# The Mineral Industry of Florida

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The value of mineral production in Florida increased from $426.6 million in 1972 to $601.1 million in 1973. The increase of $174.5 million, or 41% more than the value in 1972, was principally caused by increases in the value of crude petroleum, natural gas, cement, stone, and phosphate rock. A general increase in the value of all minerals produced helped to create this record reported value.

Of the 42.1 million tons of phosphate rock produced in the United States, Florida and North Carolina produced 34.4 million. Of this total, Florida was the predominant producer and, for the 80th consecutive year, supplied more than any other State. The State ranked first in the value of fuller's earth, second in the value of production of titanium concentrates, and third in the value of peat and kyanite production. Staurolite was produced only in Florida. Florida and North Carolina supplied 82% of the domestic phosphate rock market and about 95% of the exports from the United States. Only Morocco exported more phosphate rock than was exported from the ports of Tampa, Boca Grande, and Jacksonville. Shipments were made to 29 countries. The principal recipients were West Germany, Canada, and Japan.

Crude petroleum production from the Jay field in the northern Panhandle near the Alabama border was responsible for the State's surge in production, from 16.9 million barrels in 1972 to 32.7 million barrels in 1973. Florida's onshore oil production was important, but interest in 1973 shifted to offshore sites. On December 20, 1973, the Bureau of Land Management, U.S. Department of the Interior, opened sealed bids made by some 51 oil firms on 147 tracts off Mississippi, Alabama, and Florida (MAFLA). The industry winners spent $1.491 billion for the right to drill on 87 tracts covering 485,000 acres of ocean floor. The Bureau of Land Management estimated the reserves in the December MAFLA sale as 2 to 3.2 billion barrels of oil and 2.4 to 3.9 trillion cubic feet of gas. Recovery of the petroleum will require 925 to 1,500 wells drilled from 100 to 300 platforms. Some 500 to 800 miles of pipeline will be needed to transport the crude oil to shore facilities. The MAFLA sale was divided into four sections. Twenty-nine tracts were identified in the Pascagoula, La., to Pensacola area. Another 32 tracts are located in the Gulf of Mexico, about halfway between Fort Walton Beach and Panama City, called the Apalachicola South area. Fourteen tracts are located south of Tallahassee and west of Homosassa. Twelve tracts are located west of Tarpon Springs. Most are located between 50 and 150 miles out into the Gulf of Mexico.

**Legislation and Government Programs.**—The State did not enact any new significant legislation that directly concerned mineral production. The Department of Natural Resources issued interim guidelines for State acquisition of environmentally endangered lands. The criteria for identifying these lands will be their ecological value, their vulnerability, and their endangerment. Priority will be given where the degree of urgency for environmental protection is high and where specific objectives are iden-

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tified for land protection; if possible, other laws will be used to acquire land rather than direct purchase by the State.

On June 10, 1973, the Governor signed into law the act creating an Energy Study Commission. The law is designed to assure monitoring of the State's resources. The Commission will be required to study the national energy situation and its relationship to the Florida energy position. The Commission will also be required to recommend comprehensive energy policies to assure that Florida will have sufficient energy for future needs.

Florida's oil spill law was ruled valid by a unanimous U.S. Supreme Court decision. The law imposes absolute and unlimited liability on shipowners whose vessels pollute and damage the State's territorial waters and coastal zone. The State Department of Natural Resources will enforce the law.

The Governor and cabinet approved the drilling of one 13,000-foot oil well in the Apalachicola National Forest on October 16.

The Bureau of Mines Albany Metallurgy Research Center, Albany, Oreg., initiated studies to demonstrate the physical and economic feasibility of phosphoric acid manufacture by direct sulfuric acid digestion of Florida land-pebble matrix. It was shown that direct sulfuric acid digestion of a Florida phosphate matrix sample could be controlled to produce phosphoric acid and achieve a high $P_2O_5$ recovery. The waste product, a quartz-gypsum filter cake, was characterized as sandy, readily dewatered, and suitable for backfilling mined-out areas to reclaim land. Elimination of the slime storage areas that cover up to 70% of Florida phosphate mined land, and a 20% to 30% increase in phosphate recovery were the principal justifications for developing a process to produce phosphoric acid directly from Florida phosphate matrix.

A number of samples from operating mines in Florida were tested in a continuous-circuit miniplant. Phosphoric acid, containing from 21% to 30% $P_2O_5$, was produced with recoveries ranging from 90% to 95%. A larger pilot plant capable of processing 100 pounds per 24-hour day was designed and is under construction. It will have an acid attack-gypsum crystallization section and a matching rotating tilting pan filter.

The Bureau of Mines Tuscaloosa Metallurgy Research Laboratory, Tuscaloosa, Ala., had seven active programs related to Florida phosphate mining and beneficiation problems.

The Florida Hawthorn Formation that underlies the phosphate matrix contains some phosphate minerals. The Hawthorn is characterized, for the most part, as a tan, cream- or white-colored, sandy argillaceous-appearing, hard dolomitic limestone. The upper part of the formation contains traces to large amounts of black phosphate nodules. Recovery of the phosphate minerals was attempted by calcining and slaking a sized fraction of the material to separate the lime from the phosphate. Laboratory flotation tests were also made on Hawthorn Formation samples. Floating the phosphate minerals from the dolomitic gangue was attempted with petroleum sulfonate. The results from these tests were not promising.

The research program to develop a system to dewater phosphate slimes sponsored by the Florida Phosphate Council, representing 10 operating Florida companies, and the Bureau of Mines continued through 1973. The program, conducted by The Tuscaloosa Metallurgy Research Laboratory, was divided into a number of studies. Phosphate slime samples were characterized, and the identification of attapulgite clay as the major factor responsible for the poor settling rate of the slimes was confirmed. The study also confirmed that the quantity and character of slime solids discharged to settling ponds were highly variable. The relationship of electrophoretic mobilities and cation exchange capacities of phosphate slimes to their mineralogical, chemical, and physical properties was investigated during the year. Results indicated that the hydrogen ion was potential-determining for the slime systems, and the mobility was reduced to zero at a pH of about 2.5. Anions in the slime systems were also found to have significant effects on particle mobility. The studies indicated that the conditons for maximum mobility correspond to conditions for minimum slime viscosity and minimum amount of flocculant needed to agglomerate and settle the slime particles.

Studies were made of phosphate rock matrix in place to determine if selective mining could be used to reduce the quantity of attapulgite in the feed to washing

plants. In one pit attapulgite did occur near the bottom, thus opening the potential for selective mining.

Flocculation studies were made with a wide variety of anionic, cationic, and nonionic polymers. Dow AP–30 was found to be most effective.

Research on the consolidation behavior of sand-slime mixtures showed that addition of sand tailings to slime improved dewatering rates.

## Table 1.—Mineral production in Florida [1]

| Mineral | 1972 Quantity | 1972 Value (thousands) | 1973 Quantity | 1973 Value (thousands) |
|---|---|---|---|---|
| Cement: | | | | |
| Masonry ---- thousand short tons -- | 213 | $6,901 | 256 | $8,706 |
| Portland ---------- do ---- | 2,425 | 59,773 | 2,725 | 72,666 |
| Clays ---------- do ---- | [2] 922 | [2] 10,336 | 1,139 | 13,718 |
| Lime ---------- do ---- | 180 | 3,527 | 187 | 4,026 |
| Natural gas -------- million cubic feet -- | 15,521 | 4,967 | 33,857 | 11,613 |
| Peat ---------- thousand short tons -- | 45 | 362 | 44 | 384 |
| Petroleum (crude) thousand 42-gallon barrels -- | 16,897 | W | 32,695 | 150,070 |
| Sand and gravel -- thousand short tons -- | r 22,363 | r 17,009 | 20,167 | 21,415 |
| Stone [3] ---------- do ---- | 53,093 | 81,621 | 61,735 | 103,595 |
| Value of items that cannot be disclosed: Clay (kaolin, 1972), kyanite, magnesium compounds, natural gas liquids, phosphate rock, rare-earth metal concentrates, staurolite, stone (shell), titanium concentrates, zircon concentrates, and values indicated by symbol W ---------- | XX | r 242,136 | XX | 214,907 |
| Total ---------- | XX | r 426,632 | XX | 601,100 |
| Total 1967 constant dollars -------- | XX | 352,014 | XX | p 441,328 |

p Preliminary. r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes kaolin; included with "Value of items that cannot be disclosed."
[3] Excludes shell; included with "Value of items that cannot be disclosed."

## Table 2.—Value of mineral production in Florida, by county [1 2]

(Thousands)

| County | 1972 | 1973 | Minerals produced in 1973 in order of value |
|---|---|---|---|
| Alachua ---------- | $1,741 | $1,971 | Stone. |
| Bay ---------- | W | W | Sand and gravel. |
| Bradford ---------- | W | W | Natural gas liquids. |
| Brevard ---------- | W | 392 | Stone, sand and gravel. |
| Broward ---------- | 18,226 | 20,346 | Stone, sand and gravel. |
| Calhoun ---------- | W | W | Sand and gravel. |
| Charlotte ---------- | W | W | Do. |
| Citrus ---------- | W | W | Stone, clays, phosphate rock. |
| Clay ---------- | W | W | Titanium concentrates, zircon, staurolite, clays, rare-earth metal concentrates, kyanite. |
| Collier ---------- | 5,548 | 8,762 | Stone, petroleum, natural gas. |
| Dade ---------- | r 69,966 | 88,330 | Cement, stone, sand and gravel. |
| Escambia ---------- | 9,079 | 30,735 | Petroleum, natural gas, sand and gravel, clays. |
| Franklin ---------- | 3 | W | Peat, sand and gravel. |
| Gadsden ---------- | 9,563 | W | Clays, sand and gravel. |
| Gilchrist ---------- | W | W | Phosphate rock. |
| Gulf ---------- | W | W | Magnesium compounds, lime. |
| Hamilton ---------- | W | W | Phosphate rock. |
| Hendry ---------- | W | 18,978 | Petroleum, sand and gravel, natural gas. |
| Hernando ---------- | W | W | Stone, lime, phosphate rock. |
| Hillsborough -------- | W | W | Cement, sand and gravel, peat. |
| Indian River -------- | W | -- | |
| Jackson ---------- | W | W | Stone, sand and gravel. |
| Lake ---------- | 1,767 | 2,160 | Sand and gravel. |
| Lee ---------- | W | 3,879 | Stone, petroleum, natural gas. |
| Leon ---------- | W | W | Sand and gravel. |
| Levy ---------- | W | W | Stone. |
| Manatee ---------- | -- | 59 | Do. |
| Marion ---------- | 3,205 | 4,306 | Stone, clays, sand and gravel, phosphate rock. |
| Monroe ---------- | W | 1,336 | Stone. |

See footnotes at end of table.

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

(Thousands)

| County | 1972 | 1973 | Minerals produced in 1973 in order of value |
|---|---|---|---|
| Okaloosa | W | W | Sand and gravel. |
| Orange | W | W | Peat. |
| Palm Beach | W | $326 | Stone. |
| Pasco | -- | 420 | Do. |
| Pinellas | W | W | Stone, sand and gravel. |
| Polk | $155,238 | 175,605 | Phosphate rock, sand and gravel, stone, peat. |
| Putnam | 1,571 | W | Sand and gravel, clays, peat. |
| St. Lucie | W | W | Sand and gravel. |
| Santa Rosa | 35,625 | 110,404 | Petroleum, natural gas. |
| Sarasota | W | -- | |
| Sumter | 7,135 | W | Stone, lime, peat. |
| Suwannee | W | W | Stone. |
| Taylor | W | W | Do. |
| Walton | W | W | Sand and gravel. |
| Washington | -- | W | Do. |
| Undistributed [3] | r 107,963 | 133,092 | |
| Total [4] | r 426,632 | 601,100 | |

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Baker, Columbia, De Soto, Dixie, Duval, Flagler, Glades, Hardee, Highlands, Holmes, Jefferson, Lafayette, Liberty, Madison, Martin, Nassau, Okeechobee, Osceola, St. Johns, Seminole, Union, Volusia, and Wakulla.

[2] Values of petroleum are based on an average price per barrel for the State.

[3] Includes value of counties indicated by symbol W.

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

## Table 3.—Indicators of Florida business activity

| | 1972 | 1973 p | Change, percent |
|---|---|---|---|
| Employment and labor force, annual average: | | | |
| Total nonagricultural employment ---- thousands -- | 2,474.6 | 2,708.2 | +9.4 |
| Manufacturing ---- do ---- | 344.0 | 372.5 | +8.3 |
| Mining ---- do ---- | 9.1 | 8.9 | −2.2 |
| Contract construction ---- do ---- | 221.0 | 265.7 | +20.2 |
| Other nonagricultural employment [1] ---- do ---- | 1,900.5 | 2,061.1 | +8.5 |
| Personal income: | | | |
| Total ---- millions -- | $31,779 | $35,680 | +12.3 |
| Per capita | $4,378 | $4,647 | +6.1 |
| Construction activity: | | | |
| Housing units authorized | 283,900 | 277,254 | −2.3 |
| Value of nonresidential construction ---- millions -- | $1,237.9 | $1,421.5 | +14.8 |
| Highway construction contract awards ---- do ---- | r $210.0 | $366.3 | +74.4 |
| Farm marketing receipts ---- do ---- | $1,590.1 | $1,936.9 | +21.8 |
| Mineral production value ---- do ---- | $426.6 | $601.1 | +40.9 |
| Export trade ---- do ---- | $1,390.4 | $1,775.3 | +27.7 |
| Import trade ---- do ---- | $1,610.1 | $1,939.7 | +20.5 |

r Estimate. p Preliminary.

[1] Includes transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; service; and government.

Sources: Survey of Current Business; Employment and Earnings; Farm Income Situation; Construction Review; Area Trends in Employment and Unemployment; Roads and Streets; Highlights of U.S. Export and Import Trade; and U.S. Bureau of Mines.

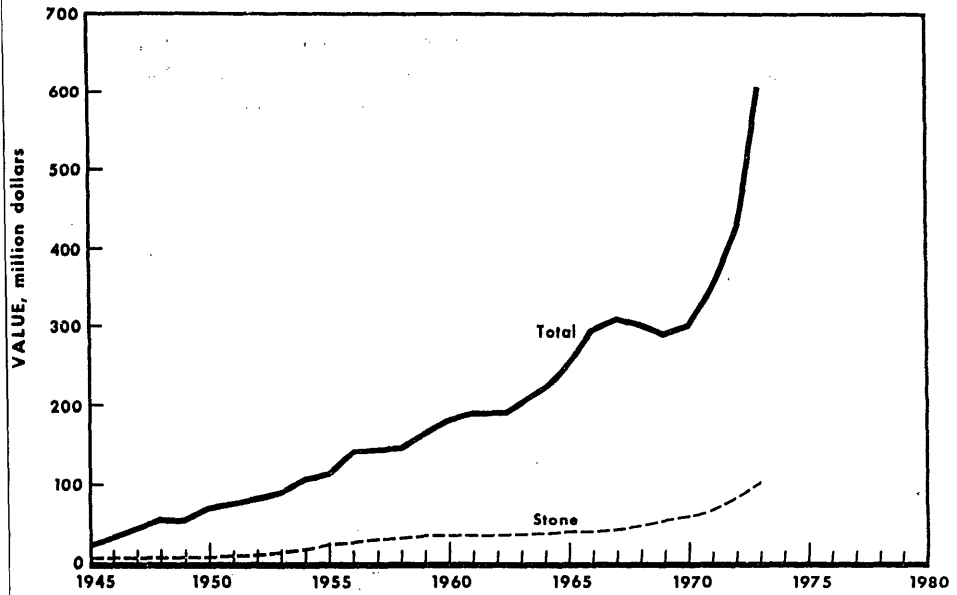


**Figure 1.—Value of phosphate rock, stone, and total value of mineral production in Florida.**

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

Nonmetals represented 70%, fuels 28%, and metals 2% of the total value of the State's mineral production in 1973. The principal nonmetals produced were, in decreasing order of value, phosphate rock, stone, cement, sand and gravel, and clays.

**Cement.**—Although shipments of both portland and masonry cement significantly increased over 1972 levels, 12% and 20% respectively, the supply was insufficient to meet the demand. Portland cement shipments were 2.7 million short tons, and masonry cement shipments were 256,000 short tons. The value of portland and masonry cement shipments was $72.7 million and $8.7 million respectively. The gains in values were 22% for portland cement and 26% for masonry cement compared with values reported in 1972.

The number of cement plants in Florida has remained constant since 1966. The expansion of existing plants has accounted for the annual increases in production. The consumption pattern of portland cement in the State was 66% to ready-mix concrete companies, 8% to building material dealers, 15% to concrete product manufacturers, and 11% for miscellaneous applications.

Maule Industries, Inc., Miami, is expanding its cement mill capacity from 0.43 to 1.2 million tons per year. The new capacity is expected to become available in May 1974. Plans to increase the mill's capacity to 2.1 million tons per year were authorized. The scheduled completion date was the end of 1975.[3]

Florida Mining and Materials Corp., Tampa, announced construction of a 0.56-million-ton-per-year cement plant in Brookville. The plant is scheduled to go onstream in the fourth quarter of 1975.[4]

**Clays.**—Total clay production and value increased from 1972 levels by 24% and 33% respectively.

Fuller's earth production increased 19% and its value increased 24% above those of 1972. Florida's fuller's earth production ranked second highest in the Nation. Three mines were operating in Gadsden County, and one operated in Marion County. Full-

[3] Pit & Quarry. Maule To Expand Florida Aggregate Plant Cement Mill. V. 65, No. 10, April 1973, p. 19.
[4] Rock Products. V. 77, No. 3, March 1974, p. 108.

er's earth was used for fillers, absorbers, pesticides, drilling mud, filter aids, and other purposes.

Kaolin production increased 3% and its value increased 7%. Kaolin was produced from one mine in Putnam County. It was principally used for manufacturing china and dinnerware.

Production of common clay used to manufacture cement, lightweight aggregate, and building brick increased 22% in quantity, and 48% in value. Four mines in Citrus, Clay, Escambia, and Gadsden Counties operated in 1973.

**Gypsum.**—Crude gypsum was imported from mines in Nova Scotia, Canada, and processed into various building products at two plants in Duval County and one plant in Hillsborough County. U.S. Gypsum Co., National Gypsum Co., and Kaiser Cement & Gypsum Corp. calcined crude gypsum in kettles, a rotary kiln, and a Holoflite unit. A total of 642,000 short tons of calcined gypsum was produced, an increase of 8% over 1972 production. The value of the production increased 17% over that of 1972 to $8.2 million.

**Kyanite.**—E. I. du Pont de Nemours & Co. recovered a small quantity of a kyanite-sillimanite mixture from a beach sand deposit in Clay County. It is a byproduct of a titanium mineral recovery operation. Both producton and value decreased 76% from 1972 levels. The kyanite-sillimanite mixture was sold to refractory manufacturers.

**Lime.**—Quicklime and lime hydrate were produced by Basic Magnesia, Inc., Gulf County; Chemical Lime, Inc., Hernando County; and Dixie Lime & Stone Co., Sumter County. The total sold or used was 186,769 short tons and was valued at $4 million. Compared with those of 1972, quantity and value increased 3.9% and 14.1% respectively. The lime was consumed in pulp and paper industries, in the recovery of magnesia from seawater, in construction, and in waste neutralization, water treatment, and other chemical processes. Lime consumption exceeded the production in the State.

**Magnesia.**—Basic Magnesia, Inc., Port St. Joe, Gulf County, produced caustic-calcined magnesia and refractory-grade magnesia from seawater. Production was less than the plant's design capacity of 60,000 short tons per year. Shipments increased 8.5% and the value increased 22.3% compared with 1972 shipments and values.

**Perlite.**—Four companies produced expanded perlite from ore mined in Colorado and New Mexico. Production increased to 23,378 short tons in 1973 from 19,124 short tons in 1972. The quantity sold or used was 22,613 short tons, an increase of 24% over that of 1972. The value of the quantity sold or used was $1,287,000, an increase of 29% over the comparable value in 1972. Production from plants in Broward, Duval, Escambia, and Indian River Counties was used in plaster aggregate, concrete aggregate, formed products, horticultural aggregate, and miscellaneous filter aids and fillers.

**Phosphate Rock.**—Because Texasgulf, Inc., was the only phosphate rock producing company in North Carolina and it was necessary to conceal that company's production data, North Carolina and Florida statistics were combined. Combined production was 34.4 million short tons, an increase of 0.9% over that of 1972. The value of the marketable rock increased to $192 million, 10% greater than the 1972 value. Florida and North Carolina produced 81.7% of the total production in the United States.

The quantity of marketable rock sold or used from Florida and North Carolina was similar to that of 1972, 36.9 million short tons; however, its value was $205 million, an increase of 9% over that of 1972. With sales and consumption continuing to exceed production, stocks declined from 10.5 to 8.5 million short tons during the year.

Of the total sold or used, 63% was used to produce fertilizer and 36% was exported. The minor balance was used in industrial applications and as animal feed supplements. The distribution pattern of this fraction was 0.2% for elemental phosphorus and 1.2% for defluorinated rock and other miscellaneous applications.

Most of the 13,173,000 short tons of marketable phosphate rock exported from Florida and North Carolina was from Florida. Exports declined 3% from 1972 levels.

The percent distribution by grade of

marketable rock sold or used from Florida and North Carolina was as follows:

| *Grade, percent* BPL [1] | *Percent distribution* |
|---|---|
| Less than 60 | 0.3 |
| 60 to 66 | 9.7 |
| 66 to 70 | 45.9 |
| 70 to 72 | 14.1 |
| 72 to 74 | 18.5 |
| Over 74 | 11.5 |

[1] 1.0 BPL (bone phosphate of lime or tricalcium phosphate) = 0.458% $P_2O_5$.

The average grade of phosphate ore mined was 12.8% $P_2O_5$ and the average grade of marketable rock was 31.9% $P_2O_5$. These are less than the reported 1972 average ore grade of 13.9% $P_2O_5$ and the average marketable rock grade of 32.2% $P_2O_5$ and reflect the continuing trend in the reduction of matrix grade and the difficulty of maintaining an acceptable product grade. The average weight recovery of concentrate was 27% compared with 29.1% in 1972, and the average $P_2O_5$ recovery was 67.4%, about the same as reported in 1972. Production capacity of Florida and North Carolina phosphate mines was limited in 1973 to less than 34.5 million short tons of marketable rock. This capacity is considerably less than that estimated in prior years. The new assessment of the industry's capacity recognizes closing of older plants, power interruptions, lower grade ores, and plant breakdowns.

Soft phosphate rock was produced by four companies operating six open pit mines in four Florida counties. Total soft rock sold or used was 22,028 short tons, equivalent to 4,426 short tons $P_2O_5$ and was valued at $154,828. It was sold for direct application to soil and for animal feed supplements.

Marketable rock was produced from Florida land-pebble phosphate mines by Agrico Chemical Co., Borden, Inc., Brewster Phosphates, Gardinier, Inc., W. R. Grace & Co., International Minerals & Chemical Corp., Mobil Oil Corp., Poseidon Mines, Inc., P.S.A. Enterprises, Occidental Petroleum Corp., U.S.S. Agri-Chemicals, Inc., and Swift Chemical Co.

Agrico Chemical Co., a subsidiary of the Williams Co. of Tulsa, Okla., awarded contracts for an 80-ton-per-hour granular triple superphosphate plant and a 1,800-ton-per-day sulfuric acid complex at South Pierce, Fla. In addition, contracts were awarded for a 200,000-ton-per-year $P_2O_5$ phosphoric acid plant and a 100-ton-per-hour single-train diammonium phosphate plant at Faustina, La., that will use Florida rock. Plans were advanced to design and construct the Fort Green mine in Polk County to produce 3.5 million short tons per year of marketable phosphate rock.

Beker Industries Corp., Greenwich, Conn., signed options to purchase 8,000 acres of phosphate reserves from PPG Industries, Inc., Pittsburgh, Pa. From these reserves, located in eastern Manatee County, Beker plans to produce 3 million tons per year of marketable phosphate rock to supply fertilizer plants in Illinois and Louisiana.

Conserve, Inc., Nichols, Fla., started operating the modernized fertilizer plant at this location and produced the first monoammonium phosphate in commercial quantities in the United States.

CF Industries completed and dedicated a new phosphate fertilizer terminal on Tampa Bay. The terminal has the capability of handling 500,000 tons per year. Vessels and barges loaded on Tampa Bay can distribute fertilizer to farm cooperatives in the Midwest and Canada. CF Industries is constructing an 800-ton-per-day $P_2O_5$ wet-process phosphoric acid plant in Plant City, Fla. Completion is scheduled for 1974.

The Cities Service Co. sold its Tampa Agricultural Chemical Operations to Société des Participation Gardinier of Paris, France. The new name will be Gardinier, Inc.–U.S. Phosphoric Products.[5]

W. R. Grace & Co. announced plans to expand its chemical plant at Bartow, Fla., with a 250,000-ton-per-year phosphoric acid plant and a 700,000-ton-per-year sulfuric acid plant. A 60-cubic-yard dragline was ordered for Hooker's Prairie mine, planned for Polk County in 1977.[6]

International Minerals & Chemical Corp. started construction on a 600,000-ton-per-year $P_2O_5$ fertilizer plant near Bartow, Fla. Mining rights to 20 million tons of Florida phosphate rock reserves were acquired in 1973.[7] The screening plant at the Phosphoria mine is scheduled to start in 1974. Deslimed ore will be pumped 6 miles to the Noralyn recovery plant.

Occidental Petroleum Corp. purchased 24,000 acres of phosphate reserves from

[5] Phos Pholks. V. 9, No. 1, February 1973.
[6] Engineering and Mining Journal. V. 147, No. 5, June 1973.
[7] Industrial Minerals, No. 69, June 1973, p. 41.

Owens-Illinois Corp. and Monsanto Co. Occidental estimated that 23 million short tons of marketable phosphate rock could be recovered from this reserve, located near the Suwannee River phosphate mine and chemical complex.[8] A 45-cubic-yard dragline was assembled and will be used to increase mining capability. The washing plant expansion will increase capacity to 3.5 million short tons per year of marketable phosphate rock. The Suwanee River complex will increase phosphoric acid capacity by 350,000 tons of $P_2O_5$ per year, and diammonium phosphate capacity will be increased by 350,000 tons per year. A new but unspecified amount of sulfuric acid capacity will be added to furnish sufficient acid for rock digestion.

**Sand and Gravel.**—Sand and gravel production totaled 20.2 million tons valued at $21.4 million. Production decreased 10% from that of 1972 because of reduced output of fill sand. The value increased 26% over that of 1972. The distribution pattern of sand and gravel in commercial operations was building sand 51%, fill sand 31%, paving sand 11%, and other sand and gravel uses 7%.

**Stone.**—Crushed limestone and dolomite were produced from 89 quarries in 18 counties in 1973, compared with production from 75 quarries in 16 counties in 1972. Production increased from 53.1 million tons in 1972 to 61.7 million tons in 1973. The value increased correspondingly from $81.6 million to $103.6 million. Dade, Hernando, and Broward Counties, in that order, were the principal producing counties in the State, supplying 71% of the total production and accounting for 72% of the total value. Sixteen companies produced 76% of the total tonnage and generated 77% of the total value. This production was from 37 of the State's 91 operating quarries. Eighty-five percent of the stone was hauled by truck, 12% was moved by rail, and the remaining 3% was unspecified. One company processed oystershells for roadbase material. Of the total crushed limestone and dolomite sold or used by producers, 78% was used for concrete aggregate, dense graded roadbed stone, construction aggregate, and roadstone.

[8] The Tampa Tribune. Aug. 1, 1973.

**Table 4.—Florida: Sand and gravel sold or used by producers, by county**
(Thousand short tons and thousand dollars)

| County | 1972 | | | 1973 | | |
|---|---|---|---|---|---|---|
| | Number of mines | Quantity | Value | Number of mines | Quantity | Value |
| Brevard | 1 | W | W | 1 | 57 | 165 |
| Broward | 3 | 760 | W | 3 | 1,480 | 1,455 |
| Dade | 6 | W | W | 5 | 2,541 | 3,889 |
| Escambia | 8 | 978 | 622 | 5 | 506 | 688 |
| Hendry | 2 | W | W | 1 | 1,529 | 1,816 |
| Hillsborough | 1 | W | W | 1 | 268 | W |
| Lake | 5 | 1,852 | 1,767 | 4 | 2,137 | 2,160 |
| Polk | 8 | 3,760 | 4,645 | 8 | 4,371 | 5,567 |
| Santa Rosa | 1 | 3 | (1) | — | — | — |
| Undistributed[2] | r 25 | r 15,009 | r 9,974 | 23 | 7,335 | 6,175 |
| Total[3] | r 60 | r 22,363 | r 17,009 | 51 | 20,167 | 21,415 |

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Less than ½ unit.
[2] Includes Bay, Calhoun, Charlotte, Franklin, Gadsden, Indian River (1972), Jackson, Leon, Marion, Okaloosa, Pinellas, Putnam, St. Lucie, Sarasota (1972), Walton, and Washington Counties (1973).
[3] Data may not add to totals shown because of independent rounding.

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

(Thousand short tons and thousand dollars)

| Class of operation and use | 1972 Quantity | 1972 Value | 1973 Quantity | 1973 Value |
|---|---|---|---|---|
| Commercial operations: Sand: | | | | |
| Building | r 7,446 | r 7,601 | 10,299 | 11,522 |
| Paving | r 4,344 | r 4,556 | 2,246 | 2,758 |
| Fill | W | W | 6,183 | 3,128 |
| Other sand and gravel [1] | r 10,573 | r 4,851 | 1,439 | 4,007 |
| Total [2] | r 22,363 | r 17,009 | 20,167 | 21,415 |

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Other sand and gravel."
[1] Includes glass, blast, engine, filtration, filler (1973), and other sands; building gravel, paving gravel, fill gravel (1973), and railroad ballast (1973).
[2] Data may not add to totals shown because of independent rounding.

## Table 6.—Florida: Crushed limestone and dolomite sold or used by producers, by county

(Thousand short tons and thousand dollars)

| County | 1972 Number of quarries | 1972 Quantity | 1972 Value | 1973 Number of quarries | 1973 Quantity | 1973 Value |
|---|---|---|---|---|---|---|
| Alachua | 4 | 2,166 | 1,741 | 4 | 2,438 | 1,971 |
| Brevard | 1 | 185 | 192 | 1 | 196 | 227 |
| Broward | 19 | 9,278 | 14,613 | 17 | 10,271 | 18,891 |
| Citrus | 4 | W | 1,039 | 5 | 1,072 | 1,593 |
| Collier | 4 | 1,766 | W | 9 | 2,705 | 5,473 |
| Dade | 15 | 21,100 | 26,752 | 19 | 23,185 | 33,478 |
| Hernando | 5 | 8,617 | 17,186 | 5 | 10,399 | 21,853 |
| Levy | 3 | 415 | W | 3 | 304 | W |
| Marion | 5 | 1,099 | 2,486 | 6 | 1,543 | 3,032 |
| Monroe | 1 | W | W | 1 | 625 | 1,336 |
| Palm Beach | 3 | W | W | 3 | 313 | 326 |
| Pasco | -- | -- | -- | 1 | 300 | 420 |
| Polk | -- | -- | -- | 1 | 127 | 145 |
| Sumter | 3 | 4,693 | W | 4 | 5,274 | W |
| Undistributed [1] | 8 | 3,773 | 17,611 | 10 | 2,982 | 14,792 |
| Total [2] | 75 | 53,093 | 81,621 | 83 | 61,734 | 103,536 |

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes Jackson, Lee, Suwannee and Taylor Counties.
[2] Data may not add to totals shown because of independent rounding.

## Table 7.—Florida: Crushed limestone and dolomite sold or used by producers, by use

(Thousand short tons and thousand dollars)

| Use | 1972 Quantity | 1972 Value | 1973 Quantity | 1973 Value |
|---|---|---|---|---|
| Bituminous aggregate | 3,843 | 6,488 | 2,671 | 4,424 |
| Concrete aggregate | 16,573 | 28,042 | 20,067 | 40,176 |
| Dense graded roadbase stone | 17,270 | 24,678 | 22,930 | 34,139 |
| Macadam aggregate | 348 | 492 | 1,446 | 2,612 |
| Surface treatment aggregate | W | W | 828 | 1,392 |
| Unspecified construction aggregate and roadstone | 4,324 | 4,249 | 5,399 | 4,877 |
| Agricultural purposes [1] | 1,034 | 4,273 | 1,425 | 4,326 |
| Cement manufacture | W | W | 1,775 | 2,271 |
| Fill | 3,029 | 3,219 | 1,020 | 1,476 |
| Manufactured fine aggregate (stone sand) | 2,335 | 3,100 | 2,210 | 3,297 |
| Railroad ballast | 361 | 633 | 295 | 566 |
| Other uses [2] | 3,977 | 6,448 | 1,668 | 3,980 |
| Total [3] | 53,093 | 81,621 | 61,734 | 103,536 |

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Data include agricultural limestone and stone used in poultry grit and mineral food.
[2] Data include stone used in other fillers, lime manufacture, rip rap and jetty stone and uses not specified. 1973 data also include stone used in drain fields.
[3] Data may not add to totals shown because of independent rounding.

**Staurolite.**—This complex iron and aluminum silicate mineral was recovered as a byproduct from the heavy minerals separation plants of E. I. du Pont de Nemours & Co. at its Highland and Trail Ridge plants. Florida was the only State that produced commercial quantities of staurolite. It was principally used in sand blasting equipment. Production increased 22% and its value increased 37%, compared with respective production and value in 1972.

**Sulfur.**—Recovered sulfur from oil and natural gas production in Escambia and Santa Rosa Counties increased from 87,842 long tons in 1972 to 224,416 long tons in 1973. Sulfur sales increased from 85,915 long tons in 1972 to 225,407 long tons with a reported value of $3.5 million. As oil and gas production increase, byproduct sulfur is expected to proportionately increase in Florida.

**Vermiculite.**—Exfoliated vermiculite was produced at four plants in Broward, Duval, and Hillsborough Counties. Production, the quantity sold or used, and the value of sales increased over those of 1972 by 28%, 68%, and 72% respectively.

## METALS

**Ferroalloys.**—Two companies produced ferrophosphorus as a coproduct with elemental phosphorus from electric furnace smelting of phosphate rock in Florida. The value of ferroalloys is not included in the State mineral production statistics.

**Rare Earth Minerals.**—Production of monazite concentrate from the Green Cove Springs plant of Titanium Enterprises increased 330% over that of 1972. The value increased 336%. The monazite concentrate contains rare-earth metals and thorium oxide. Production and value cannot be published.

**Titanium Concentrates.**—Both E. I. du Pont de Nemours & Co. and Titanium Enterprises produced ilmenite concentrate from plants in Clay County. Shipments declined 2% and value increased 2% over that of 1972. Titanium Enterprises increased the production and value of rutile 151% and 145% respectively, compared with 1972 levels, from the Green Cove Springs mine in Clay County.

**Zircon Concentrates.**—Production of zircon concentrates from the E. I. du Pont de Nemours & Co. Trail Ridge plant, and Titanium Enterprises Green Cove Springs mine in Clay County increased 29% over that of 1972. The value was 37% higher than that reported in 1972. The zirconium sands were used in ferrous foundries, refractory shapes, and ceramics.

## MINERAL FUELS

Mineral fuels produced were natural gas, natural gas liquids, crude petroleum, and peat.

**Natural Gas.**—Total net sales of natural gas in Florida in 1973 was about 27 billion cubic feet. The difference between the total net sales volume and the 34 billion cubic feet measured at the wellhead was a 12.3% $H_2S$, $CO_2$, and $N_2$ content, plus plant losses and inplant consumption for combustion purposes. All of the gas sold was from the Jay field, except a small quantity that was produced from the nearby Mt. Carmel field. The Florida Gas Transmission Pipeline Co. marketed over 90% of the sales volume for intrastate consumption. The remainder was sold through Five Flags Pipeline Co. to industrial customers in the Pensacola area.

Prior to distribution by the Florida Gas Transmission Pipeline Co., the gas was stripped of natural gas liquids at its processing plant in north-central Florida. The Btu value of the gas was reduced from 1,450 to 1,040 Btu per cubic foot before distribution through the intrastate pipeline.

**Peat.**—Peat production decreased from 45,000 short tons valued at $362,000 in 1972 to 43,800 short tons valued at $384,000 in 1973. The 3% decrease in production was accompanied by a 6% increase in value. Eight companies produced moss, reed-sedge, and humus peat. Shipments totaled 44,000 short tons and consisted of 38% moss, 20% reed-sedge, and 42% humus peat. All but a few tons were shipped in bulk and used to pack flowers, plants, and shrubs; for general soil improvement and potting soils; and for earthworm culture.

**Petroleum.**—Total oil production in Florida was nearly 33 million barrels in 1973. This was almost double the 17 million barrels produced in 1972. The increase was primarily attributed to further development of the Jay field. The Jay field yielded 85.3% of the total crude oil production in the State. The wellhead value of northwest Florida high-grade crude ranged from $3.64 per barrel in January 1973 to $10.06 per barrel in December 1973. The yearly

average value was approximately $5.88 per barrel. Northwest Florida's oil production was primarily derived from the Smackover Limestone Formation. Additional production from the Blackjack Creek field, some 10 miles from Jay, is scheduled. A 12,000-barrel-per-day facility was being readied to be operational by the end of 1974. The field life was estimated to be 20 years.

Crude petroleum production from south Florida was derived entirely from the Lower Cretaceous Sunniland Limestone Formation. The average depth of a development well in the Sunniland trend is about 11,500 feet. There are 66 producing wells in 7 fields in this trend. A new field in Hendry County, not named, was brought in by Weiner Oil Properties in November 1973. No other discoveries were made in 1973.

Approximately 4.6 million barrels of crude oil ranging from 25 to 32 API gravity, representing 14% of Florida's total production, was produced from south Florida's fields. Wellhead prices ranged from $2.58 per barrel in January to over $8 per barrel in December 1973 for new oil.

**Table 8.—Florida: Oil and gas well drilling completions, by county**

| County | Proved field wells [1] | | | Exploratory wells | | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Oil | Gas | Dry | Oil | Gas | Dry | Number of wells | Footage |
| Bay | -- | -- | -- | -- | -- | 1 | 1 | 12,313 |
| Charlotte | -- | -- | -- | -- | -- | 1 | 1 | 11,500 |
| Collier | -- | -- | -- | 1 | -- | 7 | 8 | 96,071 |
| Columbia | -- | -- | -- | -- | -- | 2 | 2 | 6,086 |
| De Soto | -- | -- | -- | -- | -- | 1 | 1 | 13,000 |
| Escambia | 4 | -- | -- | -- | -- | 1 | 5 | 80,835 |
| Gulf | -- | -- | -- | -- | -- | 1 | 1 | 14,297 |
| Hendry | 8 | -- | 1 | -- | -- | 2 | 6 | 69,703 |
| Lake | -- | -- | -- | -- | -- | 1 | 1 | 5,778 |
| Lee | -- | -- | 3 | -- | -- | 3 | 6 | 53,286 |
| Pasco | -- | -- | -- | -- | -- | 1 | 1 | 9,600 |
| Santa Rosa | 14 | -- | 5 | 2 | -- | 9 | 30 | 485,259 |
| Union | -- | -- | -- | -- | -- | 3 | 3 | 9,111 |
| Washington | -- | -- | -- | -- | -- | 1 | 1 | 11,593 |
| Total | 21 | -- | 9 | 3 | -- | 34 | 67 | 878,432 |

[1] Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

**Table 9.—Principal producers**

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement, portland and masonry: | | | |
| General Portland, Inc., Florida Division. | 4400 Republic National Bank Tower Box 324 Dallas, Tex. 75221 | 2 plants | Dade and Hillsborough. |
| Lehigh Portland Cement Co | 718 Hamilton St. Allentown, Pa. 18105 | Plant | Dade. |
| Pennsuco Cement & Aggregates, a subsidiary of Maule Industries, Inc. | P.O. Box 2035 P V S Hialeah, Fla. 33012 | do | Do. |
| Clays: | | | |
| Fuller's earth: | | | |
| Engelhard Minerals & Chemicals Corp. | Menlo Park Edison, N. J. 08817 | Open pit mines | Gadsden. |
| Floridin Co | Box 187 Berkley Springs, W. Va. 25411 | Open pit mine | Do. |
| Mid-Florida Mining | Box 68-F Lowell, Fla. 32663 | do | Marion. |
| Kaolin: | | | |
| Edgar Plastic Kaolin Co | Edgar, Fla. 32049 | do | Putnam. |
| Miscellaneous: | | | |
| Appalachee Correctional Institute. | Box 699 Sneads, Fla. 32460 | do | Gadsden. |
| Bickerstaff Clay Products Co., Inc. | Box 1178 Columbus, Ga. 31902 | Open pit mine and plant. | Escambia. |
| Florida Solite Co | P.O. Box 27211 Richmond, Va. 23261 | Open pit mine and plant. | Clay. |

Table 9.—Principal producers—Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Clays—Continued | | | |
| Miscellaneous—Continued | | | |
| General Portland Cement Co. | Box 22348 Tampa, Fla. 33622 | Open pit mine | Citrus. |
| Gypsum, calcined: | | | |
| Kaiser Cement & Gypsum Corp | 300 Lakeside Dr. Oakland, Calif. 94612 | Plant | Duval. |
| National Gypsum Co | 325 Delaware Ave. Buffalo, N.Y. 14202 | do | Hillsborough. |
| U.S. Gypsum Co | 101 South Wacker Dr. Chicago, Ill. 60606 | do | Duval. |
| Lime: Primary: | | | |
| Basic Magnesia, Inc | Box 160 Port St. Joe, Fla. 32456 | do | Gulf. |
| Chemical Lime, Inc | Box 250 Ocala, Fla. 32670 | do | Hernando. |
| Dixie Lime & Stone Co | Drawer 217 Ocala, Fla. 32670 | do | Sumter. |
| Magnesium compounds: | | | |
| Basic Magnesia, Inc | Box 160 Port St. Joe, Fla. 32456 | do | Gulf. |
| Peat: | | | |
| Oxford Peat Co | Box 154 Oxford, Fla. 32684 | Bog | Sumter. |
| Peace River Peat, Inc | P.O. Box 1192 Bartow, Fla. 33830 | Bog | Polk. |
| F. E. Stearns Peat | Rt. 1 Box 347-I Valrico, Fla. 33594 | Bog | Hillsborough. |
| Traxler Peat Co | Box 10 Florahome, Fla. 32685 | Bog | Putnam. |
| Raymond Johnson | Box 555 Zellwood, Fla. 32798 | Bog | Orange. |
| Perlite, expanded: | | | |
| Airlite Processing Corp. of Florida. | Rt. 2 Box 740 Vero Beach, Fla. 32960 | Plant | Indian River. |
| Armstrong Cork Co | Box 1991 Pensacola, Fla. 32589 | do | Escambia. |
| Chemrock Corp | End of Osage St. Nashville, Tenn. 37208 | do | Duval. |
| W. R. Grace & Co | 62 Whittemore Ave. Cambridge, Mass. 02140 | do | Broward. |
| Petroleum: | | | |
| Exxon Co., U.S.A | Box 2024 Houston, Tex. 77001 | Jay field | Santa Rosa. |
| Sun Oil Company | Box 2880 Dallas, Tex. 75221 | Sunoco-Felda field. | Collier and Hendry. |
| Refinery: Seminole Asphalt Refining, Inc. | Box 128 St. Marks, Fla. 32355 | Plant | Wakulla. |
| Phosphate rock: | | | |
| Land pebble: | | | |
| Agrico Chemical Co | Box 3166 Tulsa, Okla. 74101 | 3 open pit mines | Polk. |
| Borden, Inc | Box 790 Plant City, Fla. 33566 | Open pit mine | Do. |
| Brewster Phosphates | Wayne, N.J. 07470 | do | Do. |
| Gardinier, Inc | Box 3269 Tampa, Fla. 33601 | do | Do. |
| W.R. Grace & Co | Box 471 Bartow, Fla. 33830 | do | Do. |
| International Minerals & Chemical Corp. | Box 867 Bartow, Fla. 33830 | 3 open pit mines | Do. |
| Mobil Oil Corp., Chemical Div. | Box 311 Nichols, Fla. 33863 | 2 open pit mines | Do. |
| Occidental Petroleum Corp., Suwannee River Phosphate Div. | White Springs, Fla. 32096 | Open pit mine | Hamilton. |
| Swift Chemical Co | Box 208 Bartow, Fla. 33830 | 2 open pit mines | Polk. |
| U.S.S. Agri-Chemicals, Inc | Box 867 Ft. Meade, Fla. 33841 | Open pit mine | Do. |
| Phosphorus, elemental: | | | |
| Mobil Chemical Co | Box 311 Nichols, Fla. 33863 | Electric furnace | Do. |

## Table 9.—Principal producers—Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Sand and gravel: | | | |
| General Development Corp | 1111 South Bayshore Dr. Miami, Fla. 33131 | 3 open pit mines | Brevard, Charlotte, St. Lucie. |
| E. R. Jahana Industries, Inc | First & East Tillman Lake Wales, Fla. 33853 | Open pit mine | Lake and Polk. |
| Ortona Sand Co | do | Dredge | Hendry. |
| Seminole Rock Products, Inc | 8100 NW. 74th St. Miami, Fla. 33166 | do | Dade. |
| Standard Sand & Silica Co | Box 35 Davenport, Fla. 33837 | Open pit mine | Polk. |
| Staurolite: E. I. du Pont de Nemours & Co. | Du Pont Bldg., D-10084 Wilmington, Del. 19898 | Plant | Clay. |
| Stone: | | | |
| Limestone, crushed: | | | |
| Florida Crushed Stone Co | P.O. Box 668 Ocala, Fla. 32670 | 2 quarries | Hernando. |
| Florida Mining and Materials Corp., Div. of Miami Stone Co. | Box 59351 Miami, Fla. 33159 | Quarry | Dade. |
| Florida Rock Industries Inc. | Box 4667 Jacksonville, Fla.32201 | 6 quarries | Collier, Hernando, Lee, Sumter, Suwannee. |
| Maule Industries, Inc | Box 2601 Hialeah, Fla. 33012 | 2 quarries | Broward and Dade. |
| Sterling Crushed Stone Co | Box 630877 OJUS Branch Miami, Fla. 33163 | do | Dade. |
| Oystershell: | | | |
| Bay Dredging & Construction Co. | Box 1484 Tampa, Fla. 33601 | Dredge | Hillsborough. |
| Benton & Company, Inc | Box 1347 St. Petersburg, Fla. 33731 | do | Pinellas. |
| Houdaille-Duval-Wright Co | Box 1588 Jacksonville, Fla. 32201 | do | Duval. |
| Radcliff Materials, Inc | Box 1288 Mobile, Ala. 36601 | do | Walton. |
| Titanium concentrates: | | | |
| E. I. du Pont de Nemours & Co | Du Pont Bldg. D-10084 Wilmington, Del. 19898 | 2 dredges and plants. | Clay. |
| Titanium Enterprises | Box 1036 Greencove Springs, Fla. 32043 | Mine and plant | Do. |
| Vermiculite, exfoliated: | | | |
| W. R. Grace & Company | 62 Whittemore Ave. Cambridge, Mass. 02140 | 3 plants | Broward, Duval, Hillsborough. |
| Zircon concentrates: | | | |
| E. I. du Pont de Nemours & Co | Du Pont Bldg. D-10084 Wilmington, Del. 19898 | Mine and plant | Clay. |
| Titanium Enterprises | Box 1036 Greencove Springs, Fla. 32043 | do | Do. |

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