MAP SERIES NO. 131

FLORIDA GEOLOGICAL SURVEY
DEPARTMENT OF NATURAL RESOURCES

MINERAL RESOURCES OF ALACHUA COUNTY FLORIDA 1990

EXPLANATION

- CLAY
- LIMESTONE
- PEAT
- SAND
- UNDIFFERENTIATED RESOURCES
- HARD ROCK PHOSPHATE (HISTORICAL MINING)
- CLAY TESTED DEPOSIT
- PEAT TESTED DEPOSIT
- MINE SITE (INACTIVE)
  - LIMESTONE
  - CLAY
- MINE SITE (ACTIVE PIT, QUARRY OR MINE)
  - LIMESTONE
  - SAND
- STATE PRESERVE / PARK

SCALE

0 0.5 1 2 3 4 MILES
0 1 2 3 4 5 6 KILOMETERS

R 16 E 82°40' R 17 E R 18 E 82°30' R 19 E 82°20' R 20 E R 21 E 82°10' R 22 E 82°00' R 23 E

T 6 S T 7 S T 8 S T 9 S T 10 S T 11 S T 12 S

29°50' 29°40' 29°30'

UNION COUNTY
COLUMBIA COUNTY
BRADFORD COUNTY
CLAY CO.
PUTNAM COUNTY
GILCHRIST COUNTY
LEVY COUNTY
MARION COUNTY

Santa Fe River
O'LENO STATE PARK
HIGH SPRINGS
ALACHUA
LA CROSSE
WALDO
Lake Alto
Little Santa Fe Lake
Santa Fe Lake
GAINESVILLE
CAMPVILLE
NEWBERRY
Newnans Lake
PAYNES PRAIRIE STATE PRESERVE
LAND GRANT
LOT NO. 9
Lake Wauberg
MICANOPY
ARCHER
Levy Lake
Ledwith Lake
Tuscawilla Lake
HAWTHORNE
Lochloosa Lake
Orange Lake
ISLAND GROVE

MAP SERIES NO. 131

MINERAL RESOURCES OF ALACHUA COUNTY, FLORIDA

BY

RONALD W. HOENSTINE, P.G.#57, STEVEN M. SPENCER

AND

ED LANE

FLORIDA GEOLOGICAL SURVEY
DIVISION OF RESOURCE MANAGEMENT
DEPARTMENT OF NATURAL RESOURCES

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ALACHUA 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, this development occurred in areas underlain by known mineral deposits, precluding 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 Alachua County Department of Planning and Development, the Florida Geological Survey initiated this compilation of Alachua County's mineral resources. The objective of this report is to interpret and summarize 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 Alachua County's mineral resources is basic and integral to the process of initiating, developing, and implementing an effective comprehensive land use plan. This information is essential to planners and officials in their analyses 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, thus complicating an accurate assessment. The evaluation process is inherently dependent 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 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 with the various aspects of resource evaluation lends substantial confidence to the general assessments and inferences of this report.

Metric Conversion Factors

In order to prevent the 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
tons	907.18	kilograms

GEOMORPHOLOGY

Alachua County falls within the Northern (Proximal) and Central (Mid-peninsular) Zones of White (1970). The line separating these major geomorphic regions approximates a line passing through the cities of St. Augustine, Palatka, Hawthorne, and Gainesville. Figure 1 is a geomorphic map of Alachua County.

The northern geomorphic zone extends across the northern portion of Florida. Within this zone is the Northern Highlands, a major geomorphic feature characterized by broad rolling uplands, which extends across the northern part of the state of Florida from Trail Ridge on the east to the state of Alabama on the west. In Alachua County, the Northern Highlands encompasses the north-central and northeastern parts of the county. It is bounded to the south by the Cody Scarp, a prominent escarpment named and described by Puri and Vernon (1964) as the most persistent topographic break in Florida.

The trend of the Cody Scarp in Alachua County is very irregular and difficult to observe. It is present in the northwestern part of the county extending southward to an area just west of Gainesville then eastward in a sinuous path into neighboring Putnam County (Figure 1).

The Cody Scarp forms a boundary separating the Northern Highlands from the Central Highlands. White (1970) describes the Central Highlands as a region containing a number of elevated areas which rise above surrounding general uplands of considerably less elevation.

The Central Highlands enclose large lowland features including the Central Valley and the Western Valley. The Central and Western Valleys are elongate features oriented parallel with the length of the peninsula. The Central Valley originates in southeastern Alachua County and extends southward through neighboring Marion County, terminating in Lake and Orange Counties. The Western Valley is present in the western and southern parts of the county and extends southward into Hillsborough County.

White (1970) identified two smaller features - the High Springs Gap and the Alachua Lake Cross Valley as being present in Alachua County. The High Springs Gap, the more northerly feature, is described as an opening in the western valley wall of the Western Valley providing drainage to the Gulf Coastal Lowlands. The Santa Fe River flows through this area merging with the Suwannee River to the northwest at the intersection of Lafayette, Gilchrist and Suwannee Counties. In a similar manner the Alachua Lake Cross Valley serves as a gap joining the Western and Central Valleys in southern Alachua County. This broad valley once contained Alachua Lake, a shallow lake which drained abruptly into a sinkhole in the late 1800's. Paynes Prairie occupies the basin of this former lake.

The northern section of the Brooksville Ridge is present in extreme southwestern Alachua County. This highland feature, a subdivision of the Central Highlands, is a large, linear high extending 110 miles from eastern Gilchrist County southeastward into southern Pasco County. Extremely variable in elevation, the Brooksville Ridge attains a height of approximately 135 feet above mean sea level (MSL) in Alachua County. The sediments making up the Brooksville Ridge include sand, clayey sand, and sandy clay which overlie limestone and dolomite.

A small section of the Fairfield Hills is present in the southern part of the county near the town of Micanopy. This geomorphic subzone of the Central Highlands is a north-south trending topographic high that separates the Western Valley from the Central Valley in Alachua County.

Several relict marine terraces are superimposed on the surface topography of Alachua County (Figure 2). These plains, generally considered depositional features, were formed by higher sea stands during the Pleistocene Epoch. Healy (1975) recognized three terraces in the county based on elevation. These terraces, from highest to lowest, include the Coharie Terrace (170 to 215 feet MSL), the Sunderland/Okefenokee Terrace (100 to 170 feet MSL), and the Wicomico Terrace (70 to 100 feet MSL) and are shown in Figure 2.

GEOLOGY

The following discussion of geology is primarily compiled from Puri and Vernon (1964), Williams et al. (1977), and Knapp (1978). Figure 3a is a map showing the locations of the north-south and east-west geologic cross sections used in this report (Figures 3b and 3c).

Alachua County is underlain by Paleozoic basement rocks consisting of quartzitic sandstone, shale and quartzite (Barnett, 1975). For example, an oil test well in northeast Alachua County (W-12226, section 34, Township 8S, Range 21E) penetrated Ordovician quartzite at a depth of 3,204 feet below MSL (Barnett, 1975). In this oil test well, basement rocks are overlain by sequences of Cenozoic and Mesozoic Erathem carbonates (limestone and dolomite) measuring thousands of feet in thickness. Overlying these carbonates in the near-surface are deposits of fine to medium grain quartz sand, clayey sand, sandy clay, silt, limestone and organic-rich (peat) sediments.

The oldest rocks cropping out in Alachua County are the Ocala Group limestones. These carbonate rocks, referred to in the cross sections (Figures 3b and 3c) as Ocala Group undifferentiated, form the upper portion of the Floridan aquifer system in Alachua County. The lithology of the Ocala Group ranges from white to tan to brown, recrystallized limestone to a very fine grained, chalky, porous, cream colored, fossiliferous limestone. Deposited during the Eocene Epoch, these sedimentary rocks are present in the near-surface throughout the county. The Ocala Group, which has an approximate average thickness of 150 feet in Alachua County, crops out over a wide area in the western portion of the county. Excellent exposures occur in numerous limestone quarries and pits such as the area several miles north of the city of Newberry. Here, a number of quarries are present in a relatively small area.

The Suwannee Limestone overlies the Ocala Group in very limited localized areas of northwestern and western Alachua County. Occurrences are sporadic in these areas as erosion has removed much of these Oligocene age deposits. Its lithology ranges from an indurated, cream to yellow, chalky limestone over most of the area of occurrence to silicified boulders in the immediate area around High Springs. Although this formation is highly variable in thickness, approximately 21 feet of Suwannee Limestone was observed in the cuttings in Florida Geological Survey well W-324 (section 14, Township 9S, Range 19E).

The Miocene Hawthorn Group unconformably overlies the Ocala Group, except in limited areas where the Suwannee Limestone is present, in which case it unconformably overlies the Suwannee Limestone. In Alachua County, the Hawthorn Group consists of three formations. These are from oldest to youngest: the Penney Farms Formation, the Marks Head Formation and the Coosawhatchie Formation. The highly variable nature of the Hawthorn sediments in this area makes identification of the individual units difficult using well cuttings. These sediments are referred to in the cross sections as Hawthorn Group undifferentiated (Figures 3b and 3c). The Hawthorn Group is present throughout most of Alachua County, except in the extreme western portion of the county, where it is absent due to erosion. Exposures can be observed in the vicinity of the Santa Fe River. It is present in a number of sinkholes including one located several miles northeast of High Springs (section 19, Township 7S, Range 18E).

These siliciclastic sediments have a diverse lithology consisting of phosphatic, interbedded sand, clayey sand, sandy clay, limestone and dolomite. The Hawthorn Group ranges in thickness from zero in western Alachua County to approximately 150 feet in northeastern Alachua County.

A number of exposures can be observed in the old hard-rock mines in the vicinity of Newberry. Although extremely variable in thickness, these sediments attain a maximum observed thickness of approximately 50 feet in several of the abandoned phosphate quarries located several miles to the northwest of Newberry (Mineral Resources Map).

The Cypresshead Formation is present along the eastern edge of Alachua County bordering Putnam County and in the southwestern corner of Alachua County where it forms part of the Brooksville Ridge (Scott, 1988b). The lithology of this Plio-Pleistocene age unit varies from a red to reddish-orange, clayey to gravelly sand. This lithology is similar to the Citronelle Formation that occurs to the west in the Florida panhandle. The Cypresshead Formation is underlain by the Ocala Group and the Hawthorn Group in eastern Alachua County, and is overlain by undifferentiated sand and clay.

The majority of Alachua County is blanketed by a veneer of Pleistocene and Holocene sands and clays referred to as "Undifferentiated Sands and Clays." Associated with past sea level stands and lacustrine deposits, which once covered Alachua County, these sediments consist of fine to medium grain sand, silt and clay. In central and eastern Alachua County, this unit unconformably overlies the Hawthorn Group. These sediments vary in thickness from less than a foot in areas, such as western Alachua County, where limestone occurs near the surface, to as much as 80 feet or more in karst features developed in the Ocala Group limestone.

Mineral Resources

Introduction

The following discussion of the economic geology of Alachua County is not intended to be a complete investigation leading to immediate industrial development because in many cases, the data represents information on a single outcrop, pit or mine. However, favorable data may indicate that certain areas might warrant further investigation.

The Mineral Resources Map is designed to present an overview of the major mineral commodities in an area. Factors such as thickness of overburden as well as the quality and volume of the deposit will 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 (Figures 3b and 3c). Occasional variations between the geologic cross sections and the Mineral Resources Map may occur. The following is a discussion of clay, heavy minerals, peat, phosphate, limestone, sand and undifferentiated resources of Alachua County.

Clay

Clay is present in the surface and near-surface sediments of Alachua County. The predominant mineralogical forms are smectite and kaolinite (United States Soil Conservation Service (SCS) 1985). Kaolinite occurs as a matrix material in the quartz sands (Cypresshead Formation) present along a narrow portion of the Alachua-Putnam County boundary. Smectite-bearing sediments occur over much of the county and are associated with the near-surface Hawthorn Group.

The SCS (1985) utilized the uppermost 80 inches of the sediment profile to map soil type and determine usefulness of the material. In their study they identified several sandy, clayey loam soil types as present in the county. One soil type, Oleno clay, is described as clay or clayey from total depth (TD) to the surface. The Oleno clay is present primarily along the floodplain of the Santa Fe River in northwestern Alachua County. The SCS rates the Oleno clay poor as a construction material. Many other clayey soil types are present in areas such as Paynes Prairie State Preserve, Levy Lake, Orange Lake, and the community of Island Grove (Mineral Resources Map).

Clay has not been mined in Alachua County since the early 1920s when it was extracted near Campville (sample 1, section 33, Township 9S, Range 22E). The clay from this site was used in the manufacture of a poor grade of common brick (Greaves-Walker et al., 1949). They reported that in addition to common brick, test results indicated the clay from this site would make a good grade of refractory brick (Table 1).

Table 1. Characteristics of Campville Clay
(From Greaves-Walker et al., 1949)

Forming Behavior	Good
Drying Behavior	Excellent
Firing Behavior	Good
Firing Range	Wide
Dry Compressive Strength	258 psi
Dry Modulus of Rupture	90 psi
Fired Compressive Strength, Laboratory Cone 10	1022 psi
Fired Modulus of Rupture, Cone 10	382 psi
Resistance to Abrasion, Dry	Good
Resistance to Abrasion, Fired, Laboratory Cone 10	Fair
Percent Water of Plasticity	11.6
Percent Absorption, Fired, Laboratory Cone 10	15.4
Percent Linear Shrinkage, Dry	1.9
Percent Linear Expansion, Fired, Laboratory, Cone 10	1.2
Percent Total Linear Shrinkage, Laboratory, Cone 10	.7
Fired Color, Laboratory Cone 10	White
Pyrometric Cone Equivalent, (PCE) Cone 30	(3002° F.)
Silica (SiO)	80.88%
Alumina and Titania(Al_2O_3 + TiO_2)	12.11%
Ferric Oxide(Fe_2O_3)	1.00%
Lime (CaO)	0.03%
Magnesia (MgO)	0.23%
Alkalies (Na_2O + K_2O)	None
Loss on Ignition (lgn)	5.73%
Total	99.98%

Heavy Minerals

Heavy minerals are present throughout much of Florida as discrete grains intermingled with quartz sand (Campbell, 1986). Economic deposits of this commodity (percentages averaging about 3-8 percent of the total) are present in neighboring Clay County along the Trail Ridge and south of Green Cove Springs.

Theonen and Warne (1949) investigated heavy mineral occurrences as part of a regional investigation for the United States Bureau of Mines. In Alachua County, they analyzed sediments along State Highways 20, 26, 121, 222, and 231. Results of analyses indicated that the average heavy mineral percentage was 0.03 (Theonen and Warne, 1949). This value is far below any deposit of economic significance. To date, there are no known commercial deposits of heavy minerals in the county.

Peat

Peat is an accumulation of partly decomposed organic material (mainly plant matter) which accumulates in perennially wet areas (Davis 1946; Bond et al., 1984). Along with wet conditions, which affect peat accumulation, other factors of importance include topography and climate. Alachua County is well suited for the occurrence of peat deposits with its abundant low areas, continuous standing water and ample vegetation.

Davis (1946) reported on three peat deposits in Alachua County: 1) in Lake Wauberg (sample 3, section 9, Township 11S, Range 20E), 2) in Newmans Lake (sample 4, section 5, Township 10S, Range 21E), and 3) in the marsh of Orange Lake (sample 5, section 12, Township 12S, Range 22E). Table 2 is an analysis of these deposits.

Table 2
Analysis of Alachua County Peats
(From Davis, 1946)

Sample/Location	Moisture Free Basis, Analysis in Per Cent: Proximate Analysis Volatile Matter	Fixed Carbon	Ash	Ultimate Analysis H	C	N	O	S	BTU Per Pound Moisture Free
3 In Lake Wauberg near Micanopy, Levy Grant, lot 9, T11S, R20E	43.6	13.6	40.1	4.2	33.8	2.9	18.5	0.5	5960
4 In Newmans Lake sec. 5, T10S, R21E	21.4	4.9	73.7	1.9	15.5	1.2	7.5	0.2	....
5 Orange Lake, in drained marsh sec. 12, T12S, R22E	60.5	30.7	8.8	5.9	55.9	3.4	25.4	0.6	9460

The Soil Conservation Service (1985) designated numerous areas of the county as having peaty soils. A number of these soils occur in Orange Lake, Lochloosa Lake, Levy Lake and portions of the Paynes Prairie State Preserve as well as other small areas (Mineral Resources Map). The SCS soil types associated with peat or peaty muck include Samsula, Shenks, Okeechobee, Terra Cela and Ledwith.

Peat is not presently mined in Alachua County. If such operations were to begin, the typical extraction procedures include removal of surface vegetation followed by site dewatering and then removal of peat by draglines or bulldozer. The material would then be shredded and stockpiled for future use. Currently, all Florida peats are used for horticultural purposes.

Hardrock Phosphate

In Florida, hardrock phosphate was first discovered by Alburtus Vogt in 1889 in southwestern Marion County at Dunnellon. The hardrock phosphate district, as mapped by Vernon (1951) trends northwest to southeast and includes western Alachua County (Mineral Resources Map). Cooke (1945) described the phosphatic sediments of this deposit as plates and boulders which lie upon and/or have replaced some of the underlying limestone. This hardrock phosphate, which is associated with paleokarst features in Alachua County, was mined years ago; however, when pebble phosphate began to be mined at a substantially lower cost the demise of the hardrock phosphate industry was inevitable. The industry continued until 1966 when mining of the commodity in Alachua County finally ceased (Olson, 1972).

Pebble Phosphate

Economic grade deposits of pebble phosphate are known to exist in several counties throughout Florida. Alachua County has been mapped in the Northern Phosphate District (Zellars and Williams, Inc., 1978; Scott, 1988a). Phosphatic sediments of the pebble variety are present in the Hawthorn Group sediments within the county. It was in this county that mining of pebble phosphate was first attempted in 1883 near the town of Hawthorne (Knapp, 1978). The phosphatic sediments which occur in the Hawthorn Group are often deeply buried and consist of pebble-sized grains comprising 2 to 10 percent of the sediment suite (Scott, 1988a). Characteristics of the Northern Phosphate District are shown in Table 3.

Table 3. Characteristics of the North Florida
Phosphate District (From Zellars and Williams, Inc., 1978)

Overburden Thickness feet	20-50
Ore Zone Thickness feet	10-25
Pebble Percent Product	10-20
Percent BPL*	66-70
Percent MgO	0.75
Percent U_3O_8 of Product	0.008
Percent F	3.0-4.0

*Bone Phosphate of Lime

Pirkle (1957) conducted a study of the phosphatic sediments in the vicinity of Gainesville, Florida, and found phosphate zones within the Hawthorn sediments at the top and bottom of the unit. The suite of sediments, however, constituted a low grade (50% Bone Phosphate of Lime) ore deposit. When compared to the Central Phosphate District to the south, the economics of the Alachua County deposits probably precludes any mining in the near future.

Limestone

Limestone has been mined extensively in the vicinity of Newberry for many years. Its close proximity to the ground surface enhances the place value of the deposit. In Alachua County, economic deposits of limestone are limited to the western part of the county as the top of the limestone dips and deepens to the northeast (Mineral Resources Map).

Four companies mining limestone in Alachua County use the open pit method for extracting rock. Heavy equipment removes vegetation and overburden material prior to mining. The limestone in this area is generally soft and friable, however, if indurated, blasting may be required to loosen the deposit to enhance recovery.

Operators report that the water surface is 25 to 30 feet below the top of the mineable limestone. Draglines permit mining to depths of 40 to 50 feet below the water surface. Therefore, the maximum mineable section ranges from 65 to 80 feet.

Stockpiled sediments are loaded by dragline or front-end loaders into trucks and transported to processing areas. Processing techniques involve reduction and screening to obtain various size fractions (Campbell, 1986).

The four major rock producers in the county include Florida Rock Industries, Limerock Industries, Limestone Products and the S.M. Wall Company. Limestone from western Alachua County is utilized primarily as base coarse material. The product is usually distributed to nearby Florida markets and occasionally to south Georgia. Total resource and production estimates are not available. The wide occurrence, thin overburden and thick sections of the Ocala Group limestone suggest that these deposits can be economically mined for many years.

Sand

Quartz sand occurrences in Alachua County typically contain clay and silt. Sand grain size varies from fine to coarse. Mining is concentrated in the Brooksville Ridge area and the Northern Highlands (Figure 1). Sand is used as fill material, construction ingredients and in asphalt mixtures (Knapp, 1978).

The SCS (1985) determined that as many as 14 soil types, which are widely distributed throughout the county, are suitable as sources for road fill. Many areas are defined by the SCS as "probable" sources of sand based on compaction, processing and other construction practices.

Undifferentiated Resources

A large portion of central and eastern Alachua County's surface and near-surface sediments are comprised of sand, clayey sand, clay and organic muck. The clays and muck are often inundated by water. The sand and clayey sand have widespread occurrences. They may be especially important as a source of fill in the county for many areas which are subject to flooding. In addition, the organic-rich sands may have value as top soil. The possibility exists that a future comprehensive investigation of these undifferentiated sediments may lead to additional economic or industrial applications.

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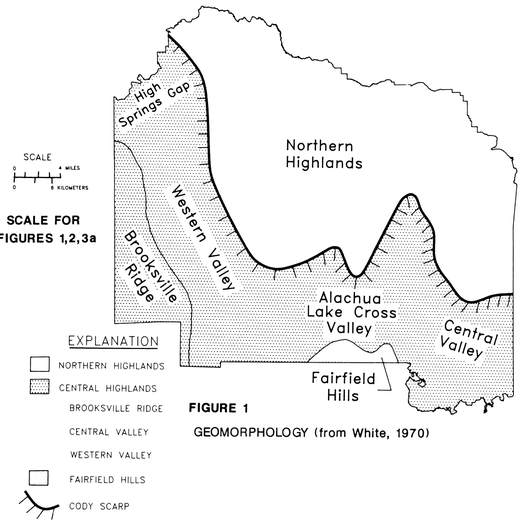

SCALE FOR FIGURES 1,2,3a

FIGURE 1
GEOMORPHOLOGY (from White, 1970)

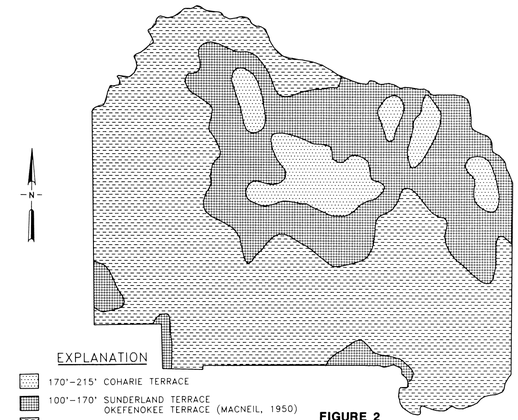

FIGURE 2
TERRACES (from Healy, 19750

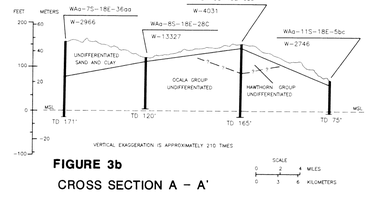

FIGURE 3b
CROSS SECTION A - A'

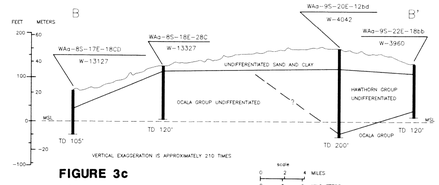

FIGURE 3c
CROSS SECTION B - B'

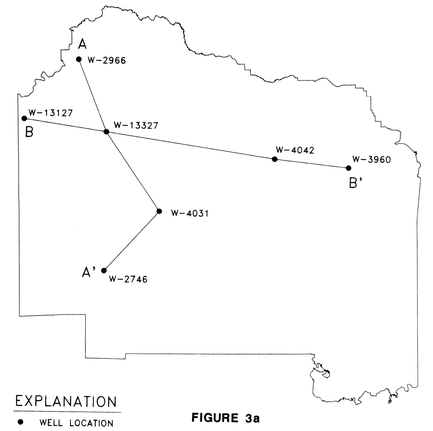

FIGURE 3a
CROSS SECTION LOCATIONS

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 abbreviation, the Township, Range, and Section, and the quarter/quarter location within the section.

DEPARTMENT OF NATURAL RESOURCES
FLORIDA GEOLOGICAL SURVEY

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