instead of rail to move the phosphate to the port. By yearend, negotiations were underway to settle the dispute.

The C. F. Industries, Inc., proposed mine in Hardee County would require a Natural Pollutant Discharge Elimination System permit. The mine's capacity was to be 2 million tons per year for the first 4 years, possibly increasing to 4 million tons per year. Construction of the company's second phosphate plant in Hardee County continued, with completion of the 2-million-ton-per-year facility expected by 1984.

Estech, Inc., continued to plan development of its proposed 3-million-ton-per-year Duette Mine in Manatee County. In an effort to ensure no damage to the area's main water supply near the minesite, county officials adopted the toughest phosphate restrictions in the State and denied permit approval. The Governor and Cabinet agreed to granting of the permits, but the action was challenged in the courts by Manatee County officials. The court upheld the State's decision, and negotiations between county and company officials began. In Polk County, Estech began mining phosphate rock that was previously buried under slime ponds. By dewatering the ponds, about 3.5 to 4 million tons of phosphate will be recovered, extending the life of the mine nearly 2 years.

Farmland Industries, Inc., continued efforts to develop its first mining operation in Hardee County; the company presently operates a chemical plant near Bartow. Jacobs Engineering Group was awarded a contract for engineering and design work for the

proposed mine and beneficiation plant. Engineering and design work was scheduled for completion by mid-1982, with plant startup for late 1983. The facility's capacity was rated at 2 million tons per year.

W. R. Grace & Co. continued construction and participated in two joint ventures; one with International Minerals & Chemical Corp. (IMC) in the Four Corners Mine and beneficiation plant, and the other with U.S.S. Agri-Chemicals, Inc. (USSAC), in a chemical complex. The Four Corners Mine is a \$615 million investment to produce 5 million tons of phosphate per year. The mine, located in Hardee, Hillsborough, Manatee, and Polk Counties, was scheduled to start operating in 1983. The other project involves a \$200 million phosphoric acid plant at Fort Meade, with completion scheduled for July 1982.

IMC, the world's largest private producer of phosphate and phosphate chemical products, completed construction of its New Wales sulfuric acid plant in Polk County. Through the venture with W. R. Grace and purchase of other properties, IMC reported an increase in reserves by an estimated 270 million tons of phosphate rock. The new IMC 61-yard dragline, the largest in the area, began mining at the company's Clear Spring Mine. IMC, with funding by the Florida Institute of Phosphate Research, is working with the other phosphate companies on a process to reduce the number of phosphate slime ponds. The experiment calls for pumping thickened clay, stored in a centralized slime pond for 6 months, to mining sites. The clays would be topped with overburden. The objective is to restore the mining site and reduce the need for large storage areas. Early in the year, IMC signed an agreement to ship 360,000 tons of phosphate rock per year by unit train to Canada. Approximately 58 unit trains

would be required each year.

Mobil Chemical Co. proceeded with the permitting process to develop the South Fort Meade Mine scheduled for operation in 1984. The 3-million-ton-per-year mine will replace Mobil's Fort Meade Mine, scheduled to close in 1988. Mobil plans to construct a new phosphate rock terminal in Tampa. The terminal would have loading and unloading facilities, a storage area, and berthing facilities for large ore carriers. The facility was scheduled to be operational in 1984.

USSAC and W. R. Grace started constructing a new phosphoric acid plant at Fort Meade. Completion and startup was scheduled for July 1982. The planned \$24 million expansion of the company's Rockland Mine has been deferred because of reduced market demands.

Sand and Gravel.—To reduce reporting burdens and costs, the Bureau of Mines implemented new canvassing procedures for its surveys of sand and gravel producers. Beginning with the collection of 1981 production data, the survey of construction sand and gravel producers will be conducted for even-numbered years only; the survey of industrial sand and gravel producers will continue to be conducted annually. Therefore, this chapter contains only preliminary estimates for construction sand and gravel production but contains complete data on industrial sand and gravel. The preliminary estimates for production of construction sand and gravel for odd-numbered years will be revised and finalized the following year.

Total sand and gravel production decreased from that of 1980. The Florida Rock Industries, Inc., sand plant at Keuka was refurbished, and a new sand plant in Marion County went onstream during the year.

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

	1980			1981		
	Quantity (thousand short tons)	Value (thou- sands)	Value per ton	Quantity (thousand short tons)	Value (thou- sands)	Value per ton
Construction:						
Sand	¹ 13,263	¹ \$26,174	\$1.97	NA	NA	NA
Gravel	1,169	2,592	2.24	NA	NA	NA
Total or average	¹ 14,412	¹ \$28,766	1.99	^P 13,800	^P \$28,300	^P \$2.05
Industrial sand	W	W	¹ \$6.82	349	4,419	12.66
Grand total or average	W	W	¹ \$2.27	^P 14,149	^P \$32,719	^P \$2.31

^PPreliminary. ¹Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

Staurolite.—Florida was the only State with a recorded production of staurolite. Staurolite was recovered as a byproduct of ilmenite processing at the Highland and Trail Ridge plants of E. I. duPont de Nemours & Co. and the Green Coves Springs plant of Associated Minerals (USA) Ltd., both in Clay County. Although production and total value decreased, unit value increased. Staurolite was mainly used in sandblasting, with minor amounts used in cement and as foundry sand.

Stone.—Florida ranked second in the Nation in crushed stone production, which included limestone, marl, and oyster shell. Output dropped slightly, but unit value increased.

Stone was produced by 88 companies at 131 quarries in 25 counties. The three leading counties were Dade, Broward, and Her-

nando, which supplied 70.1% of the State's total production. Thirteen companies produced over 1 million tons each from 28 quarries and accounted for 67% of the production and 72% of the value.

Crushed stone was transported mainly by truck and railroad and was used for dense-graded road base, concrete and bituminous aggregate, and cement manufacture. Six companies processed oyster shell for road-bed material. Companies supplying crushed stone throughout the State often utilized a dedicated train concept for markets over 60 miles distant.

The Florida Rock Industries, Inc., modernization and expansion program at the Gulf Hammock plant was completed during the year, with capacity tripling to 450 tons per hour of finished product.

Table 5.—Florida: Crushed stone¹ sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1980		1981	
	Quantity	Value	Quantity	Value
Agricultural limestone	1,729	8,299	1,264	7,064
Agricultural marl and other soil conditioners	115	632	196	840
Poultry grit and mineral food	497	3,064	W	2,748
Concrete aggregate	14,583	57,891	15,168	65,208
Bituminous aggregate	4,604	17,010	3,465	14,565
Dense-graded road base stone	16,497	40,325	15,485	42,605
Surface-treatment aggregate	3,708	14,716	2,482	11,536
Other construction aggregate and road stone	12,164	32,946	13,088	37,739
Riprap and jetty stone	59	398	256	687
Filter stone	W	W	139	850
Manufactured fine aggregate (stone sand)	5,813	23,134	4,498	17,909
Cement manufacture	2,337	5,615	2,432	7,816
Lime manufacture	449	1,120	387	1,062
Asphalt filler	20	221	26	264
Other fillers	184	1,288	191	1,447
Fill	2,288	5,068	5,539	13,334
Glass manufacture	20	191	21	214
Other ²	1,140	4,257	490	304
Total³	66,209	215,972	65,067	226,192

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

¹Includes limestone, shell, and marl.

²Includes stone used for macadam aggregate, railroad ballast (1980), whitening or whitening substitute (1981), and other uses not specified (1981).

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

Sulfur.—Florida ranked fifth in the Nation in the production of byproduct elemental sulfur. Recovered sulfur from Exxon's natural gas desulfurization plants in Santa Rosa County decreased in 1981 compared with that of 1980.

Vermiculite (Exfoliated).—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 slightly over that of 1980, while unit value increased 19.6%. Principal uses were for concrete aggregate, horticulture, and insulation.

METALS

Mineral Sands.—Du Pont and Associated Minerals (an Australian-based company) produced concentrates from their heavy mineral operations in Clay County. In 1980, Associated Minerals acquired the Titanium Enterprise operation at Green Cove Springs. Since then, Associated Minerals has been modifying the operation to increase efficiency and capacity. Changes have been made in the dredging sequence, and wet mill facilities.

Rutile shipments increased, while ilmenite shipments decreased.

Rare-Earth Minerals.—Associated Minerals produced monazite concentrates as a byproduct from its operations in Clay Coun-

ty. Florida was the only domestic producer of rare earth from mineral sands mining. Production and value increased substantially over that of 1980.

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

Zircon.—Production and value of zircon concentrates from Du Pont and Associated Minerals, both in Clay County, increased in 1981. Florida was the only producer of zircon concentrates in the United States.

¹State Liaison Officer, Bureau of Mines, Tuscaloosa, Ala.

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

³Chemical Week. Mar. 18, 1981, p. 25.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
General Portland, Inc. -----	12700 Park Central Place Suite 2100 Dallas, TX 75251	Plants -----	Dade and Hillsborough.
Lonestar Florida Pennsoco, Inc. -	Box 2035 PVS Hialeah, FL 33012	Plant -----	Dade.
Moore McCormack Resources, Inc. -----	Box 23965 Tampa, FL 33622	-----do-----	Hernando.
Rinker Portland Cement Corp. ---	Box 650679 Miami, FL 33165	-----do-----	Dade.
Clays:			
Engelhard Minerals & Chemical Corp. -----	Menlo Park Edison, NJ 08817	Open pit mines and plant.	Brevard.
Mid-Florida Mining -----	Box 63-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 Intl. Bldg. Dallas, TX 75270	-----do-----	Hillsborough.
United States Gypsum Co. -----	101 South Wacker Dr. Chicago, IL 60606	-----do-----	Duval.
Lime:			
Basic Magnesia, Inc. -----	Box 160 Port St. Joe, FL 32456	-----do-----	Gulf.
Chemical Lime, Inc. -----	Box 317 Leesburg, FL 32748	-----do-----	Hernando.
Dixie Lime & Stone Co. ¹ -----	Drawer 217 Sumterville, FL 33585	-----do-----	Sumter.
Magnesia:			
Basic Magnesia, Inc. -----	Box 160 Port St. Joe, FL 32456	-----do-----	Gulf.
Peat:			
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 1688 Sebring, FL 33870	Bog -----	Highlands.
Perlite (expanded):			
Airlite Processing Corp. of Florida. -----	Route 2, Box 740 Vero Beach, FL 32960	Plant -----	Indian River.
Armstrong Cork Co. -----	Box 1991 Pensacola, FL 32589	-----do-----	Escambia.
Chemrock Corp. -----	End of Osage Street Nashville, TN 37208	-----do-----	Duval.
W. R. Grace & Co. ² -----	62 Whittemore Ave. Cambridge, MA 02140	-----do-----	Broward.

See footnotes at end of table.

Table 6.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Phosphate rock:			
Agrico Chemical Co -----	Box 3166 Tulsa, OK 74101	Open pit mines and plants.	Polk.
AMAX Phosphate, Inc.-----	402 South Kentucky Ave. Lakeland, FL 33801	Open pit mine and plant.	Hillsborough.
Beker Phosphate, Inc -----	Box 9034 Bradenton, FL 33506	-----do-----	Manatee.
Brewster Phosphates -----	Bradley, FL 33835-----	-----do-----	Hillsborough and Polk.
C. F. Industries, Inc -----	Box 790 Plant City, FL 33566	-----do-----	Hardee.
Estech, Inc -----	Box 208 Bartow, FL 33830	Open pit mines --	Polk.
Gardinier, Inc -----	Box 3269 Tampa, FL 33601	Open pit mine and plant.	Do.
International Minerals & Chemical Corp.	Box 867 Bartow, FL 33830	Open pit mines --	Do.
Mobil Chemical Co. ³ -----	Box 311 Nichols, FL 33863	-----do-----	Do.
Occidental Petroleum Corp -----	White Springs, FL 32096-----	-----do-----	Hamilton.
U.S.S. Agri-Chemicals, Inc -----	Box 867 Fort Meade, FL 33841	Open pit mine	Polk.
W. R. Grace & Co -----	Box 471 Bartow, FL 33830	Open pit mine and plant.	Do.
Sand and gravel:			
Florida Rock Industries, Inc., Shands & Baker.	744 Riverside Ave. Jacksonville, FL 32201	Pits-----	Clay, Glades, Lake, Lee, Marion, Polk, 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, Hendry, Polk.
Silver Sand Co. of Clermont Inc --	Route 1, Box US 1 Clermont, FL 32711	Pit -----	Lake.
Staurolite:			
Associated Minerals (USA) Ltd., Inc.	Green Cove Springs, FL 32043	Mine and plant--	Clay.
E. I. duPont de Nemours & Co --	DuPont Bldg. D-10084 Wilmington, DE 19898	Mines and plants--	Do.
Stone:			
Florida Crushed Stone Co -----	Box 317 Leesburg, FL 32748	Quarries-----	Hernando, Sumter, Taylor.
Florida Rock Industries, Inc -----	Box 4467 Jacksonville, FL 32201	-----do-----	Collier, Hernando, Lee, Levy, St. Lucie.
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 (USA) Ltd., Inc.	Green Cove Springs, FL 32043	Mine and plant--	Clay.
E. I. duPont de Nemours & Co --	DuPont Bldg. D-10084 Wilmington, DE 19898	Mines and plants--	Do.

¹Also stone.²Also exfoliated vermiculite.³Also elemental phosphorus.

**FLORIDA DEPARTMENT OF NATURAL RESOURCES
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