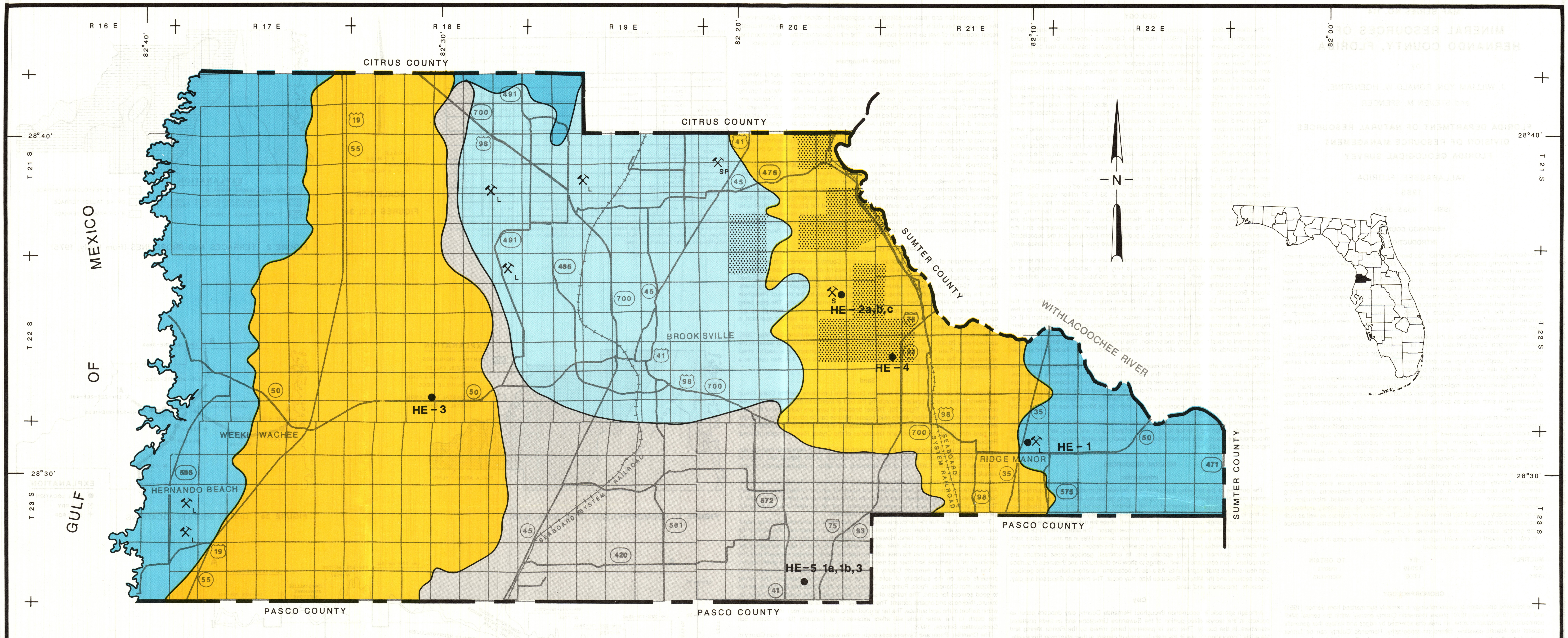
MAP SERIES NO. 114

Published for
FLORIDA GEOLOGICAL SURVEY

FLORIDA GEOLOGICAL SURVEY
DEPARTMENT OF NATURAL RESOURCES



EXPLANATION

LIMESTONE

LIMESTONE, AGGREGATE

LIMITED POTENTIAL
(TOPSOIL, FILL ETC.)

SAND

HARD ROCK PHOSPHATE
(HISTORICAL MINING)

MINE SITE

L LIMESTONE

LA LIMESTONE, AGGREGATE

SP SOFT ROCK PHOSPHATE

HE-1 SAND SAMPLING LOCATION

MINERAL RESOURCES OF
HERNANDO COUNTY
FLORIDA
1988

SCALE

0 0.5 1 2 3 4 MILES

0 1 2 3 4 5 6 KILOMETERS

MAP SERIES NO. 114

MINERAL RESOURCES OF HERNANDO COUNTY, FLORIDA

by

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DIVISION OF RESOURCE MANAGEMENT

FLORIDA GEOLOGICAL SURVEY

TALLAHASSEE, FLORIDA

1988

ISSN 0085-0624

HERNANDO COUNTY

INTRODUCTION

In recent years, considerable attention has been focused on Florida's rapid development, the accompanying population increase and their effect on the state's important mineral resources. Frequently, urban development has occurred in areas underlain by known mineral deposits, precluding future extraction of the minerals. The economics associated with these mineral resources represent substantial employment and income to the private sector as well as taxes to county and state governments. One response to this growing conflict between rapid growth and development of the state's mineral resources was in the form of legislation enacted by the Florida Legislature in 1985 requiring each county to establish a comprehensive land use plan. Additional guidelines and due dates were established by the 1986 Florida Legislature.

In response to this act and at the request of the Withlacoochee Planning Council, the Florida Geological Survey initiated a study of Hernando County's mineral resources. The objective of this report is to summarize and interpret geologic data (i.e., core and well cutting descriptions, geophysical logs and data derived from field reconnaissance) in a format appropriate for use by city and county planners.

A knowledge of Hernando County's mineral resources is basic and integral to the process of initiating, developing and implementing an effective comprehensive land use plan. This information and data are essential to planners and officials in their analysis of urban and rural development in such areas as zoning, road construction and the establishment of waste disposal sites.

Factors used in evaluating the economic value of the county's known and potential mineral resources are varied, changing, and in many instances, interrelated conditions which greatly complicate an accurate assessment. This evaluation process is inherently dependant on an extensive exploration program, which is a necessary precursor to mining in order to determine reserves, content and extent of specific mineral resources. In addition, such factors as operating expenses, transportation, beneficiation, reclamation and capital costs of mining must be included in the overall calculations.

Resource evaluation for this report is based on a number of sources, including Florida Geological Survey reports and unpublished data, field reconnaissance, state and federal statistical data, company reports, questionnaires, and numerous discussions with mining company personnel and state and federal officials. Although detailed information on company statistics is confidential, information of a more general nature is readily available or can be reasonably extrapolated from existing data. The diversity of sources as well as their close association to the various aspects of resource evaluation lends substantial confidence to the general assessments and inferences of this report.

In order to prevent the awkward duplication of English and metric units in this report the following conversion factors are provided.

MULTIPLY	BY	TO OBTAIN
feet	0.3048	meters
miles	1.609	kilometers

GEOMORPHOLOGY

The following discussion of geomorphology is primarily summarized from Vernon (1951) and White (1970). White (1970) places Hernando County entirely within the central (Mid-peninsular) physiographic zone, an area characterized by ridges and valleys that generally parallel the Atlantic coastline. Based on topography, Hernando County can be further subdivided within this zone into two geomorphic provinces, the Central Highlands and the Gulf Coastal Lowlands (Figure 1).

The Western Valley, a subdivision of the Central Highlands, is located eastward of the Brooksville Ridge in the southeastern corner of the county. The eastern half of this geomorphic region is comprised of a generally lower and flatter area known as the Tsala Apopka Plain. The elevations in the Western Valley range from 50 to 75 feet above mean sea level (MSL).

The Brooksville Ridge, which forms much of the eastern part of Hernando County, extends from eastern Lafayette County southward to southern Pasco County. The surface and near-surface sediments comprising this ridge are varied and include sands, sandy clays and clayey sands which overlie extensive limestones and dolomites.

The Brooksville Ridge ranges from 75 feet to over 250 feet above MSL, elevations substantially higher than those present in the adjoining Gulf Coastal Lowlands. The markedly higher elevations of the carbonates in this region may be attributed to overlying, relatively impermeable clayey sands and clays as compared to the more porous and permeable sands of the adjacent Lowlands (Vernon,1951). The impermeable clayey sands impede or prevent the downward percolation of surface waters and their resultant dissolution of the underlying limestone.

Three terraces (Figure 2), which have undergone erosion over a long period of time and represent higher, ancient sea levels, are present in the Central Highlands of Hernando County (Healy, 1975). These are the Coharie Terrace (170 to 215 feet above MSL), Sunderland Okeefenokee Terrace (100 to 170 feet above MSL), and the Wicomico Terrace (70 to 100 feet above MSL).

In Hernando County the Gulf Coastal Lowlands, which contain the Coastal Swamps region, comprises an 8 to 15-mile wide band that generally parallels the Gulf coastline. The boundary marking the juncture of the Gulf Coastal Lowlands and the Central Highlands is readily distinguished on the basis of elevation differences in which the Brooksville Ridge (a part of the Central Highlands lying contiguous to the Lowlands) has elevations generally greater than 50-feet higher than the adjacent Coastal Lowlands.

Three marine terraces (Figure 2) formed by ancient seas occur in Hernando County within the Gulf Coastal Lowlands (Healy, 1975). These terraces and their respective elevations include the Penholoway Terrace (42 to 70 feet MSL), Talbot Terrace (25 to 42 feet MSL) and the Pamlico Terrace (8 to 25 feet above MSL).

A number of relict coastal features representing ancient near-shore environments associated with the younger terraces are present in the western portion of the county. These features, which include ancient dunes, beach ridges, barrier/lagoon complexes and near-shore and beach sediments, can be observed along State Road 595, State Road 98 and State Road 50 in an area to the west of Brooksville. Of special significance are the numerous relict sand dunes associated with the Pamlico Terrace which stand in sharp contrast to the thin sand veneer occurring along Hernando County's present day coastline. This suggests a more abundant source of sand in the past and depositional processes similar to those found today further south along the coastline of Pinellas County.

GEOLOGY

The following discussion of geology is primarily a summarization of Yon and Hendry (1972) and Deuerling and MacGill (1981). Hernando County is underlain by igneous and metamorphic basement rocks which occur at depths greater than 4,000 feet below land surface. Overlying these basement rocks are Paleozoic siliciclastic sediments (Barnett, 1975). These are in turn overlain by a thick section of carbonates (limestone and dolomite) with some evaporites that are in turn overlain near the surface by siliciclastic sediments composed of quartz sands, silts, clayey sands and clays.

Much of the surface geology of Hernando County has been influenced by the Ocala Uplift which crests in neighboring Levy and Citrus Counties. This feature, which was described by Puri and Vernon (1964) as ". . . a gentle anticlinal flexure about 230 miles long and 70 miles wide exposed near the surface in west-central Florida," has altered the orientation of older deeply buried sediments and affected the deposition of younger sediments.

The oldest rocks exposed in Hernando County are the Ocala Group limestones which were deposited in a shallow marine environment approximately 38 to 40 million years ago. These sediments, which can be observed in various quarries throughout the county and along the Withlacoochee River, occur at elevations near sea level in the western part of the county. Figure 3a shows the location of cross sections used in this report. As cross section A-A' shows, the Ocala Group thickens to the east and is present at elevations in excess of 100 feet above MSL at the eastern limits of the county (Figure 3b).

Overlying these limestones is the Suwannee Limestone deposited during the Oligocene Epoch, which represents marine sediments laid down 33 to 37 million years ago. This formation is fairly continuous over most of Hernando County. Exceptions to this include an area in the northwestern portion of the county and a narrow band bordering the Withlacoochee River on the eastern side of Hernando County where these sediments are missing (cross section A-A', Figure 3b). The contact between the Suwannee and the underlying Ocala Group is unconformable, a geologic term indicating that the depositional record is not complete and intervening sediments may have been present and subsequently eroded.

This variably recrystallized limestone, although not as pure as the Ocala Group in terms of calcium carbonate ($CaCO_3$) content, contains a very high carbonate percentage. It is generally fossiliferous with common occurrences of mollusks and several distinctive Foraminifera including *Rotalia mexicana*. The Suwannee Limestone, as observed in quarries around Brooksville, occurs as alternating layers of hard and soft beds.

The Suwannee Limestone is variable in thickness ranging from 12 to 15 feet on the western side of Hernando County to 100 feet in the central portion and thinning again to a few feet on the eastern side of the county (cross section A-A', Figure 3b). Cross section B-B' of Figure 3c shows increased thicknesses of Suwannee sediments in the northern and southern parts of Hernando County. The top of the Suwannee Limestone is irregular, due to the development of karst topography and erosion. This uneven surface is overlain by siliciclastic sediments (sands, clayey sands, silts and clays) deposited during the Miocene and younger epochs.

The sediments which belong to the Hawthorn Group or to various Pliocene to Holocene age deposits are undifferentiated in this report. They overlie the Suwannee Limestone, forming a surface or near-surface veneer of siliciclastics with varying thicknesses. The clays and sands associated with the Hawthorn Group are in contrast to the dominantly carbonate lithology of the underlying limestone units. This change from a carbonate depositional environment to a siliciclastic depositional environment in the Miocene was accompanied by the formation of phosphate.

A sequence of widespread surface sands and sandy clays overlie the Hawthorn Group. These sands, which are referred to as undifferentiated sands and clays, vary in thickness throughout the county and are believed to have been deposited during past episodes of higher stands of sea level.

MINERAL RESOURCES

Introduction

The purpose of the following discussion is to provide information on the occurrence of certain minerals in Hernando County, types of tests performed and analyses of samples collected. The information presented is not intended to be an exhaustive investigation leading to immediate industrial development because, in many cases, the data represent information on a single outcrop, pit or mine. However, where the data are favorable they may indicate that certain areas might warrant further investigation. The Mineral Resource Map is designed to present an overview of the major mineral commodities in an area. Factors such as thickness of overburden, and quality and quantity of the deposit could affect the mining of the mineral commodity at any specific site. In contrast, geologic cross sections are extrapolated from cores and/or well cuttings to show the distribution and thickness of surface and near-surface stratigraphic units. As a result, occasional variations between the geologic cross sections and the Mineral Resource Map may occur. The minerals discussed are clay, limestone, phosphate and sand.

Clay

Although sporadic in occurrence throughout Hernando County, clay deposits occur as pockets in the recrystallized portion of the Suwannee Limestone and as beds scattered elsewhere in the county. This clay is presently being mined by the Florida Mining and Materials Corporation for use in the manufacturing of cement at their plant near Brooksville.

The Hernando County Road Department is removing clayey sediments for use as road fill from two pits located in the SE 1/4, NE 1/4, section 11, Township 22S, Range 20E (Locality HE-2, Table 1) and NW 1/4, NE 1/4, section 34, Township 23S, Range 20E, (Locality HE-5, Table 1). Analyses of samples collected from HE-2 and HE-5 indicate that these deposits range from sands to clayey sands (Mineral Resources Map). X-ray diffraction of clays from these sites were used to determine that the primary clay mineral is kaolinite.

In the Soil Survey of Hernando County (United States Soil Conservation Service, 1977), the Nobleton-Blichton-Flemington soil associations were found to have clayey sediments at depths of three to five feet. These soils occur predominantly along the Brooksville Ridge in the center of the county. The determination of the suitability of these areas for industrial development will require extensive drilling and laboratory analyses.

Limestone

Limestones of potential economic use in Hernando County include the Ocala Group and the Suwannee Limestone. Both limestones lie near the surface throughout the county. Analyses of the Suwannee Limestone indicate that it ranges from 92.91 to 99.56 percent calcium carbonate (Yon and Hendry, 1972).

Suwannee Limestone underlies all of Hernando County except for areas in the northwestern and eastern parts of the county. In these areas, the Ocala Group lies below post-Suwannee siliciclastics. The distribution of the limestone deposits is shown on the Mineral Resources Map of the area.

The open pit mining method is used by companies mining limestone in the county. Prior to mining a new quarry face, a bulldozer clears away the vegetation and removes the overburden. The thickness of the overburden in Hernando County is variable, which reflects the irregular surface of the underlying limestone. This overburden, which in places has thicknesses approaching 100 feet (Figures 3b and 3c), may have potential as a local source of fill. After clearing the area to be mined, shot holes are drilled into the rock and the quarry face is shattered. The broken rock is then loaded by dragline or front-end loader into trucks and transported to rock crushers for processing.

The Ocala Group limestone and Suwannee Limestone are being mined at the Florida Mining and Materials Broco Quarry located near Brooksville. The Ocala Group and the lower portion of the overlying Suwannee is soft at the Broco location and can be dug using bulldozers and front-end loaders. At the E. R. Jahna Quarry located near Ridge Manor the Crystal River Formation is mined by dragline and bulldozer.

The limestone from the Ocala Group is generally soft and pure enough for use as coarse base material for roads or for agricultural purposes. It is also used in making cement at the Florida Mining and Materials Cement Plant near Brooksville.

The Suwannee Limestone has been mined in Hernando County for many years. Presently, there are five active mines in the county. Three of these are located near Brooksville and the other two are situated near Hernando Beach.

The rock from the three quarries near Brooksville provides aggregate for the construction industry in Florida. This aggregate is used for making concrete, and the fines left over from the production of aggregate are utilized as a filler in bituminous mixes for road surfaces. The two companies mining the softer part of the Suwannee Limestone near Hernando Beach are marketing the material for use as coarse base material for roads.

Total production and resource estimates of aggregates produced from the Suwannee in the area are not available. However, two of the aggregate producing companies in the county report production of over six million tons a year. The mine operators in the county report that at the present rate of mining the aggregate deposits will last from 25 to 100 years.

Hardrock Phosphate

Hardrock phosphate deposits occur in the eastern part of Hernando County (Mineral Resource Map). This area is part of a larger region known as the Florida Hardrock Phosphate District (Espenshade and Spencer, 1963). The district is a linear belt which extends from the eastern side of Hernando County northward through Citrus, Levy, Marion, Gilchrist and Suwannee Counties. The hardrock deposits consist of boulders, pebbles, and small grains of phosphate clay, sand, chert and silicified limestone lying upon a limestone surface, which is irregular due to solution (Vernon, 1951). According to Espenshade and Spencer (1963) "hardrock phosphate deposits seem to have been formed by very thorough groundwater leaching of phosphate from marine phosphorite beds and redeposition of phosphate at depth as secondary apatite by replacement of limestone and precipitation in cavities, as proposed by some earlier investigators."

Hardrock phosphate was first mined by horse-drawn scrapers which removed the overburden so that the ore could be removed by pick and shovel. Later, draglines were used to remove the overburden and the ore (Espenshade and Spencer, 1963).

Several abandoned quarries located on the eastern side of Hernando County are areas where hardrock phosphate has been mined (Mansfield, 1942). According to Mansfield, there were two mines operating in the county in 1909. However, at the present time, there is no hardrock phosphate mining in the county. The irregular nature of the mineable deposits of hardrock phosphate, and often thick overburden, combined with unfavorable economic factors probably precludes the mining of hardrock phosphate in the near future.

Soft Rock (Colloidal) Phosphate

The distribution of soft rock phosphate in Hernando County is confined to those areas in close proximity to the pits where hardrock phosphate was mined. In the processing phase of hardrock phosphate mining, sand and clay size phosphate material were not recovered (Vernon, 1943). The separated waste clay and sand were discharged to settling areas.

At the present time soft rock phosphate is being recovered by the Howard Phosphate Company in the Withlacoochee State Forest in eastern Hernando County. The area being mined appears to be a shallow depression where the waste clays from a hardrock phosphate operation were settled. The recovery of the phosphatic clay at the Howard operation is achieved by harrowing the clay and allowing it to dry before shipping.

According to the U. S. Bureau of Land Management (personal communication, May 1986), approximately 20,000 tons of soft rock phosphate have been mined from two leases in the Withlacoochee State Forest during the last five years. Soft rock phosphate is used for direct application to the soil. If the fluorine content of the material is low, it is also used as a supplement in animal feed.

Sand

Quartz sand occurs as a veneer over the Suwannee Limestone and the Ocala Group sediments in the Coastal Lowlands bordering the Gulf of Mexico on the western side of the county (cross section A-A', Figure 3b). Thicker deposits of sand are found east of this area (west of the Brooksville Ridge) where relict coastal features can be observed. Sand deposits also extend from the central part of the county eastward where they form the overburden on the hard rock phosphate deposits and limestones of the Crystal River Formation (Mineral Resources Map).

The sediments collected for testing (HE-1 through HE-5, Table 1) were taken from existing pits in Hernando County. In the field, a visual inspection of the deposit was made to determine the general uniformity of the sediments and either a channel sample or spot sample was taken.

In the laboratory, the material was dried and quartered using a riffle type sample splitter. After quartering, one quarter was weighed and screened using an United States Standard Sieve Series. The data obtained from the results of the screening are presented in Table 1. The data presented in Table 1 represent information that can be used for determining the general usefulness of the deposit for industrial purposes.

The tests indicate that the sands are suitable for brick masonry, sand-cement riprap, sand-asphalt hot mix and sand seal coat. No tests were performed to determine if the sands in the county are suitable for glass sand. However, the presence of an iron oxide coating on the sand grains will probably preclude their use for manufacturing glass. In using the test results, it should be remembered that the data obtained from the sieve analyses represent only one particular set of samples and does not necessarily depict all the material in a given deposit.

The Soil Survey of Hernando County (United States Soil Conservation Service, 1977) presents data on the suitability of soils for use as construction materials. This survey indicates that Chandler, Paola, Pompano, Tavares, Lake, Arredondo and Sparr soils are fair to good sources for sand. The ratings of soils as fair to good sand sources are based on texture, thickness and organic content. The sand layer must be at least three feet thick and lie within six feet of the land surface. The fair to good rating does not take into consideration how the depth to the water table will affect excavation of materials (United States Soil Conservation Service, 1977).

The Chandler, Paola and Tavares soils occur on the western side of Hernando County in the Coastal Lowlands and adjacent to the Tsala Apopka Plain in the southeastern part of the county. Arredondo, Lake, and Sparr soils form the surface materials on the western and eastern sides of the Brooksville Ridge. Pompano soils are associated with the Tsala Apopka Plain in the southern part of Hernando County.

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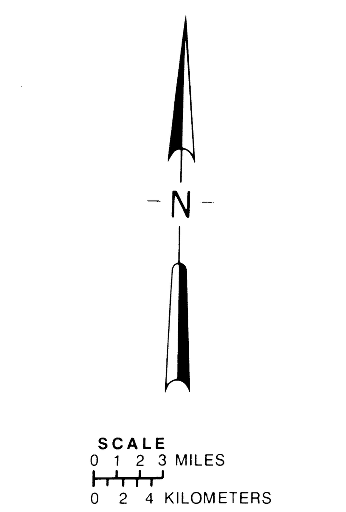
TABLE 1. SCREEN ANALYSES OF SAND IN HERNANDO COUNTY, FLORIDA

DEPOSITS			LABORATORY TEST DATA SCREEN ANALYSIS SIEVE NO. AND CUMULATIVE WEIGHT PERCENT RETAINED							
SAMPLE NO.	LOCATION	METHOD OF SAMPLING	4	8	16	30	50	100	200	FINENESS * MODULUS
HE-1	T23S,R21E SEC.1cc	CHANNEL	-	-	-	.27	6.24	51.38	98.32	1.56
HE-2a TOP OF SEC.	T22S,R20E SEC.11db	CHANNEL	-	-	-	.47	8.46	61.59	99.46	1.70
HE-2b	AS ABOVE	SPOT	-	.13	.48	1.15	7.21	54.44	97.30	1.61
HE-2c	AS ABOVE	SPOT	-	-	-	.62	16.10	74.57	99.29	1.91
HE-3	T22S.R18E SEC.28d	SPOT	-	-	.02	.11	8.89	55.52	99.16	1.64
HE-4	T22S.R21E SEC.19dd	SPOT	-	.25	.41	1.67	6.07	29.83	84.51	1.23
HE-5(1a)	T23S,R20E SEC.34ab	SPOT	-	-	-	.13	3.46	48.55	97.98	1.50
HE-5(1b)	AS ABOVE	CHANNEL	-	-	-	.36	9.27	65.65	98.14	1.73
HE-5(3)	AS ABOVE	CHANNEL	11.98	16.17	22.26	28.59	35.74	59.25	90.14	2.64

* FINENESS MODULUS: A MEANS OF EVALUATING SAND AND GRAVEL DEPOSITS WHICH CONSISTS OF SIEVING SAMPLES THROUGH A STANDARDIZED SET OF SIEVES, ADDING THE CUMULATIVE WEIGHT PERCENTAGES OF THE INDIVIDUAL SCREENS, DIVIDING BY 100, AND COMPARING THE RESULTANT FINENESS MODULUS NUMBER TO VARIOUS SPECIFICATION REQUIREMENTS. (BATES AND JACKSON, 1980)



SCALE FOR FIGURES 1, 2, 3a

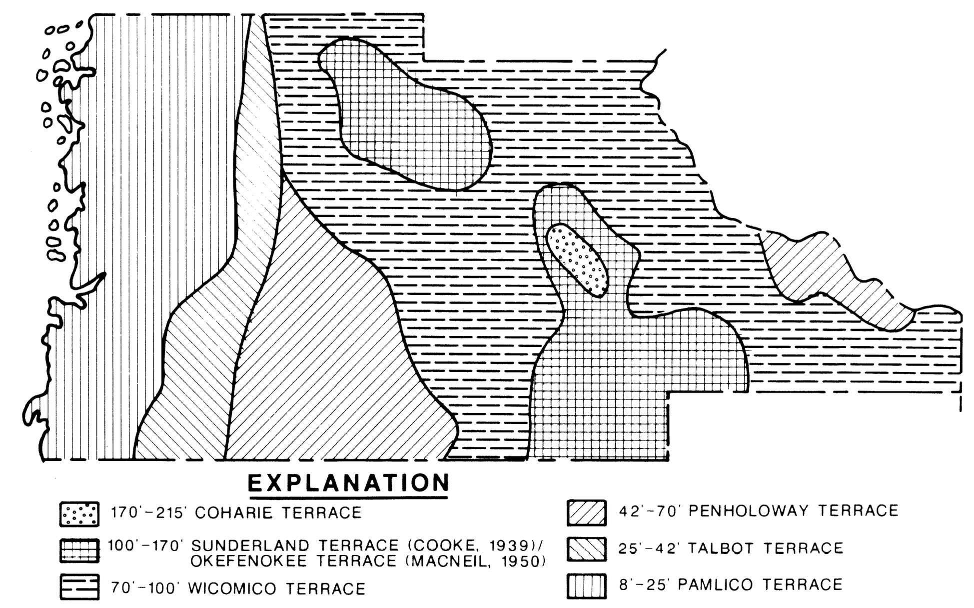


FIGURE 2 TERRACES AND SHORELINES (from Healy, 1975)

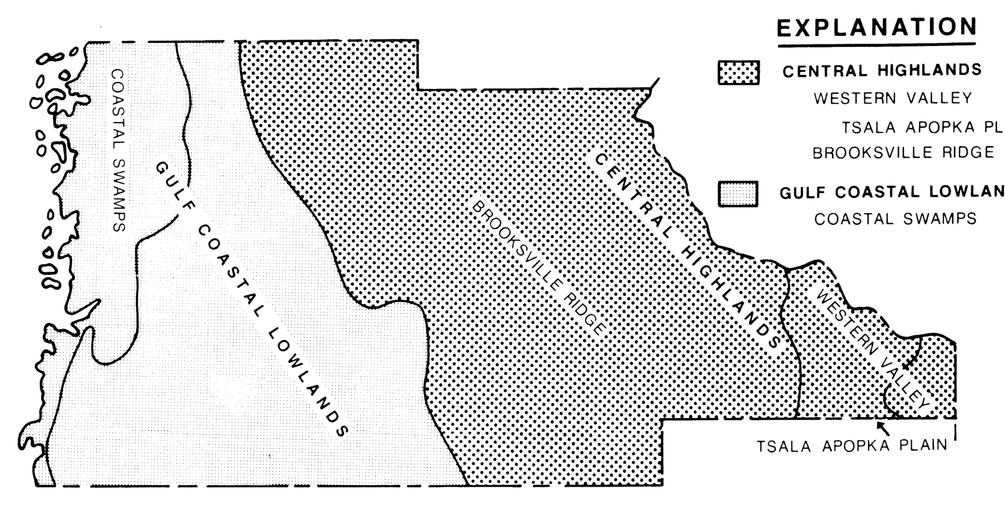


FIGURE 1 GEOMORPHOLOGY (from White, 1970)

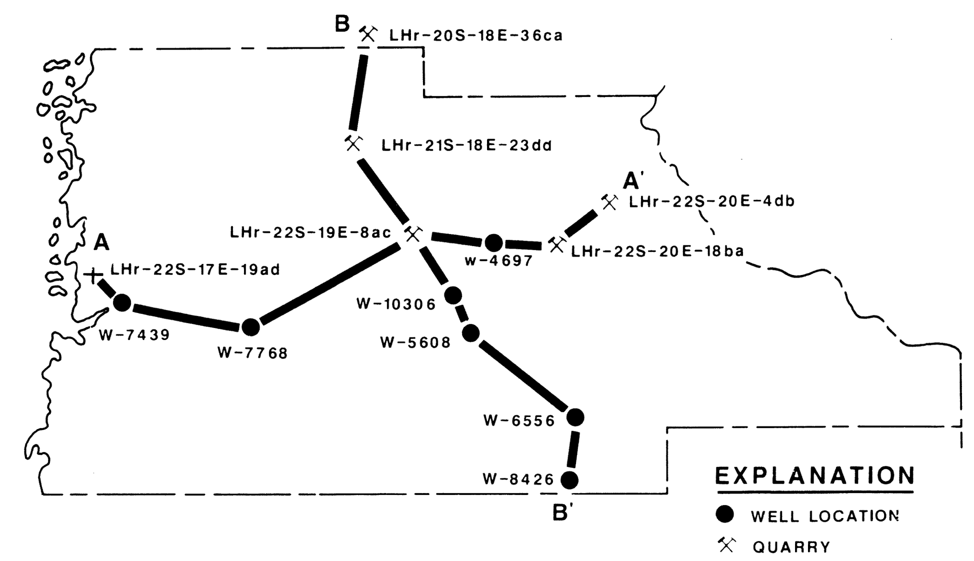


FIGURE 3a CROSS SECTION LOCATIONS

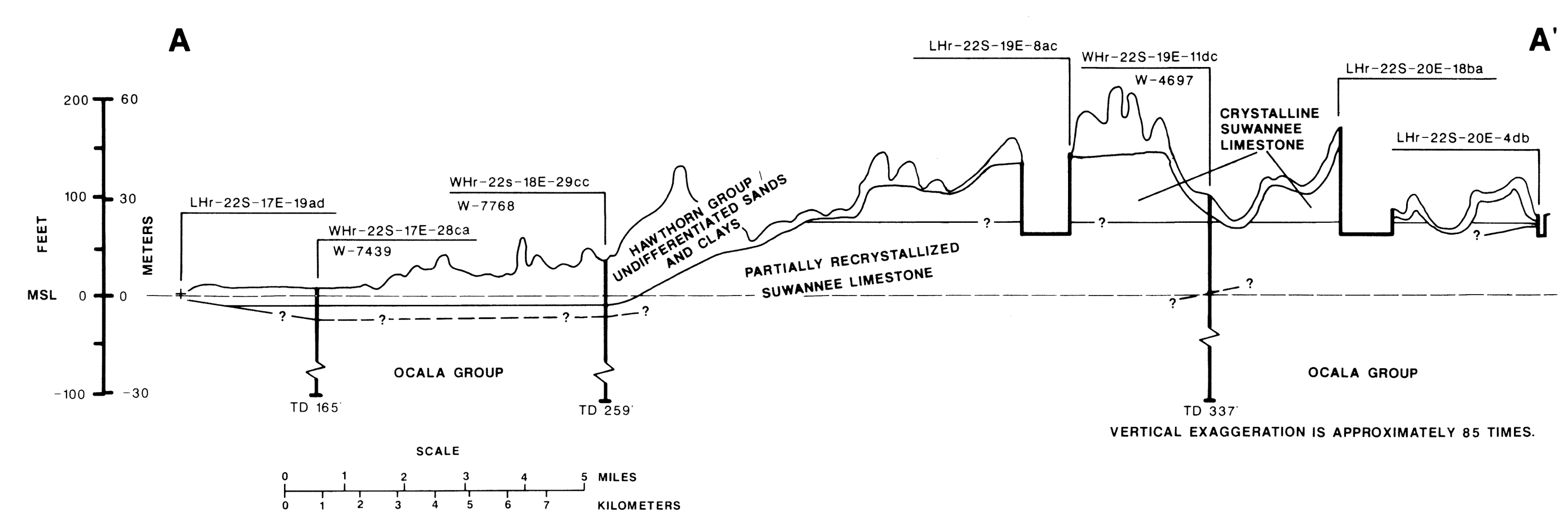


FIGURE 3b CROSS SECTION A - A'

EXPLANATION FOR CROSS SECTIONS

\+ OUTCROP

QUARRY

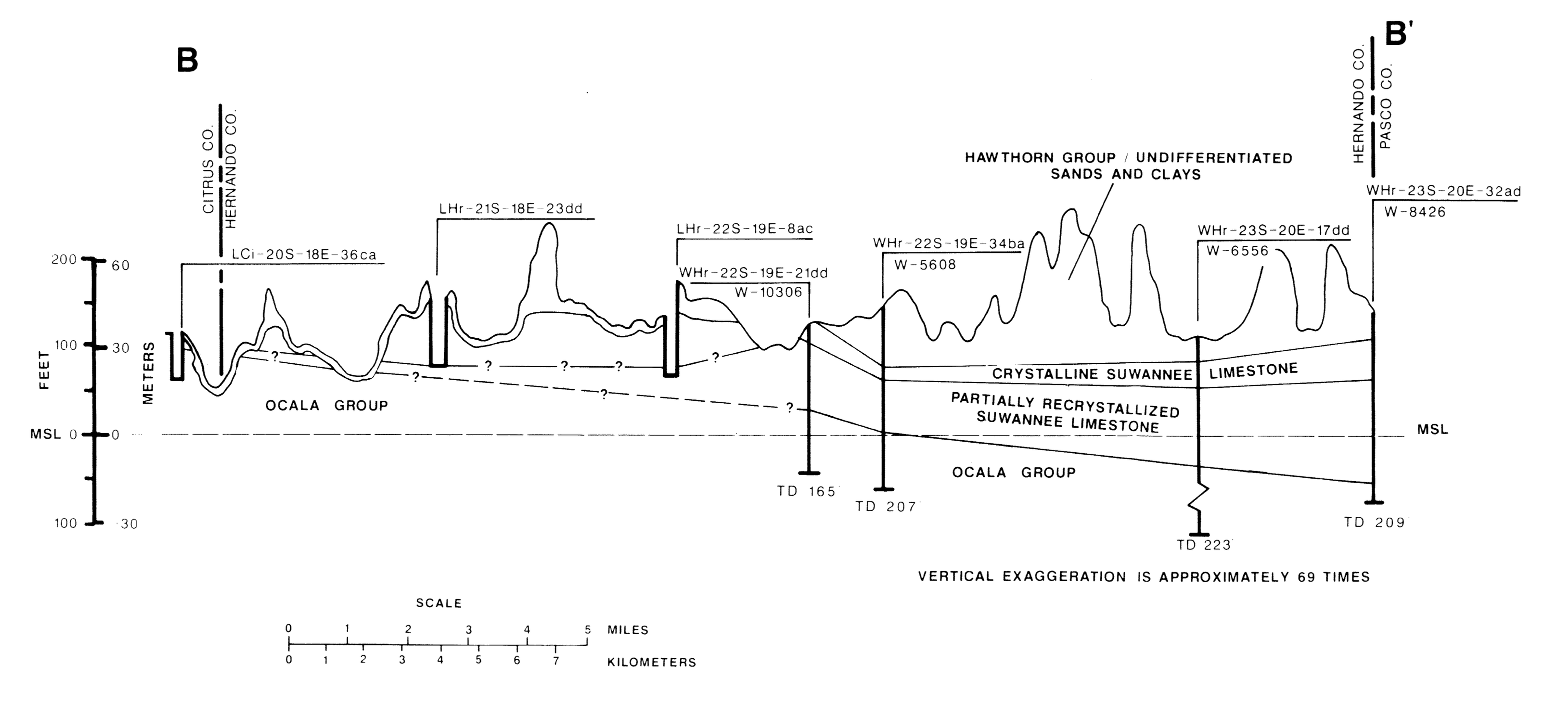


FIGURE 3c CROSS SECTION B - B'

The well and quarry system used in this report uses the rectangular system of section, township and range for identification. The well or outcrop number consists of six parts: W for well or L for quarry, county abreviation, the Township, Range, and Section, and the quarter/quarter location within the section.

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FLORIDA GEOLOGICAL SURVEY

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