FLORIDA PHOSPHATE ROCK

RESERVES - QUALITY - MINING TIME TABLE

Presentation For

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RESERVES - QUALITY - MINING TIME TABLE

INTRODUCTION

Florida Phosphate Rock Reserves

The phosphate reserves in the state of Florida, which are considered to be of present day economic significance, are located in two distinct areas within the state, as shown in Figures 1 and 2. The major area of occurrence is located in southwestern Polk, southeastern Hillsborough, DeSoto, Hardee and Manatee Counties. This area, known as the Central Florida Phosphate District, has been the dominant producing area of phosphate rock in the United States since the early 1900's with primary production developed from the Polk - Hillsborough County area. The second area of importance where mining has been in progress since the mid 1960's is what is commonly known as the North Florida Phosphate District and is located primarily in Hamilton and Columbia Counties near White Springs.

MAJOR PHOSPHATE MINING AREAS OF THE UNITED STATES

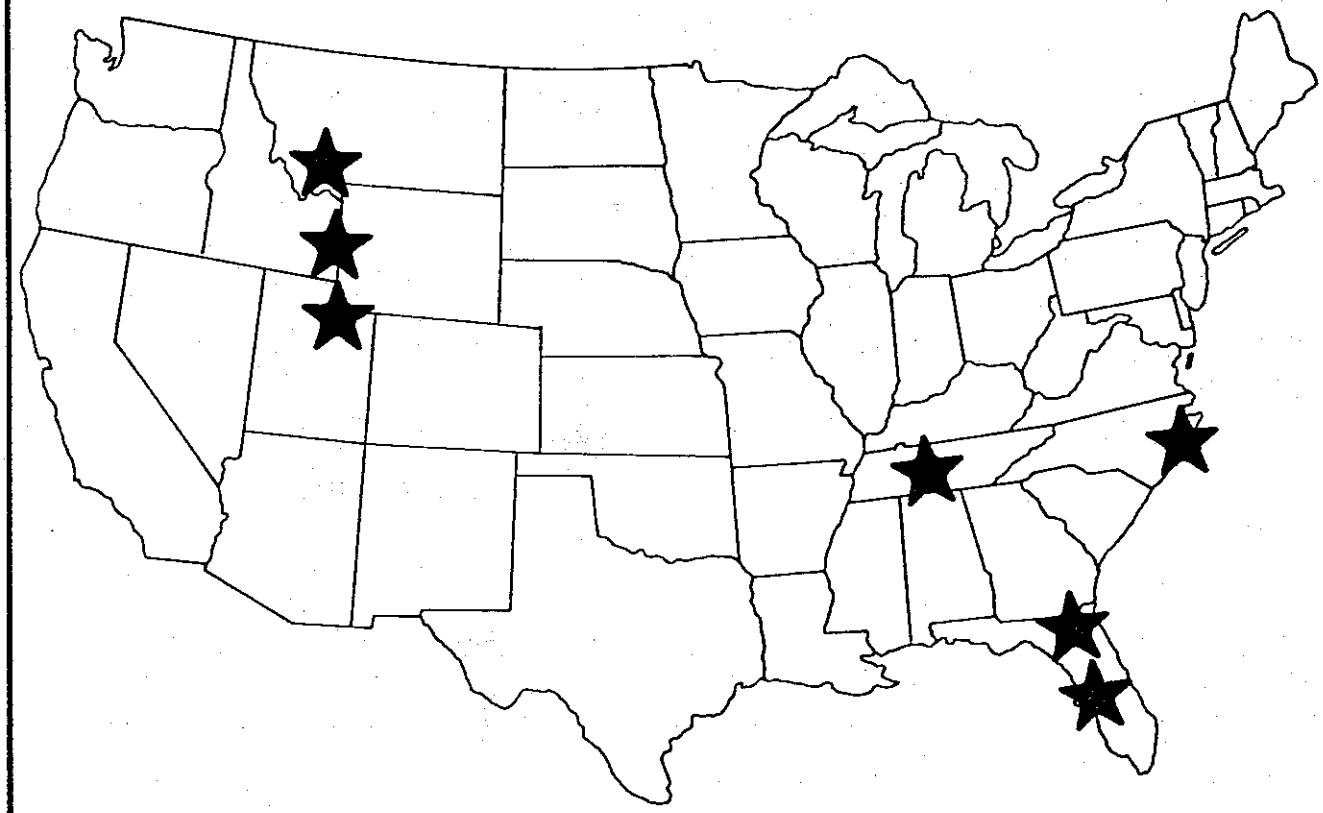


FIGURE 1

LOCATION OF THE MAJOR PHOSPHATE DEPOSITS IN THE SOUTHEASTERN UNITED STATES

FIGURE 2

These occurrences of phosphate are typically termed land pebble deposits as opposed to the hard rock deposits, which were mined at one time in Florida in the central portion of the state in and around Citrus, Marion and Levy Counties.

Future phosphate mining within the state will generally be from the land pebble deposits with perhaps some minor development in the future of the hard rock deposits previously mentioned.

Phosphate Rock Quality

The reserves currently being mined in Florida consist of a matrix composed of sand, clay and phosphate which is consolidated to semi-consolidated in nature and which is overlain by unconsolidated surficial sands of variable thickness. These deposits have been exploited on an intensive basis for the last sixty years and as is true in most mining districts, the highest quality, lowest cost reserves were initially mined. Production within the state has gradually increased throughout this time span

and as domestic and world demands for fertilizer and basic fertilizer ingredients has increased, the Florida phosphate industry has expanded to meet those needs; consequently, the majority of the higher grade reserves have now been depleted and the industry is progressively mining and producing phosphate rock from these deposits which is lower in grade and higher in some undesirable contaminating materials. The trend of quality degradation of the phosphate rock mined and processed from the state will continue throughout the life of the industry and as mining moves southward from the Polk - Hillsborough County area into reserves currently proposed for near-future and later development, quality degradation will continue.

Mining

As discussed, the industry productive capacity has increased progressively since phosphate mining began in the late 1800's and intensified in the early 1900's, at which point in time phosphate rock production from Florida began to dominate the domestic supply. Phosphate rock

production in the United States rose to 49,200,000 tons in 1976 with approximately 39,000,000 tons of this total being produced from the state of Florida.

As early as 1973, the Florida industry had begun moves to increase mining and processing capacity of phosphate rock to overcome the apparent developing deficit of supply versus demand which seemed at that time to be forthcoming. Expansions were undertaken by existing producers in the Polk - Hillsborough County area in addition to intensified exploration and development activity in DeSoto, Hardee and Manatee Counties, as well as in the North Florida District and other areas of the southeastern United States. Major expansions were completed during 1975 and 1976 by existing producers, such as Agrico Chemical Company, Brewster Phosphates, International Minerals and Chemical Corporation and W. R. Grace and Company. These expansions, coupled with reduced worldwide demand due to rock price increases and intensified foreign competition, resulted in the industry being over capacity in comparison to available sales in 1976. Of the 1976 rock production

from the state amounting to approximately 39.0 million tons, approximately 35.5 million tons were sold or used by the producers with a net estimated increase in inventory of approximately 3.5 million tons and an additional estimated 6.5 million tons of productive capacity available during the past calendar year. The net result being that the phosphate rock industry in Florida is currently capable of producing well in excess of expected sales demands for the current calendar year and for the near future without additional production coming on stream from mining projects currently under consideration or development within the state.

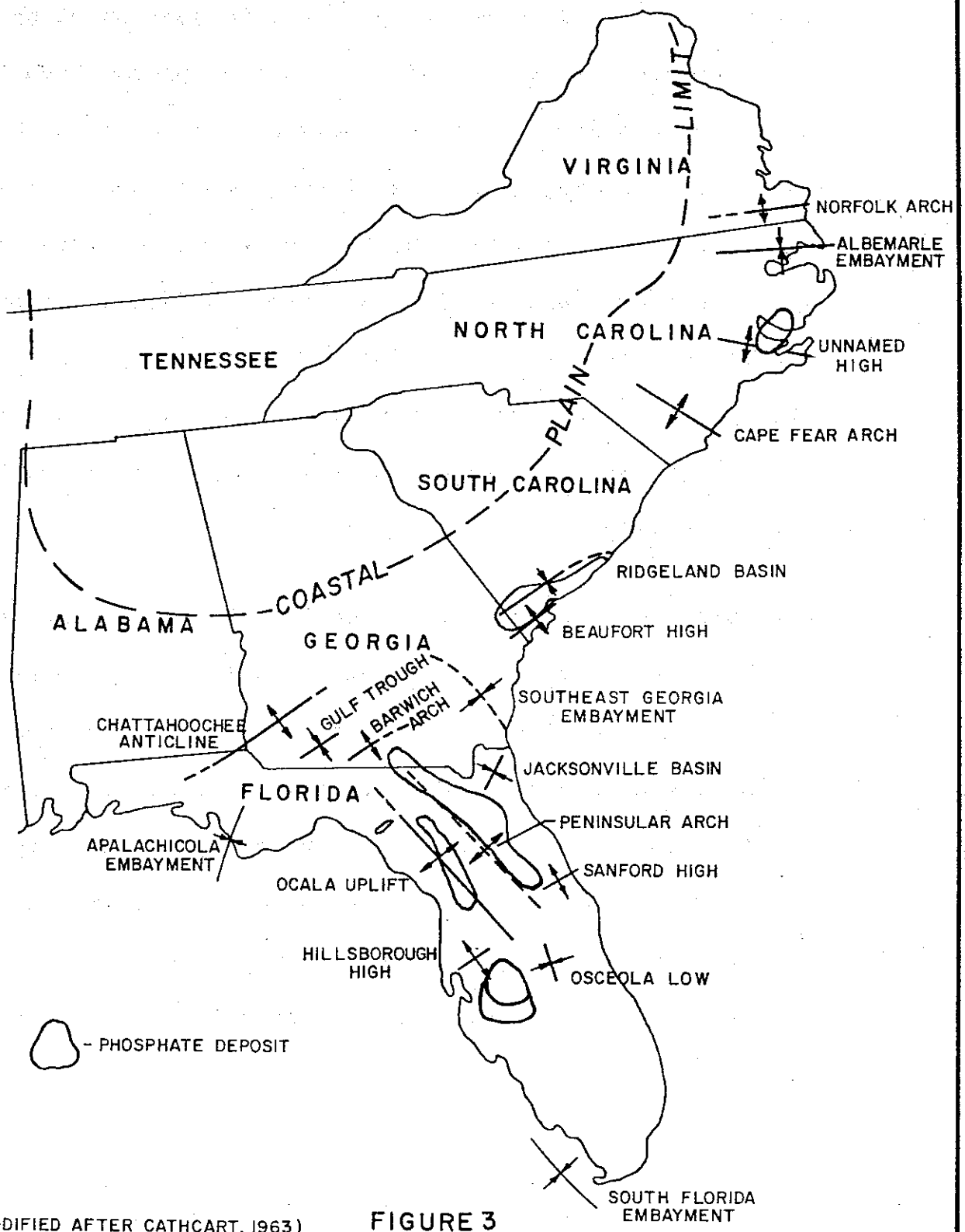
RESERVES

General Characteristics and Quality

As previously stated, the Central Florida Phosphate District is located in southwestern Polk, southeastern Hillsborough, DeSoto, Hardee and Manatee Counties. The majority of mining in the district is presently being carried out in southwestern Polk and southeastern Hillsborough Counties, which flank the southern end of the Ocala Arch, shown in Figure 3, a north-south trending anticlinal structure of probable Miocene age. Approximately 35 percent of the world production of phosphate rock is currently derived from the reserves in this district.

Here the phosphate ore body or matrix ranges in thickness from 5 to 60 feet thick and consists of several formations which are Miocene, Pliocene and Pleistocene in age. The lower geologic unit mined in the eastern part of the district is generally the upper middle Miocene Hawthorn formation, with the upper portion of the

LOCATION OF THE SOUTHEASTERN COASTAL PLAIN PHOSPHATE DEPOSITS AND VARIOUS STRUCTURAL FEATURES



(MODIFIED AFTER CATHCART, 1963)

FIGURE 3

ore body being Pliocene in age. A thin horizon of phosphate pebble occurs sporadically as the uppermost unit of the ore horizon and as channels within the unit that is mined. The major portion of the ore horizon or matrix is composed of quartz sands, kaolinite, montmorilonite, illite and attapulgite clays and about one-third to one-quarter of the horizon consists of phosphate grains in the form of a calcium fluorapatite. The phosphate particles or grains range from silt size to pebble or cobble size materials.

Overburden generally ranges from 5 to 30 feet thick, but reaches a maximum of approximately 60 feet throughout some portions of the district. The overburden is composed predominately of quartz sands with some intermittent clay lenses. The reserves which are currently mined today generally bottom out on Miocene age dolomitic limestones, dolomites or a dark gray carbonaceous dolomitic clay and these materials are collectively termed bedrock by the industry.

The phosphate reserves in central Florida are quite variable on a mine to mine basis and their characteristics are a function of original depositional environment and post-depositional weathering. As originally deposited, the majority of the reserves mined today were generally of a lower grade than the resulting products which are marketed and post-depositional weathering or leaching has upgraded the P_2O_5 content of the individual grains through the removal of more soluble components, such as calcium and magnesium, which were originally contained in them. The more highly weathered, and consequently higher grade deposits, normally occur adjacent to major surface drainage features, where both lateral and vertical migration of ground water has resulted in upgrading of the deposits.

Similar variations occur in the North Florida District which in actuality reaches up into southern Georgia, as shown in Figure 4.

For reference typical geologic cross-sections for the central and north Florida land pebble deposits are shown

PHOSPHATE DEPOSITS IN FLORIDA AND SOUTH-CENTRAL GEORGIA

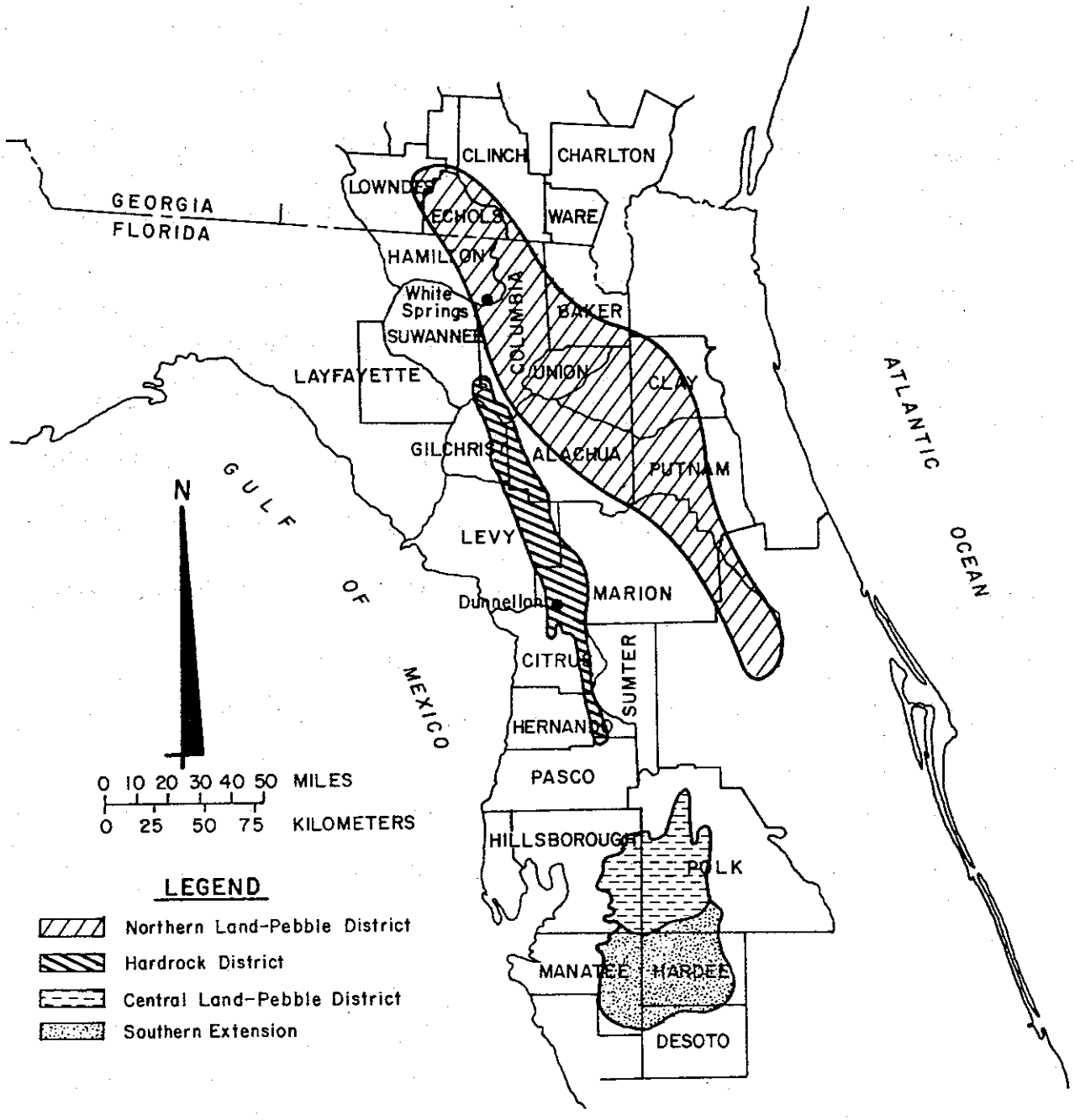


FIGURE 4

in Figures 5 and 6 and a similar section for the inactive hard rock district in Figure 7.

In the early 1940's, after the advent of phosphate flotation for the recovery of the sand sized phosphate particles, which previously had been discarded during mining and processing, producers moved into areas of high grade reserves where the sand sized particles or concentrate were predominate in the reserves. The prime contaminant, which caused a problem in the marketplace at the time the higher grade reserves were being mined, was I & A (iron and aluminum content). These components being more stable in the oxidation environment that the deposits had been subjected to are consequently higher in the high grade deposits with less problem from iron and aluminum occurring in lower grade reserves. Conversely, calcium and magnesium increase in the lower grade reserves in the producing district and in those reserves proposed for exploitation in the future which have not been subjected to as intense post-depositional weathering. The trend of calcium and magnesium contamination will be

GENERALIZED GEOLOGIC SECTION IN THE CENTRAL FLORIDA PHOSPHATE DISTRICT

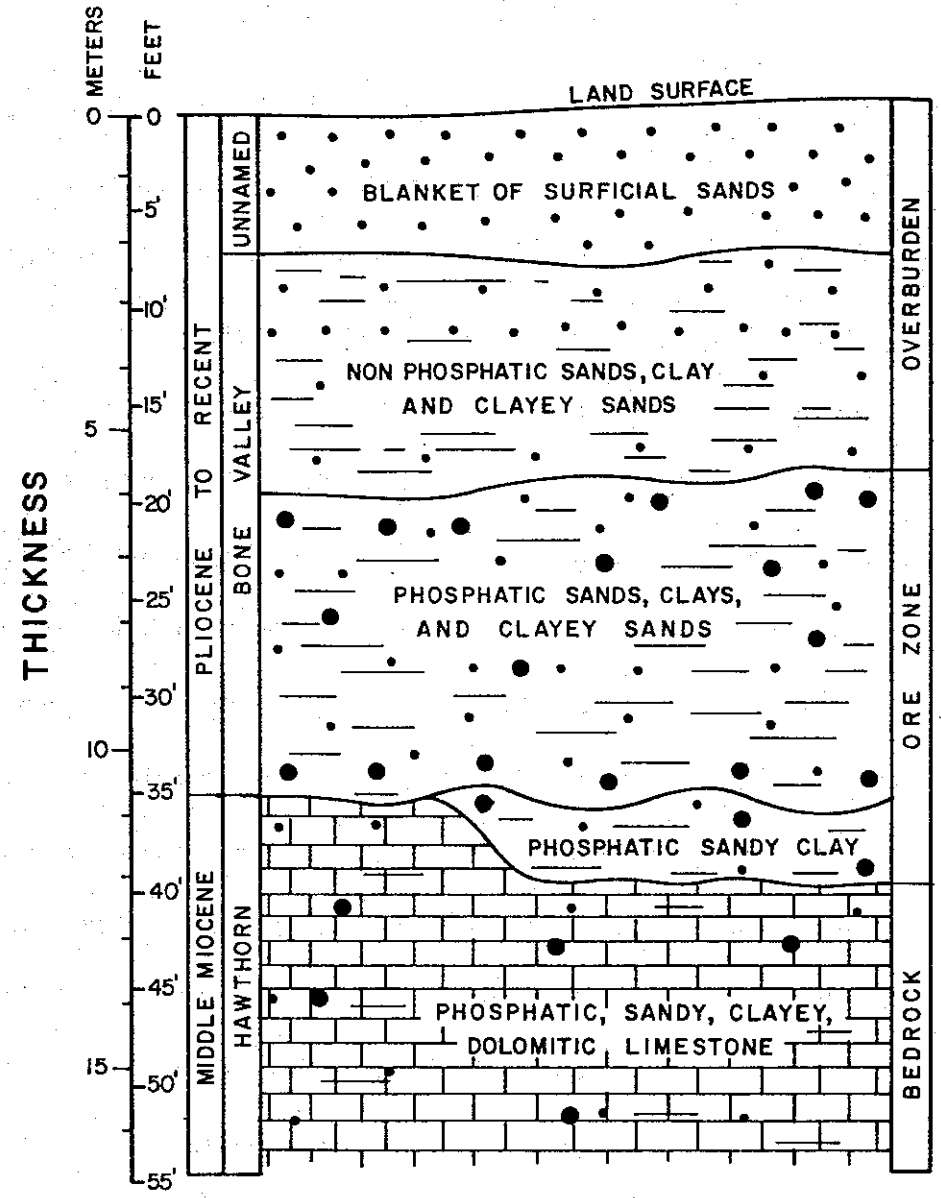


FIGURE 5

GENERALIZED GEOLOGIC SECTION IN THE SOUTH FLORIDA AND THE NORTH FLORIDA/SOUTH CENTRAL GEORGIA AREAS

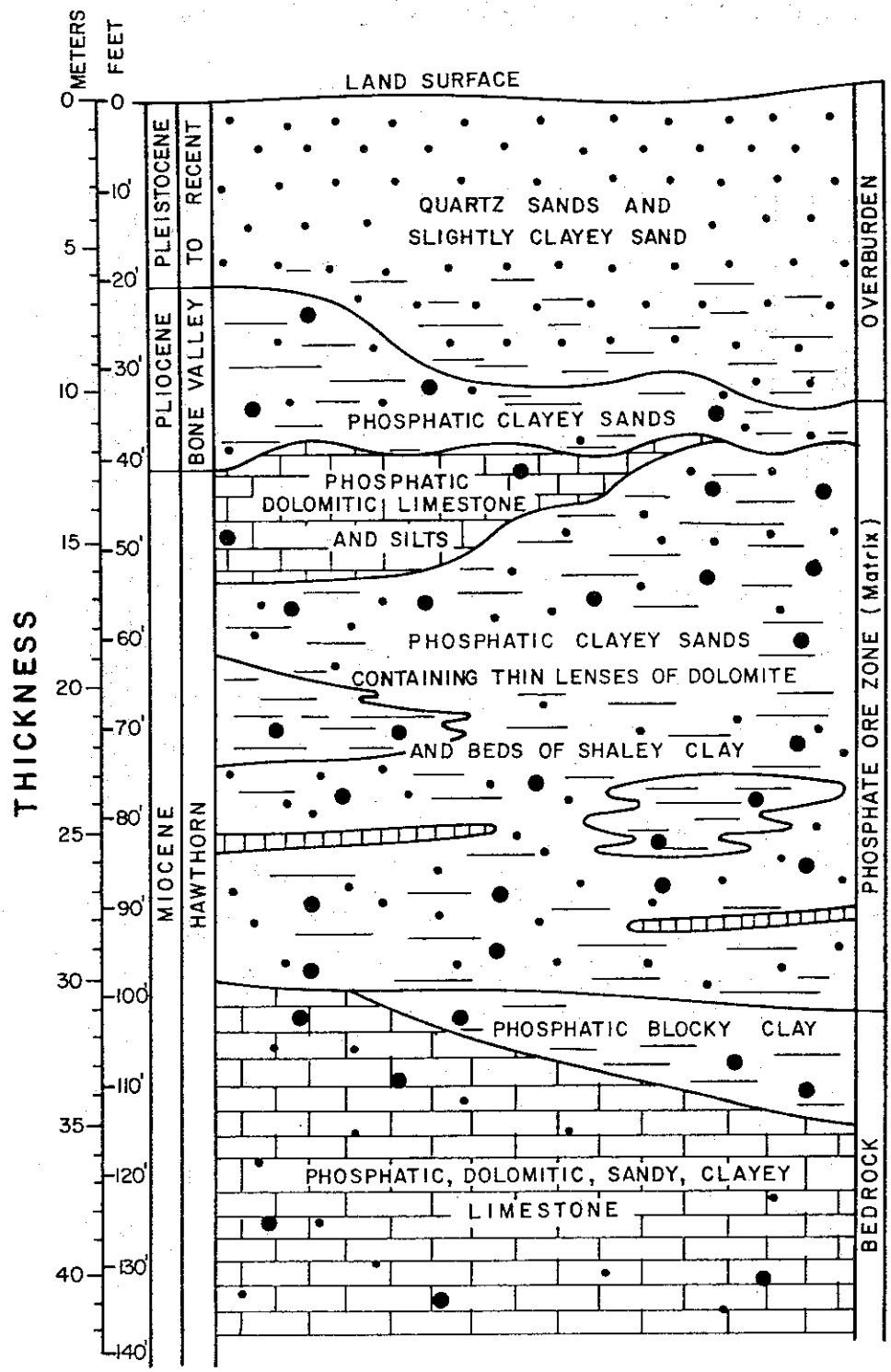


FIGURE 6

GENERALIZED GEOLOGIC SECTION
HARD ROCK PHOSPHATE DISTRICT

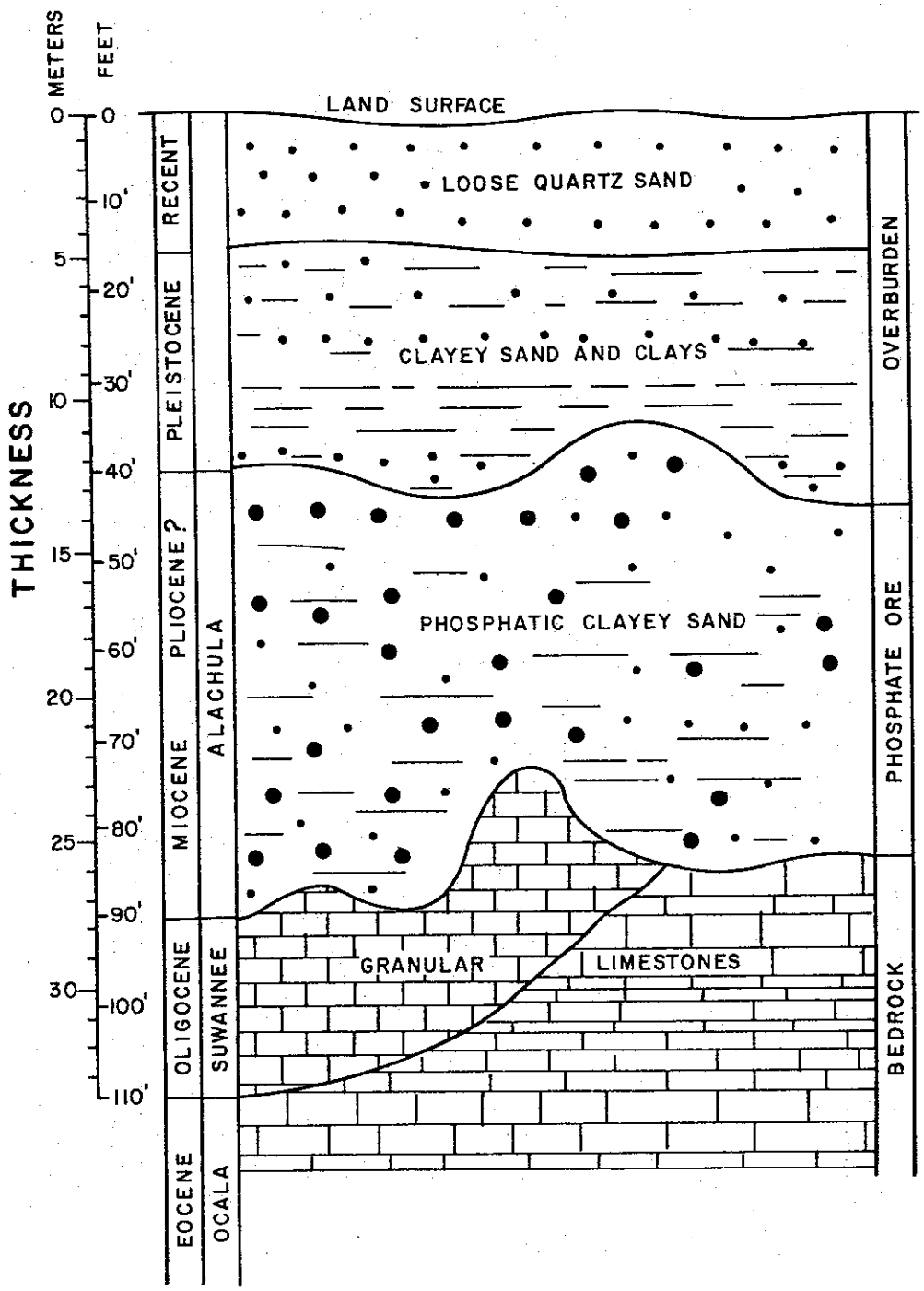


FIGURE 7

upwards as the mining within the central portion of the state progresses southward into the DeSoto, Hardee and Manatee Counties area.

The North Florida Phosphate District, as shown in Figure 4, encompasses phosphate rock reserves which are more sporatic both in areal occurrence and quality than the reserves in the central portion of the state. The primary deposits in this district occur in Columbia and Hamilton Counties, although as seen in Figure 4, phosphatic sediments in this area extend over a much larger region. The geologic associations in north Florida are quite similar to those previously discussed for the Central Florida District; however, deposition of the phosphate-rich sediments has been more erratic resulting in the sporadic lateral variation in percentage of phosphate in this area. The rock quality in the North Florida District is generally somewhat lower than that experienced for the current producing area of central Florida and in many areas throughout the district, clay and quartz contamination is prevalent in the pebble sized product. In addition,

throughout large portions of the district carbonate contamination occurs in the matrix resulting in down-grading of potential final products from these reserves. As in the yet to be developed portion of the Central Florida District, the lower grade phosphate particles found here are the result of only minor post-depositional weathering in comparison to some of the previously mined large areas of high grade reserves which formerly existed in Polk and Hillsborough Counties.

In summary, phosphate rock reserves produced in Florida will experience quality degradation in regards to MgO, CaO to P_2O_5 ratio, CO_2 and particulate $CaCO_3$. The average BPL produced from Florida over the next twenty-five years will gradually drop as lower grade reserves in the current producing areas are mined and as a result of reserves depletion. The producers in the Central Florida District will be forced into mining reserves in the DeSoto, Hardee and Manatee Counties area as a result of the depletion of reserves available to the currently existing facilities. One major contaminant, I & A, should become less of a

problem in the future, while all other quality parameters gradually become disadvantageous to the consumer.

MINING

Currently approximately 49.9 million tons of production capacity exist in the state with additional capacity scheduled to come on stream in the next several years. During the near term, the existing and near future additional capacity will result in excess phosphate rock production capability in comparison to available sales from the state. However, the total depletion of reserves available in central and north Florida to the current producers will result in capacity coming more into balance with sales in the early 1980's. By 1985 to 1990 it is expected that a major portion of the capacity in existence today in central Florida will be mined out and that by the time interval between 1995 and the year 2000, the majority of the reserves existing to current production facilities in the state will be depleted. At this point in time one of two alternatives will of necessity take place. The

first alternative will be for the development of some of the proposed unmined reserves in north Florida and/or south-central Florida by those companies currently active in the industry or by outside interests which have, in recent years, been doing development work in the future reserve areas. The second alternative will be that Florida becomes an importer of phosphate rock from other domestic sources or from the current foreign competition. A governing factor which will be involved in the importation of phosphate rock to the state of Florida will be the existence of the concentrated P_2O_5 capacity within the state at this point in time and the extremely high capital replacement costs for those facilities already in existence.