The Central Florida Phosphate District

Thomas M. Scott, Florida Geological Survey, 903 W. Tennessee Street, Tallahassee, Florida 32305

LOCATION

The Central Florida Phosphate District is located in west-central Florida in parts of Polk, Hillsborough, Manatee, and Hardee counties (Fig. 1). The vast majority of phosphate mines occur within Polk County. 7½-minute topographic quadrangles covering the area of the phosphate district and the near-future southern expansion of the district include: Plant City, Lakeland, Auburndale, Nichols, Mulberry, Bartow, Keysville, Bradley Junction, Homeland, Fort Lonesome, Duette N. E., Baird, Bowling Green, Bereah, Duette, Fort Green, Wauchula and Griffins Corner.

INTRODUCTION

The active mines of the Central Florida Phosphate District allow the visiting scientist a first-hand look at the economically important Miocene phosphorite deposits. Each mine section displays its own unique character resulting from the complex lithologic framework of the upper Hawthorn Group in this area. Often, the complexities of the Hawthorn section are evident in a single cut. Through the examination of mine sections from north to south and east to west in the district a visitor will be able to understand this complex Miocene section. Also interesting from the standpoint of the genesis of the phosphorites is the occurrence of multiple generations of phosphate, the phosphatized carbonate clasts, and the many episodes of reworking evident in the exposed sections.

SITE DESCRIPTION

Within the phosphate district there are approximately 15

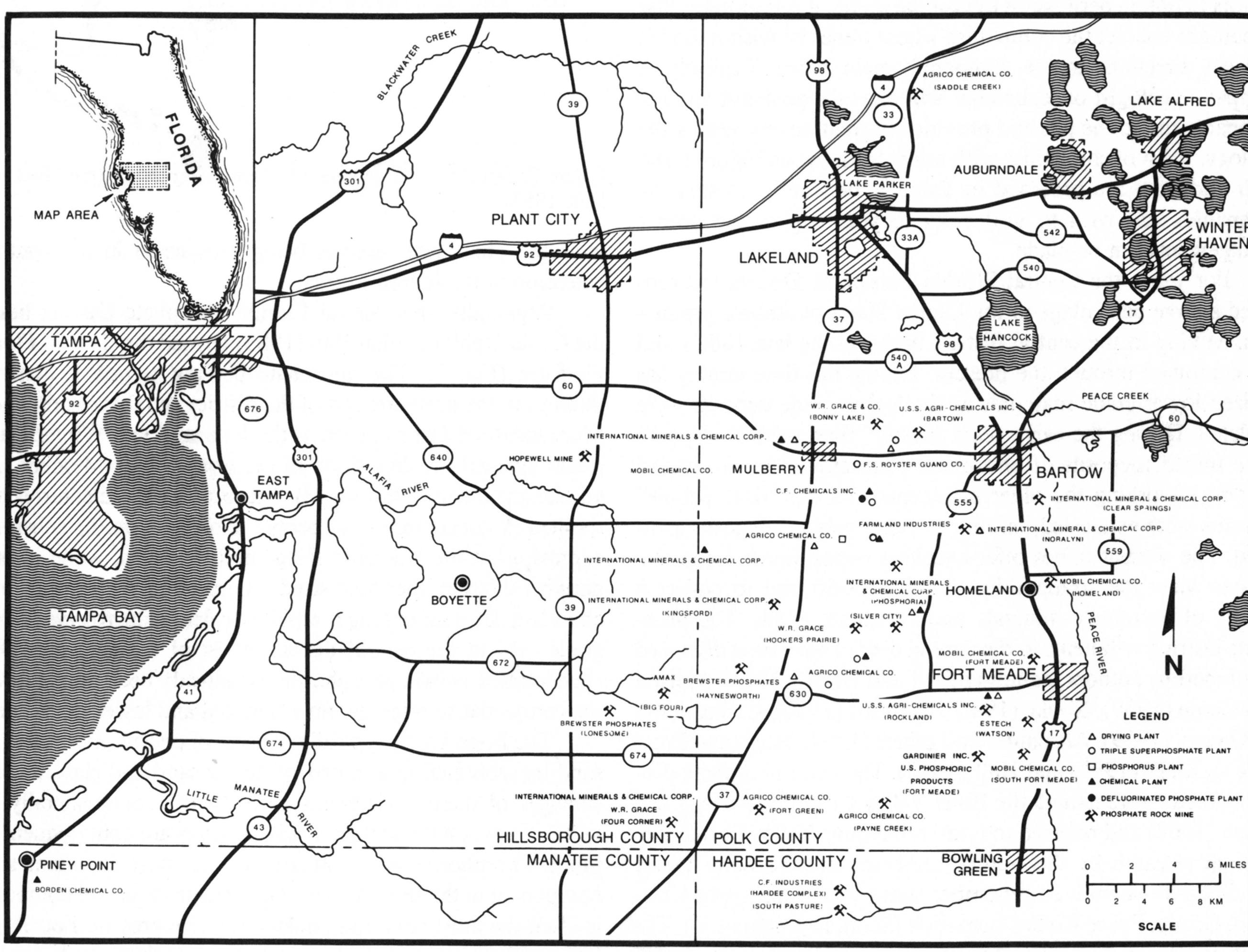

Figure 1. Location map of mines within the central Florida phosphate district.

TABLE 1. PHOSPHATE COMPANIES ACTIVE IN THE CENTRAL DISTRICT IN 1985

Agrico Mining Company P.O. Box 1110 Mulberry, Florida 33860 (813) 428-1431	Gardinier, Inc. P.O. Box 937 Fort Meade, Florida 33841 (813) 285-8125
AMAX Chemical Corporation Post Office Drawer 508 Bradley, Florida 33835 (813) 688-1130	International Minerals and Chemical Corporation (IMC) Clear Springs, Kingsford, and Noralyn Mines P.O. Box 867 Bartow, Florida 33830 (813) 533-1121
Beker Phosphate Corporation P.O. Box 9034 Bradenton, Florida 33506 (813) 322-1311	Mobile Chemical Company Ft. Meade and Nichols Mines P.O. Box 311 Nichols, Florida 33863 (813) 425-3011
Brewster Phosphates Lonesome Plant Bradley,Florida 33835 (813) 634-5551	USS Agri-Chemicals P.O. Box 867 Fort Meade, Florida 33841 (813) 285-8121
Estech, Inc. Wauchula, Florida 33873 (813) 375-4321	
Silver City and Watson Mines P.O. Box 208 Bartow, Florida 33830 (813) 533-7164	W.R. Grace and Company P.O. Box 471 Bartow, Florida 33830 (813) 533-2171

companies operating 20 mines in 1985. It is not feasible to provide exact directions to each mine. Since each company requires visitors to obtain permission to visit the mines, it is important that a geologist contact the companies whose mines he wishes to visit and get directions to the company's main office. Typically, a company geologist or technician will meet the geologist and accompany him to the pits and provide information concerning the geology. A list of companies with mines is shown on Figure 1 and their addresses are provided in Table 1. Be sure to contact the companies you wish to visit prior to your trip so the proper arrangements can be made.

For years, the Central Florida Phosphate District has provided a large percentage of the United States phosphate production. Mining in the central district began in the late 1800's and has continued through the present. During this time mining has utilized lower grade materials as the higher grade deposits were depleted. During the early years mainly "river pebble" deposits were mined (deposits of phosphate concentrated by rivers and streams reworking the older sediments). As the "river pebble" deposits were exhausted, mining of "land pebble" deposits escalated. The present mines offer excellent opportunities for geologists to view the stratigraphy of the deposits and to collect a variety of phosphate minerals and vertebrate fossils. The phosphate bearing sediments in the central district have been discussed by numerous authors including Dall and Harris (1892), Matson and Clapp (1909), Cooke (1945), Cathcart (1950), Cathcart and McGreevy (1959), Altschuler and others (1964), Riggs and Freas (1965), Riggs (1967) and Hall (1983). The main phosphate producing beds were named the Bone Valley Gravel by Matson and Clapp (1909) and referred to later as the Bone Valley Formation. Current research by this author indicates that the Bone Valley should be downgraded to member status within the upper Hawthorn Group, Peace River Formation (Scott, in preparation). The Bone Valley grades downdip into the upper part of the Peace River Formation. The Peace River Formation (new name) con-

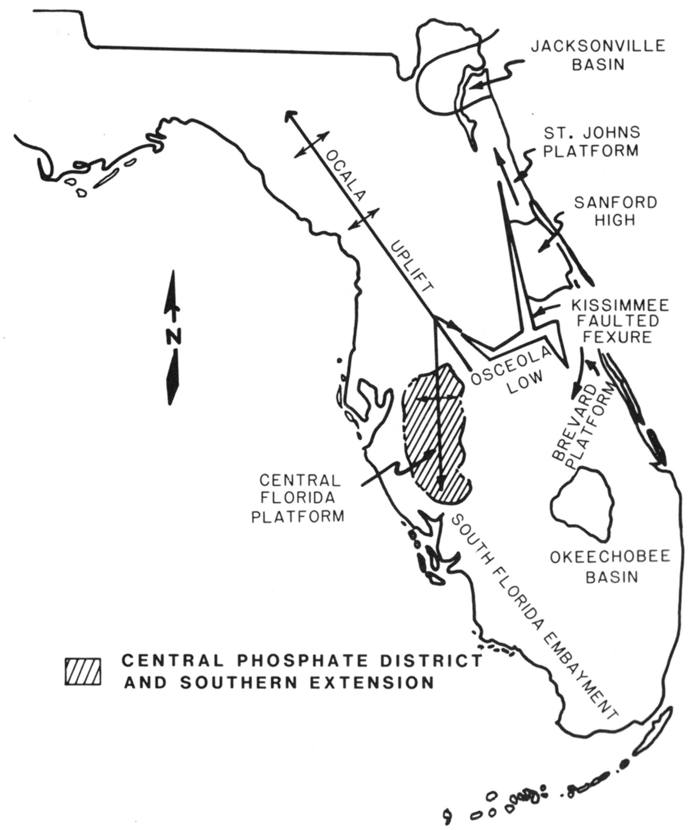

Figure 2. Structural framework of peninsular Florida (modified from Hall, 1983).

tains the phosphate reserves being prospected in the southern extension of the central district.

Regionally, the Central Florida Phosphate District lies on the Ocala Uplift on what Hall (1983) termed the Central Florida Platform (Fig. 2). The phosphate bearing section is generally thinnest in the northern part of the district and thickest downdip. More localized features such as the Lakeland and Winter Haven ridges affected the deposition of the Bone Valley Member (Altschuler and others, 1964; Fig. 3). The more localized controls have resulted in concentration of pebble phosphate on the subsurface expression of the Lakeland Ridge and its flanks, while in other peripheral areas the sand-sized phosphorite fraction is more abundant. Current mining is rapidly depleting the reserves of high grade ores in the central district. Most of the area containing concentrated pebble phosphorite has already been mined forcing the companies to mine the finer material and lower grade ores.

The Bone Valley typically consists of phosphorite gravel and sand incorporated in a matrix of quartz sand and clay. The percentages of these constituents varies widely both laterally and vertically within the section. Facies changes are both frequent and rapid. Phosphorite is almost always the most abundant single component in the Bone Valley. The phosphate gravel component is often the most common phosphorite size present. Locally, the interbedded nature of the fine and coarse (pebble) beds becomes quite complex. The phosphorite varies in color from white and

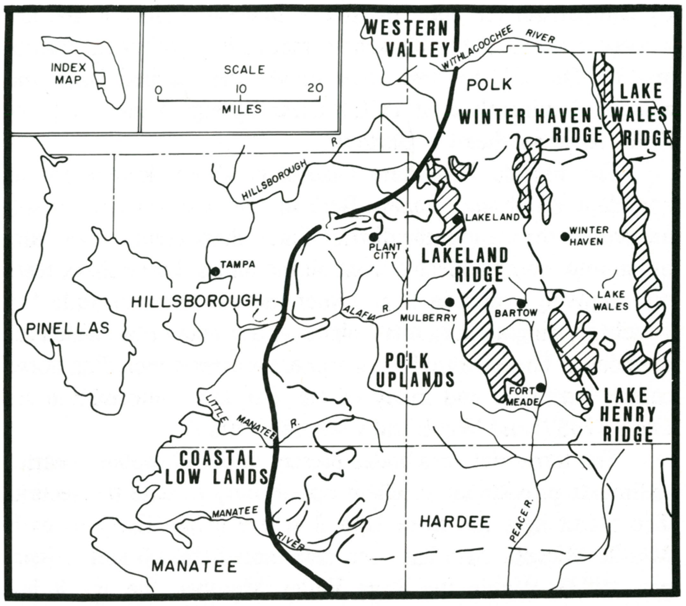

Figure 3. Map of west-central peninsular Florida showing limit of land pebble phosphate district (dashed line) and major topographic features. Shading indicates ridge areas above 150 feet (45.7 m) in elevation (modified from Altschuler and others, 1964).

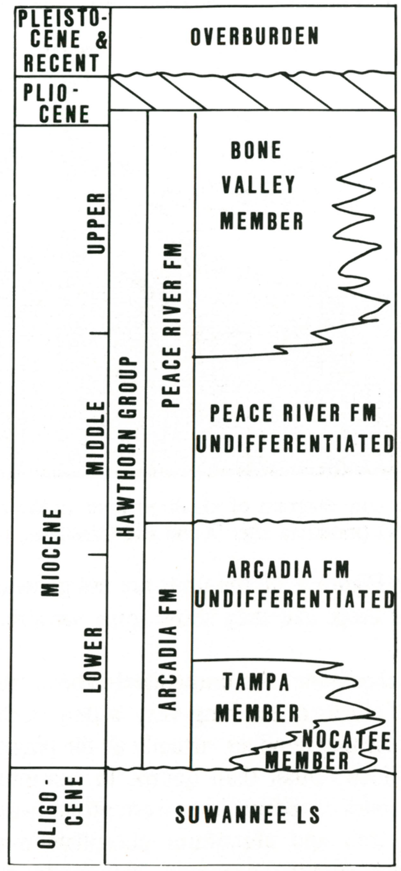

Figure 4. Stratigraphic column from the central Florida phosphate district.

tan to black. Typically the lighter colors are higher in the section. In the upper Bone Valley section the phosphorites are usually white, often earthy textured, due to leaching by ground water. This zone is often referred to as the "leached zone." Colors of the sediments of the Bone Valley range from blue greens, tans, and browns in the clays and "bed clays"; to olive grays, light grays, and brownish grays in the matrix; to light browns and white in the leached zone.

Throughout much of the phosphate district, the Bone Valley Member is underlain unconformably by the dolomites of the Arcadia Formation (new name) of the Hawthorn Group (Fig. 4; Scott, in preparation). The dolomites are sandy, sometimes clayey, phosphatic, and contain molds of mollusks. The upper part of the Arcadia Formation often contains clastic beds lithologically similar to those in the Peace River Formation. Colors vary from white to tan, yellowish, and gray. In the very southern part of the district the Bone Valley grades laterally into the upper Peace River Formation (Fig. 4). In some instances the Bone Valley may overlie beds of the Peace River Formation. The Peace River is typically a clayey, variably phosphatic, sometimes dolomitic quartz sand with scattered clay and carbonate beds. It is usually olive gray to light olive gray but may vary to lighter colors. The Peace River Formation is generally less phosphatic than the Bone Valley although zones of concentrated phosphorite do occur.

The Bone Valley Member is overlain unconformably by unconsolidated sands of Plio–Pleistocene age. These sands often appear to grade into the Bone Valley due to leaching of the upper Bone Valley by ground water. These sands, along with some of the leached zone are classified as overburden and are removed to expose the phosphate matrix.

Crissinger (in Webb and Crissinger, 1983), provides a detailed local stratigraphy of the district; ten units are recognized which recur throughout much of the district. Figure 5 graphically shows the relationship of these units within the central district. Unit 0 is the dolomites of the Arcadia Formation. Unit 1 consists of phosphatic, clayey quartz sands belonging to the Peace River Formation undifferentiated. Unit 2 is called the "bed clay." It is a sandy, silty, variably phosphatic clay that originally was thought to be a weathering product of the Arcadia dolomites. This author believes that these clays are the result of primary deposition, not weathering of the Arcadia Formation. Units 3, 4 and 5 are the clayey, phosphatic, sandy beds of the Bone Valley. Unit 3 is the phosphorite pebble unit of the Bone Valley and is well developed on the Lakeland Ridge. Unit 3 consists of abundant phosphate pebbles with a clay and sand matrix. Unit 4 is typically a sandy clay to clayey sand with abundant sand sized phosphorite and some pebble phosphorite. Unit 5 is generally a clay with sand sized phosphorite, variable amounts of pebble phosphorite and quartz sand. Unit 6 beds are channel deposits of reworked phosphorite. Unit 6 contains "button quartz" pebbles (fine to coarse gravel and occasionally cobble sized quartz clasts). Unit 7 is the "leached zone." Units 8 and 9 are overburden beds consisting of sands. Unit 10 is a modern phase reworking of the phosphate which commonly is referred to as "river pebble" phosphate. As

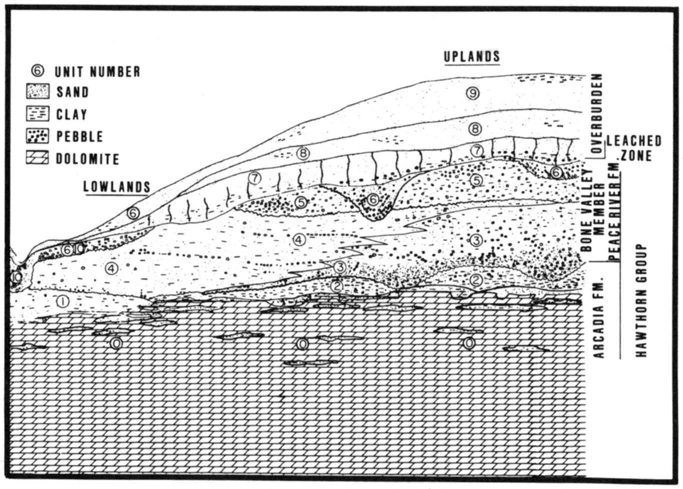

Figure 5. Schematic diagram of idealized units in the central Florida phosphate district (modified after Webb and Crissinger, 1983).

can be seen in Figure 5, all the units are not generally present at any single out crop, and they show some variations in vertical sequence.

The "leached zone" lies immediately above the phosphorite ore zone. The effects of leaching vary widely in this zone. The most intense leaching removes virtually all the phosphate mineral phases and silicates other than quartz. In less intensely altered zones and in zones of redeposition from groundwater, a number of secondary iron and aluminum phosphate minerals occur. These include beraunite, cacoxenite, crandallite, millisite, rockbridgeite, vivianite, wavellite and others (Barwood and others, 1983). By comparison the main phosphate mineral present in the unleached portion of the phosphate matrix is a carbonate fluoroapatite. One of the best areas to see the leached zone and associated minerals is at IMC's Clear Springs Mine along the Peace River southeast of Bartow.

The Florida Phosphate District is widely known for its abundant vertebrate remains. Both marine and terrestrial fossils are present throughout the district. Small shark teeth are virtually ubiquitous, being collected from all the mines. Large shark teeth are relatively common also. Other marine fossils include fish vertebrae, stingray tails, turtle plates, and sirenian ribs (which are abundant). The terrestrial fauna present is diverse including horse, camel, mastodon and many others. For more information see Olsen (1959) and Webb and Crissinger (1983).

The terrestrial vertebrates present in the phosphate bearing sediments provide an excellent opportunity to date the section. The oldest ages are from Unit 2 where a late Early to early Middle Miocene date has been determined (Webb and Crissinger, 1983). Within the Bone Valley Member, the age is late Middle to early Late Miocene while the reworked section falls in the latest Miocene to Early Pliocene (Webb and Crissinger, 1983). The overlying materials (units 8 and 10) fall into the Pleistocene.

It is obvious from the preceeding discussion that lithologic and stratigraphic specifics for any one particular site or mine can not be included here. However, company geologists will point out the Bone Valley Member and the Arcadia Formation (often called Hawthorn dolomites within the district).

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