GEOLOGY OF CITRUS COUNTY, FLORIDA

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by

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Geology

Physiography

Several authors have discussed Florida's physiographic features. For the purpose of this report White's (1970) classification will be used. The major physiographic features of Citrus County include the Gulf Coastal Lowlands, the Brooksville Ridge, and the Tsala Apopka Plain (figure 1).

The western portion of Citrus County is a poorly drained low relief region. Notable features include extensive swamps, marshes and terraces formed by ancient sea level stands. The central portion of the county is characterized by the Brooksville Ridge. The southern extent of this ridge is both higher and areally larger than that in the north. Eastern Citrus County is lower, flatter, and encompasses a substantial wetland area.

Gulf Coastal Lowlands

The Gulf Coastal Lowlands extend the entire length of Citrus County. The lowlands range in elevation from sea level to 100 feet above sea level. Located within the coastal lowlands are the coastal swamps and marine terraces of Pleistocene age (10,000-1.6 million years ago).

The westernmost region delineated on White's (1970) physiographic map is the Coastal Swamps. Puri and Vernon (1964) and White (1970) defined this area as including all continuous fresh water swamps and salt marshes adjacent to the Gulf of Mexico. The region is a low energy salt or fresh water environment with insufficient sand to build beaches. Sediments which have accumulated upon Eocene limestones have in many places been conducive to the establishment of vegetation. Elevations in the swamp area are generally less than 10 feet above mean sea level.

The marine terraces are gently sloping features with seaward facing escarpments. These features formed when sedimentary materials were alternately deposited and eroded as sea level rose and fell. Vernon (1951) distinguished the Pamlico terrace (approximately 25 foot elevation) and the Wicomico terrace (approximately 100 foot elevation) as the main terrace features in Citrus County. Also associated with the coastal lowlands are ancient dune features. The lowlands are composed of sands and clayey sands of variable thickness overlying Eocene and Oligocene limestones and dolomites.

Brooksville Ridge

The Brooksville Ridge trends north to south and occupies the central part of Citrus County. Elevations along the ridge range from about 70 to 200 feet. The southern part of the ridge is wider with higher elevations than the northern part. The ridge has an irregular surface due to karst activity and elevations may vary over 100 feet in short distances.

The ridge is composed of a core of limestone overlain by clayey sands, sandy clays, and clays which in turn are overlain by Pleistocene sands. The clays and clayey sediments have protected the underlying limestone from dissolution by limiting downward percolation of ground water in contrast to the coastal lowlands to the west and the Tsala Apopka Plain to the east which have experienced substantial dissolution of limestone resulting in lower elevations.

Tsala Apopka Plain

The Tsala Apopka Plain which is part of White's (1970) Western Valley occupies the entire eastern portion of Citrus County. Bounded on the east by the Withlacoochee River and on the west by the Brooksville Ridge, this region has a number of interconnected lakes partially separated by peninsulas and islands. Alluvial deposits of variable thickness cover the limestone surface. Elevations of the land surface range from 60-80 feet above mean sea level while water surface elevations vary from 35 to 45 feet.

STRATIGRAPHY

Exploratory drilling operations have penetrated sediments to a maximum depth of 5556 feet in Citrus County, stopping in quartzitic sandstones. Deep subsurface sediments consist of shales, sandstones, dolomites and limestones while surface and near surface deposits consist of unconsolidated sands, clays, limestones and dolomites. Only the surface and near surface units will be expanded upon here.

Eocene Series

Avon Park Limestone

The Avon Park Limestone was named by Applin and Applin (1944) for the upper Middle Eocene (40-45 million years ago) limestone recognized in a Florida Geological Survey well (W-668) drilled at the Avon Park Bombing Range in Polk County, Florida. It is the oldest stratigraphic unit to crop out in Florida. Exposures of the Avon Park Limestone in Citrus County are rare except in the northern part of the county along the Withlacoochee River and near Red Level.

In Citrus County the Avon Park Limestone can be a dolomite, or limestone with varying degrees of dolomitization. Where the lithology is that of a dolomite the grain size varies from microcrystalline (siltsized) to very fine grained. The dolomite crystals are frequently enhedral and the rock appears sucrosic and is unconsolidated to well indurated. When the Avon Park is lithologically a limestone it is white or cream to brown and gray. The limestone is cryptocrystalline to very fine grained (up to .125mm), thin bedded or laminated with organic flecks and seams. The limestone can also be relatively structureless. The Avon Park can be a recrystallized limestone in which case it typically is more indurated.

The Avon Park Limestone lies upon the Lake City Limestone. It unconformally underlies the younger Ocala Group limestones where the Ocala Group has not been eroded away.

Fossils found in the Avon Park Limestone include echinoids, foraminifera, mollusks, bryozoa, and corals. These fossil groups are indicative of a shallow marine environment.

<u>Eocene Series</u>

Ocala Group

The Ocala Group limestones consist of three formations which in ascending order are: Inglis Formation, Williston Formation, and the Crystal River Formation. These formations are, where they have not been eroded away, at or near the land surface.

Inglis Formation

The lithological chatacteristics of the Inglis Formation in Citrus County are that of a limestone (calcarenite or grainstone to packstone) with varying degrees of dolomitization, poor to well indurated, white to cream, yellowish brown to tan in color, with calcite or dolomite cement. In part, the formation is a foraminiferal coquina. Dolomitic sections are poor to well indurated, and composed of euhedral crystals of microcrystalline (silt sized) to very fine grain sized dolomite. Thickness of the formation is variable with the average being about 50 feet.

The Inglis Formation lies unconformably upon the Avon Park Limestone. The Inglis Formation conformably lies below the Williston Formation where the Williston Formation has not been eroded away.

Exposures of the Inglis Formation in Citrus County occur at a quarry near Red Level, along the coastal area on the Pamlico terrace, and along the Withlacoochee River in northeastern Citrus County.

Fauna is abundant in the Inglis and is made up of species of mollusks, echinoids, and foraminifera. Where in abundance the foraminifera may form a coquina.

Williston Formation

Lithologically, the Williston Formation is a marine limestone, cream to tan colored foraminiferal coquina of miliolids (grainstone or calcarenite). This granular to chalky limestone is loosely held together by carbonate cement. The average thickness of the Williston Formation is approximately 30 feet.

Comprising the middle unit of the Ocala Group, the Williston Formation is conformably overlain by the Crystal River Formation and conformably underlain by the Inglis Formation. The transition between the Crystal Formation and the Williston Formation is gradational and therefore, may be difficult at times to delineate.

Exposures of the Williston Formation in Citrus County occur in the western regions near the coast as well as in the eastern areas where it forms the bedrock of the Tsala Apopka Plain. Other exposures occur in solution features such as sinkholes but since these are often filled with sediments observing the formation is often difficult. Several exposures can be observed along the Withlacoochee River in northeastern Citrus County. In the southeastern areas of the county the Williston Formation is present in old phosphate quarries but vegetation and slump material has nearly obscured all of the formation (Vernon, 1951).

Miliolid foraminifera are the most abundant fauna in the Williston Formation. Other fauna include echinoids, mollusks, and other species of foraminifera.

Crystal River Formation

The Crystal River Formation of late Eocene age (35.6 - 40 million years ago) was named for an exposure in the Crystal River Rock Quarry in Citrus County (Puri, 1953; Vernon and Puri, 1956).

The lithology of the Crystal River Formation is a white or cream to buff colored, moderately indurated packstone to wackestone, variably recrystallized, foraminiferal coquina (large foraminifera) in part set in a pasty calcite matrix. The thickness of the Crystal River Formation at the Crystal River Quarry is 108 feet.

The Crystal River Formation lies conformably upon the

Williston Formation. The Crystal River Formation lies unconformably below Recent age sediments to Oligocene age limestones where present in Citrus County.

Exposures of the Crystal River Formation can be found in the Crystal River Quarry. Other exposures of this formation occur along the coastal region on the Pamlico terrace and in south-central Citrus County in sinkholes.

The common occurrence of the foraminifera genus Lepidocyclina is frequently used as a guide in identifing this formation. Other common fossil groups include bryozoa, echinoids, and mollusks.

Oligocene Series

Suwannee Limestone

The Suwannee Limestone of Oligocene age (23.7-35.6 million years ago) was named by Cooke and Mansfield (1936) for exposures along the Suwannee River near Ellaville, Madison County, Florida. The Suwannee Limestone is present at or near the ground surface in the south-central region of the Brooksville Ridge in Citrus County. Exposures may also be found in road cuts, quarries, and sinkholes.

The general lithology is a cream to tan colored limestone, which is granular to chalky, moderate to well indurated, variably recrystallized, partially silicified and very fossiliferous. Vernon (1951) states that in this region the Suwannee Limestone may be 120 feet thick. The Suwannee Limestone unconformably rests upon the Crystal River Formation and unconformably underlies Recent to Miocene age sediments.

Fragments of macrofossils and microfossils are found in the Suwannee Limestone. Common fauna groups found in the limestone include pelecypods and gastropods along with foraminifera such as miliolids and Dictyoconus cookei.

Post-Oligocene Series

Undifferentiated Sediments

A veneer of sand, clayey sand and sandy clay overlies most of Citrus County. These sediments range in age from Miocene to Recent. Thicknesses vary substantially due to the irregular surface of the underlying limestone.

The Gulf Coastal Lowlands and the Tsala Apopka Plain surface sediments are composed of light colored, medium to fine grained, poorly consolidated to unconsolidated quartz sand and silt. The surface of the Brooksville Ridge is covered by sand which is underlain by orange to reddish orange clayey sand and sandy clay which in turn is underlain by the Suwannee Limestone or Ocala Group limestones. Some of the sediments on the ridge (clays and quartz sands which are phosphatic and contain organic material) are considered to be residual material of the Hawthorn Group (Scott, personal communications, 1984, manuscript in preparation) which was present in the area prior to being eroded (Scott, et al., 1980). Cooke (1945) assigned clastic sediments of this type to the Alachua Formation. He further goes on to say that the

Brooksville Ridge is underlain by the Alachua Formation. Vernon (1951) states that marine clays overlying the Suwannee Limestone in southern Citrus County belong to the Miocene Hawthorn Formation and that terrestrial clays belong to the Alachua Formation.

ECONOMIC GEOLOGY

STONE

Limestone is mined predominantly from the Lecanto, Red Level, northern (south of Inglis) and southeast regions of Citrus County. Formational units from which mining presently is occurring are the late Middle Eocene age Avon Park Limestone, the late Eocene Ocala Group, and the Oligocene Suwannee Limestone (Schmidt, et al., 1979).

All limestone and dolomite mined in Citrus County is mined by open pit methods. Generally, overburden must be removed using bulldozers or draglines. If, after overburden removal, soft rock conditions are encountered, bulldozers equipped with a claw can rip the rock loose. When hardness increases, blasting becomes necessary prior to mining. Where pits are flooded, draglines must be utilized. After mining, the rock is loaded onto trucks for transport to a processing plant or crushed and stockpiled (Campbell, personal communication, 1984, manuscript in preparation).

Size reduction and grinding are the common processing procedures. These procedures involve crushing and screening to produce the desired size material. The beneficiation procedures, those which upgrade the material by removing impurities and adding desirable materials, are washing, screening, drying and blending. After all processing is completed the material may be utilized as a road base material, fertilizer and soil conditioners, rip rap, and as a concrete and asphalt aggregate.

SAND

In Citrus County only the Brooksville Ridge contains sand deposits of primary importance. The sands of the ridge range in age from Miocene to Recent. These clastics are predominantly poorly sorted, fine to medium grain sized quartz sands. Except for surface sand, the sand may contain a clay matrix (Scott, et al., 1980).

Recent dune and alluvial sand deposits exist in Citrus County but are of variable quality and volume. These deposits are economically valuable only on a local scale. Sand deposits of the Pleistocene terraces in the Gulf Coastal Lowlands are considered too fine grained for construction uses.

Once mined, sand may be graded by size (coarse to fine) using a series of shaker screens. Sand is almost exclusively transported by truck. The major uses of construction sand and gravel are for concrete aggregate, roadbase material, construction fill, and asphalt mixtures.

PHOSPHATE

Hard rock phosphate was mined in Citrus County for many years until about 1966 when it became economically unfeasible to continue operations (Deuerling and MacGill, 1981). The origin of Hard Rock Phosphate has been discussed for many years. Phosphoric acid in solution in water can under favorable conditions, replace the carbonate of limestone thus forming calcium phosphate (i.e., hard rock phosphate). Sellards (1913) states that the matrix material in the hard rock phosphate deposits is the residue of previously eroded limestone.

During mining and beneficiation of the hard rock phosphate, phosphatic clays were slurried and discarded as waste in previously mined out pits or simply allowed to flow onto the natural ground surface. This waste material is high in phosphate content. Today, several companies are processing the waste clays of former hardrock operations primarily for use as animal feed ingredient, and as a direct application fertilizer.

CLAYS

Clay of an unclassified nature is being mined by one company east of the Lecanto area in Citrus County.

GROUNDWATER

In Citrus County the principal source of water is the Floridan Aquifer. The aquifer is composed of the Eocene to Oligocene age limestones and dolomites of the Lake City Limestone, Avon Park Limestone, Ocala Group and the Suwannee Limestone where present. The base of the aquifer is approximately at the point where evaporites consistantly fill limestone and dolomite pore spaces. Generally, fillings of this nature occur within the lower Lake City Limestone (Fretwell, 1983). The top of the aquifer is at sea level or just submerged along the coastline. Inland, the top of the aquifer is covered by a veneer of sand, clayey sand or sandy clay. The Floridan Aquifer is described as unconfined for much of Citrus County due to the absence of well developed low permeability sediments between the ground surface and the top of the aquifer. In the Brooksville Ridge area where the aquifer is overlain by several feet of low permeability sands, clayey sands, and clays, the aquifer may be defined as semiconfined. In these areas, the local groundwater table may be developed in the surficial sands above the clayey sediments.

The Floridan Aquifer is recharged by precipitation and groundwater flow. Direction of groundwater flow is toward the Gulf of Mexico. Natural artesian discharge occurs in springs and marshes. On the basis of discharge, the Homosassa and Crystal River Springs have been labled first-order magnitude springs, that is, they discharge water at rate more than 100 cubic feet per second.

In Citrus County the Floridan Aquifer is considered to be a potable water source. The exception to this is in the coastal region where saltwater encroachment has occurred. As demand for water increases so will the problems associated with water quality. Citrus County has shown a population increase of 185 percent between the census of 1970 and 1980 (Fernald, 1981). Presently, the major demand on the aquifer comes from the agricultural and industrial communities as well as the domestic and rural users.

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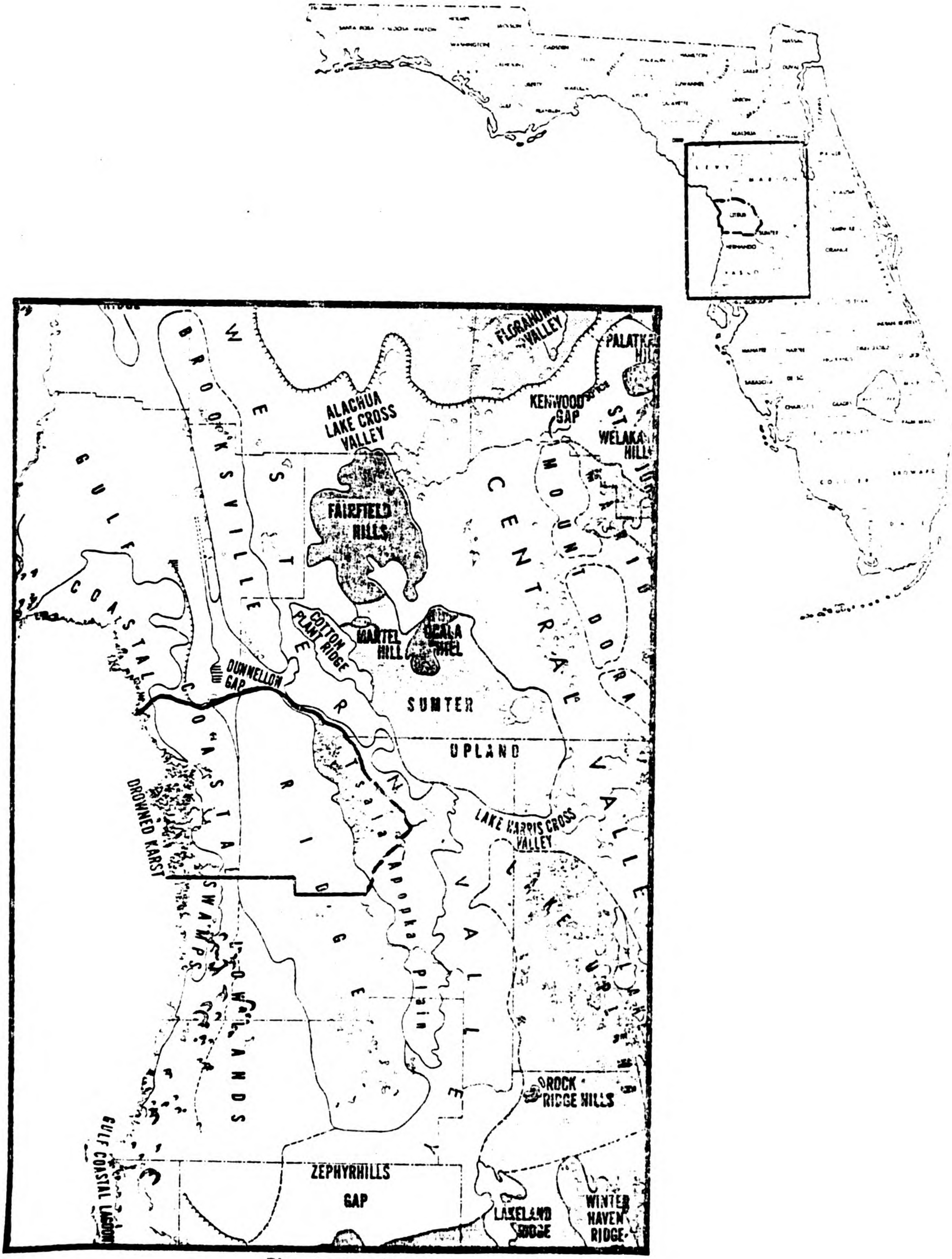
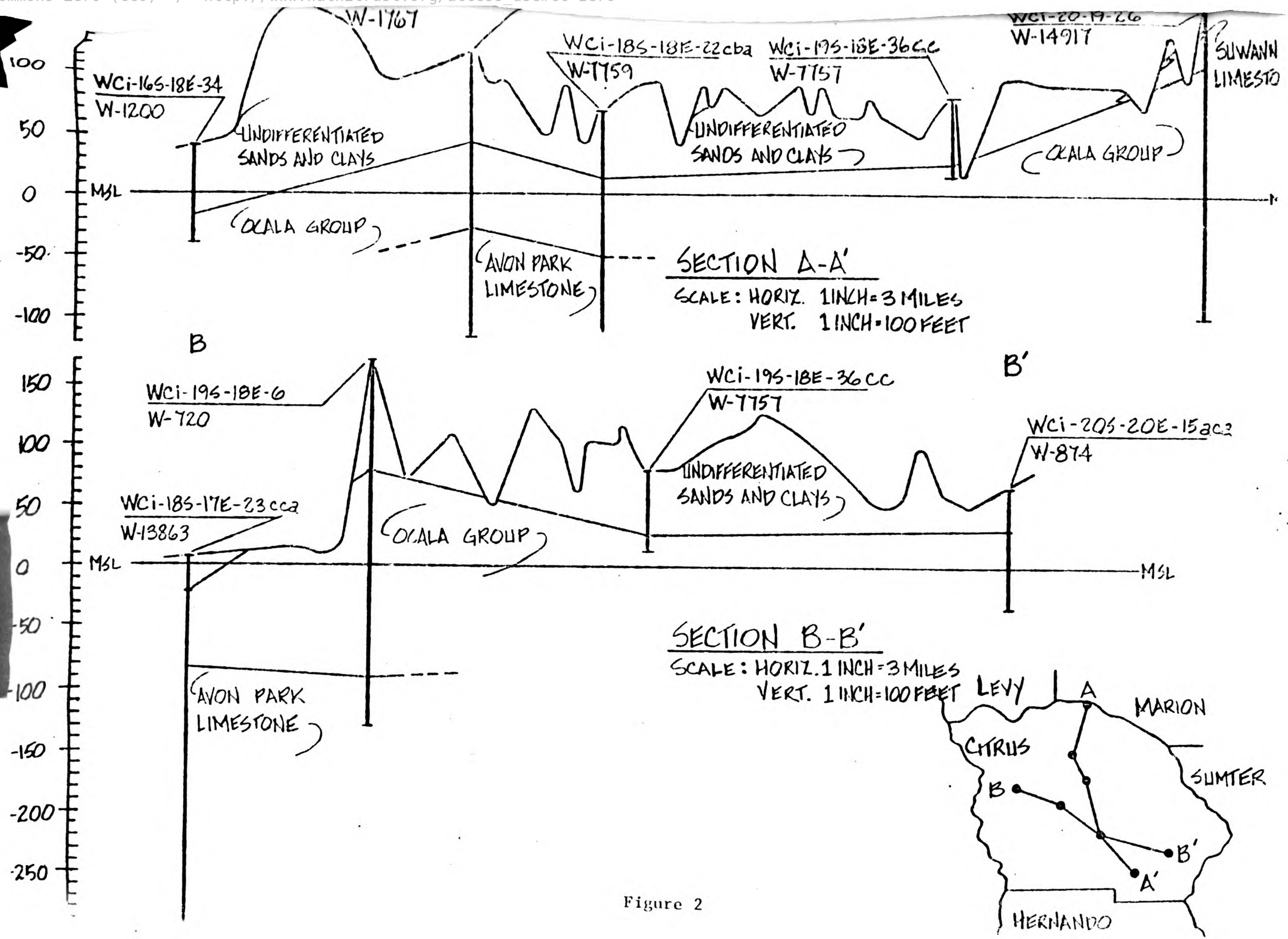


Physiographic Map
From White 1970
Figure 1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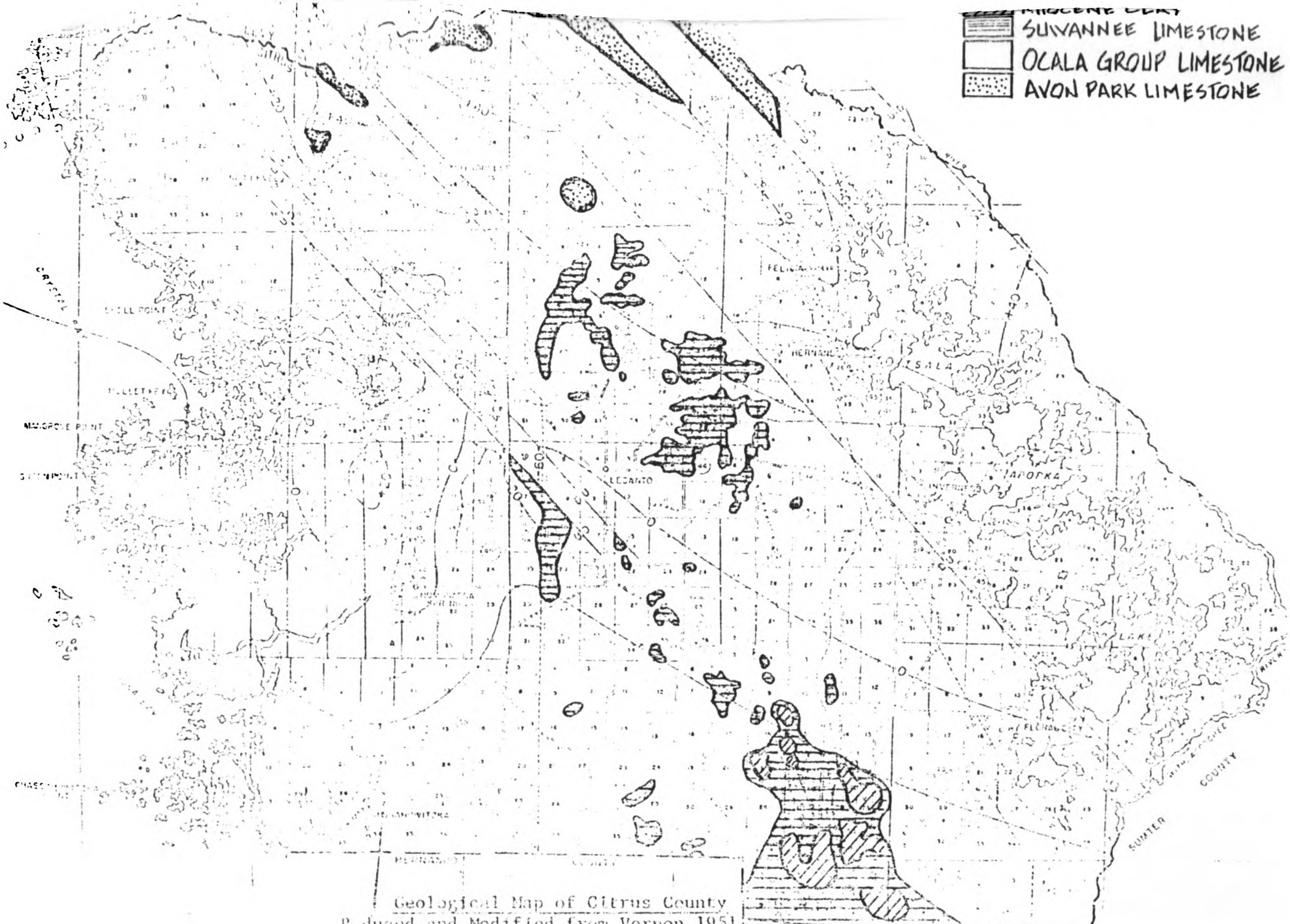
W-1200
W-1767
WCi-18S-18E-22cba
W-7759
WCi-19S-18E-36cc
W-7757
W-14917
SUWANN LIMESTO
UNDIFFERENTIATED SANDS AND CLAYS
OCALA GROUP
AVON PARK LIMESTONE
MSL
SECTION A-A'
SCALE: HORIZ. 1 INCH = 3 MILES
VERT. 1 INCH = 100 FEET
B
B'
WCi-19S-18E-6
W-720
WCi-18S-17E-23cca
W-13863
WCi-19S-18E-36cc
W-7757
WCi-20S-20E-15ac2
W-874
SECTION B-B'
SCALE: HORIZ. 1 INCH = 3 MILES
VERT. 1 INCH = 100 FEET
LEVY
MARION
CITRUS
SUMTER
HERNANDO
A
A'

Figure 2



Geological Map of Citrus County
Reduced and Modified from Vernon 1951
Figure 3