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Geology and Groundwater of Madison County
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GEOLOGY AND GROUNDWATER OF MADISON COUNTY

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REGIONAL SETTING

Located in the eastern part of the Florida panhandle, Madison County encompasses a transitional geologic area that separates the thick Tertiary carbonate sediments characteristic of the Florida peninsula from the pre-dominant age equivalent clastic sediments of western Florida. This area is underlain by thick limestone deposits of Oligocene and Eocene age which in turn are covered by younger limestones, dolomites, sands and clays in the northern half of the county.

Two major physiographic divisions occur within Madison County. As proposed by Puri and Vernon (1964), these divisions include the Northern Highlands and the Coastal Lowlands (figure 1). The Northern Highlands extend over the northern two-thirds of the county while the Coastal Lowlands occupy the remaining third of Madison County.

The boundary between these two divisions occurs at a southward-facing escarpment named the Cody Scarp (Puri and Vernon, 1964). This escarpment is considered to be one of the most persistent topographic breaks in Florida. Easily observed to the west in Jefferson County, the trend of the Cody Scarp in Madison County is irregular and frequently difficult to observe. However, a series of N-S surface elevation profiles shows a distinct break at the 100' contour. This 100' elevation, which was used by Crane, 1983 and Cooke, 1939, is also used in this report to define the Cody Scarp in Madison County.

Extending over parts of several counties in Florida and Georgia the Northern Highlands in Madison County includes all of the area north of the Cody Scarp (figure 1). This physiographic region includes a prominent physiographic feature known as the Tallahassee Hills, which in the study area lies between the Florida-Georgia state line on the north and the Gulf Coastal Lowlands on the south (figure 1). The Tallahassee Hills are erosional-remnant hills and ridges with elevations as high as 230 feet in Madison County. Occurring extensively throughout the northern two-thirds of Madison County, these hills and ridges are characterized by gently slopes and rounded tops. Although the Tallahassee Hills in this area have been highly dissected by stream erosion and subsurface solution, they probably once represented a nearly flat Miocene delta plain that covered all of northern Madison County.

With markedly lower elevations, the other major physiographic region, the Gulf Coastal Lowlands occurs in Madison County in an area bounded to the north by the Cody Scarp and south by the Taylor and Lafayette county lines. Features located, within the Gulf Coastal Lowlands include the Wicomico Terrace, which coincides with the top of the Cody Scarp in Madison County, occurring at the 100 feet elevation, San Pedro Bay and the River Valley Lowlands associated with the Suwannee, Withlacoochee and Aucilla rivers. Numerous tributaries in the form of small streams and creeks that originate in the adjoining Tallahassee Hills flow into these rivers. Although extending into the Northern Highlands, these river valley lowlands are placed in the Gulf Coastal Lowland province on the basis of their lowest elevation (Ceryak, et al., 1983).

GEOLOGIC DISCUSSION

The sediments that occur in Madison County range in age from Paleozoic to Recent. To date, the deepest penetration of subsurface sediments in the

study area occurred at a depth of 10,150 feet (MSL). These sediments obtained from an oil test well (P-1033) were identified as Paleozoic quartzitic sandstones deposited hundreds of millions of years ago. In contrast, surface and near-surface occurrences include unconsolidated sands, limestone and highly indurated dolomites ranging in age from the Eocene Epoch (36 to 58 million years ago) to the Recent. The oldest surface outcrops are dolomite and limestone belonging to the Eocene Epoch (40 to 38 million years ago). A short geologic discussion of the near-surface and surface sediments follows.

OCALA GROUP

The Ocala Group Limestones, which were deposited during the Eocene Epoch (40 to 38 million years ago), represent the oldest sediments exposed in Madison County. These limestones, which form an integral part of the Floridan Aquifer, occur at varying depths throughout the county. The Ocala Group Limestone is generally a pale orange, poor to moderately indurated, moderately to high porous, microfossiliferous, partially dolomitized, partially recrystallized limestone (calcarenite). The occurrence of the distinctive foraminifera genera Lepidocyclina is common to abundant and often used as a guide in distinguishing this formation from the overlying younger Suwannee Formation.

Unfortunately, few wells in Madison County penetrate these sediments. However, in the vicinity of the City of Madison, the top of the Ocala was found to occur at -100 feet (MSL). Varying in thickness throughout the county, it was present in the interval from 200 to 385 feet below land surface, a thickness of 185 feet in a well (W-2549) near the City of Madison. These sediments are unconformably underlain by the Avon Park Limestone and overlain unconformably by the Oligocene age Suwannee Limestone.

SUWANNEE LIMESTONE

Exposures of limestone and dolomites belonging to the Suwannee Limestone Formation, that was deposited during the Oligocene Epoch, occur along the Suwannee River at Ellaville. The Suwannee Limestone lies unconformably upon the Ocala group limestone and unconformably underlies the St. Marks or Hawthorn Formation. Where the St. Marks and Hawthorn Formation are absent, it underlies the younger Miccosukee Formation. In parts of southern and southeastern Madison County, the Suwannee is covered by Pleistocene deposits and scattered outliers of the Hawthorn Formation.

The Suwannee Formation is a marine limestone consisting of a partially recrystallized limestone (calcarenite). It is very pale orange, finely crystalline, moderate to well indurated, with moderate to good porosity and very fossiliferous. Chemical tests indicate a composition that is nearly 97 percent CaCO_3 .

In various locations such as along the Suwannee River at Ellaville, the top of the formation is silicified at the land surface and near subsurface. It has been observed from well cuttings that dolomitization of the limestone has occurred in the subsurface at different depths. This process of secondary dolomitization can also be readily observed in the outcrop area along the Aucilla River.

Measurements of the formation's thickness are approximated because most of the information available is from wells that terminate in the Suwannee. The maximum thickness encountered in a core was in W-15515 located in T2N, R8E, Sec. 5 ca, in which 157 feet of limestone was penetrated. Fossiliferous outcrops of this formation can be observed along the Suwannee River from White Springs to Ellaville.

The Suwannee Limestone, in many areas, is covered by a thin veneer of

Pleistocene sand. However, from just below Lamont to just north of Nutall Rise, it is almost continually exposed along the banks of the Aucilla River either as silicified boulders or as massive dolomite beds. Both the dolomite beds and the silicified boulders often form rapids along the river.

ST. MARKS FORMATION

Early Miocene sediments unconformably overlie the Suwannee Limestone in many parts of Madison County. These sediments, which form the St. Marks Formation, are white to very pale orange, finely crystalline, sandy, silty, clayey limestone (calcilutite). The St. Marks is poor to well indurated, has low to medium porosity, contains molluscan casts and a few species of foraminifera (Sorites sp., Archaias floridanus). The calcilutite has been partially dolomitized and silicified in the subsurface. In a sinkhole in Lee, Florida, the St. Marks occurs as a partially recrystallized limestone (calcilutite).

In contrast to the underlying Suwannee Limestone, the St. Marks sediments do not occur in all parts of Madison County but have sporadic occurrences (cross sections A-A', B-B' and C-C', figures 2, 3 and 4). St. Marks outcrops are rare as the greater part of the deposits are covered by younger sediments. The only exposure observed in Madison County occurs in a sinkhole, behind the Methodist Church in Lee, Florida.

The cross sections in figures 2, 3 and 4 show the variability of the St. Marks throughout the study area. Sediment thickness varies from very thin to absent in the central part of the county to a maximum observed thickness of 39 feet in a core (W-15537) drilled in north central Madison County in an area west of Cherry Lake.

Overlying the St. Marks Formation are the younger Miocene sediments known as the Hawthorn Formation. These sediments are present in the subsurface over most of Madison County.

HAWTHORN FORMATION

The Hawthorn Formation consists of pale olive to moderate yellow, sandy, waxey, phosphatic clays and sands. The clay contains phosphorite grains and is interbedded with very fine to medium, clayey quartz sands that also contain phosphorite. The clays and sands are frequently cherty and often associated with stringers of sandy calcilutites.

Variable in thickness, the Hawthorn Formation was observed to pinch out to the east and southeast of Madison County along the Suwannee River. In contrast, Hawthorn sediments on the western side of Madison County are significantly thicker. The thickest section of Hawthorn deposits observed, occurred in a core (W-6558) near State Road 90 where a thickness of 142 feet was encountered. Surface outcrops of Hawthorn sediments occur on the eastern side of the county along the Withlacoochee River.

In southeastern Madison, northeastern Taylor and northwestern Lafayette counties, Hawthorn clays underlie a broad low area known as San Pedro Bay. These clays inhibit the downward percolation of water resulting in extensive swampy conditions throughout the area.

The Hawthorn Formation lies unconformably upon either the St. Marks Formation or the Suwannee Limestone. It is in turn overlain by the Miccosukee Formation or, where absent, by Pleistocene sands.

MICCOSUKEE FORMATION

A prominent feature throughout the county is the varicolored, heterogeneous complex of sediments referred to as the Miccosukee Formation. Overlying the Hawthorn Formation, the Miccosukee Formation is generally

present in Madison County except in the south and southeastern parts of the county.

The Miccosukee is an aggregate of lenticular clayey sands and clay beds which individually can be traced laterally for only short distances. These sediments are moderately sorted to poorly sorted, coarse to fine-grained, varicolored, clayey, quartz sand and montmorillonitic, kaolinitic, varicolored, sandy clays. The frequently crossbedded sands contained crossbedded thin laminae of white to light gray clay. X-ray diffraction patterns indicate that the laminae associated with both quartz sands is kaolinite.

The Miccosukee sediments are in many places deeply weathered laterites. Having experienced intense weathering, the bedding that was once present has been destroyed, giving exposed sediments a massive appearance. The Miccosukee is extremely variable in thickness, a condition attributed in part to extensive weathering and associated erosion. A maximum thickness of 80 feet was encountered in the west central part of the county in core (W-6558), suggesting that the top of some of the highest hills may represent the original depositional surface. Similar thicknesses were observed in well cuttings in the same general area along State Road 90.

The formation can be observed in numerous roadcuts throughout the northern part of the county. The type locality of this formation can be seen at a roadcut on the east side of U. S. Highway 19, about 3.1 miles south of the Georgia-Florida State line in neighboring Jefferson County. The sediments in this section illustrate rapid sedimentation changes including channel cut and fill features of a deltaic environment.

PLIOCENE/PLEISTOCENE TO RECENT SEDIMENTS

Surficial sediments of Pliocene/Pleistocene age form much of the land surface in the south and southeastern part of the county. Less widespread sediments of Recent age are confined primarily to the present stream valleys.

The Pliocene/Pleistocene deposits forming the Gulf Coastal Lowlands south of the Cody Sharp are very fine to medium quartz sands with blue-green to light olive, montmorillonitic clay lenses. The Recent sediments are essentially reworked Pleistocene quartz sands and quartz sands derived from the Miccosukee Formation.

The Pleistocene deposits range in thickness from a feather edge in the southeastern part of the county to 35 feet in well (W-705) which is located 5 miles southeast of the town of Lamont at the toe of the Cody Scarp. These sediments are extremely variable in thickness throughout southern Madison County and essentially absent in the northern part of the county. These sediments unconformably overlie the St. Marks Formation and the Suwannee Limestone in the southern part of the county.

GEOLOGIC HISTORY

From the beginning of Late Cretaceous until early Middle Eocene, Madison County was an area of clastic deposition. However, changes in the depositional environment occurred at the beginning of the early Middle Eocene resulting in carbonates becoming the dominant sediment.

It was during this time that the Middle Eocene, Lake City Limestone, the Eocene Ocala Group limestone and the Oligocene Suwannee Limestone were deposited. These limestone formations were deposited in a warm, shallow, open sea.

At the close of the Oligocene Epoch, a period of predominantly clastic

sedimentation took place. Later, the St. Marks Formation was deposited by encroaching Early Miocene seas.

An influx of clastic sediments generally masked carbonate deposition during the Middle Miocene. It was at this time that the Hawthorn Formation consisting primarily of phosphatic sands and clays, was being deposited. At the cessation of Hawthorn deposition, the predominantly marine environment changed to a deltaic environment. The Miccosukee deposits forming this delta complex are widespread, covering parts of Madison, Jefferson, Leon and Gadsden counties. The age of these deposits has been established, at least in part, as Late Miocene on the basis of land mammals found in Jefferson County.

The beginning of the Pleistocene Epoch saw the return of the seas over much of Madison County resulting in the formation of the Gulf Coastal Lowlands in the southern part of the county. It was during this time that the Aucilla River in addition to many of the creeks were formed. Other changes included the erosion and subsequent removal of most of the St. Marks Formation from the Gulf Coastal Lowlands.

Sea level has been fairly stationary since the beginning of the Recent Epoch. Deposition presently occurring in Madison County is restricted to alluvium along the many streams and peat and mud in the lakes and coastal marshes.

GROUND WATER

The Floridan Aquifer is the principal water-bearing unit in Madison County. It includes all of the Middle Eocene to Early Miocene formations.

Intermediate aquifers are present in northern Madison County. These aquifers occur within discontinuous units of limestone, dolomite and sand that form the Hawthorn Formation. Although the amount of water obtained from the intermediate aquifers are minimal compared to the underlying Floridan Aquifer it may be sufficient for small domestic supplies. In addition, the quality of water in the intermediate aquifer is diminished relative to the Floridan by the presence of more dissolved solids.

Other sources of water include water table aquifers that occur within the surficial sand deposits at higher elevations. These aquifers receive recharge primarily from rainfall or through upward percolation of underlying aquifers when their potentiometric surfaces are higher than that of the water table. Water quality in these aquifers is diminished due to the high concentration of iron.

REFERENCES

- Ceryak, R., M. S. Knapp, and T. Burnson, 1983, Florida Bureau of Geology in cooperation with the Suwannee River Water Managemen District, The Geology and Water Resources of the Upper Suwannee River Basin, Florida: Florida Bureau of Geology, RI 87.
- Crane, J. J., 1983, An Investigation of the Geology, Hydrogeology and Hydro-chemistry of the Lower Suwannee River Basin: Florida Bureau of Geology, in preparation.
- Cooke, C. W., 1939, Scenery of Florida Interpreted by a Geologist: Florida Geological Survey, Bull. 17.
- Pressler, E. D., 1947, Geology and Occurrence of Oil in Florida: Am. Assoc. Petroleum Geologists Bull., v. 31, pp. 1851-1862.
- Puri, H. S. and Vernon, R. O., 1964, Summary of the Geology of Florida and a Guidebook to the Classic Exposures: Florida Geological Survey Special Publication 5 Revised.
- Vernon, R. O., 1951, Geology of Citrus and Levy Counties, Florida: Florida Geological Survey, Bull. 33.
- Yon, J. W., 1966, Geology of Jefferson County, Florida: Florida Geological Survey, Bull. 48.

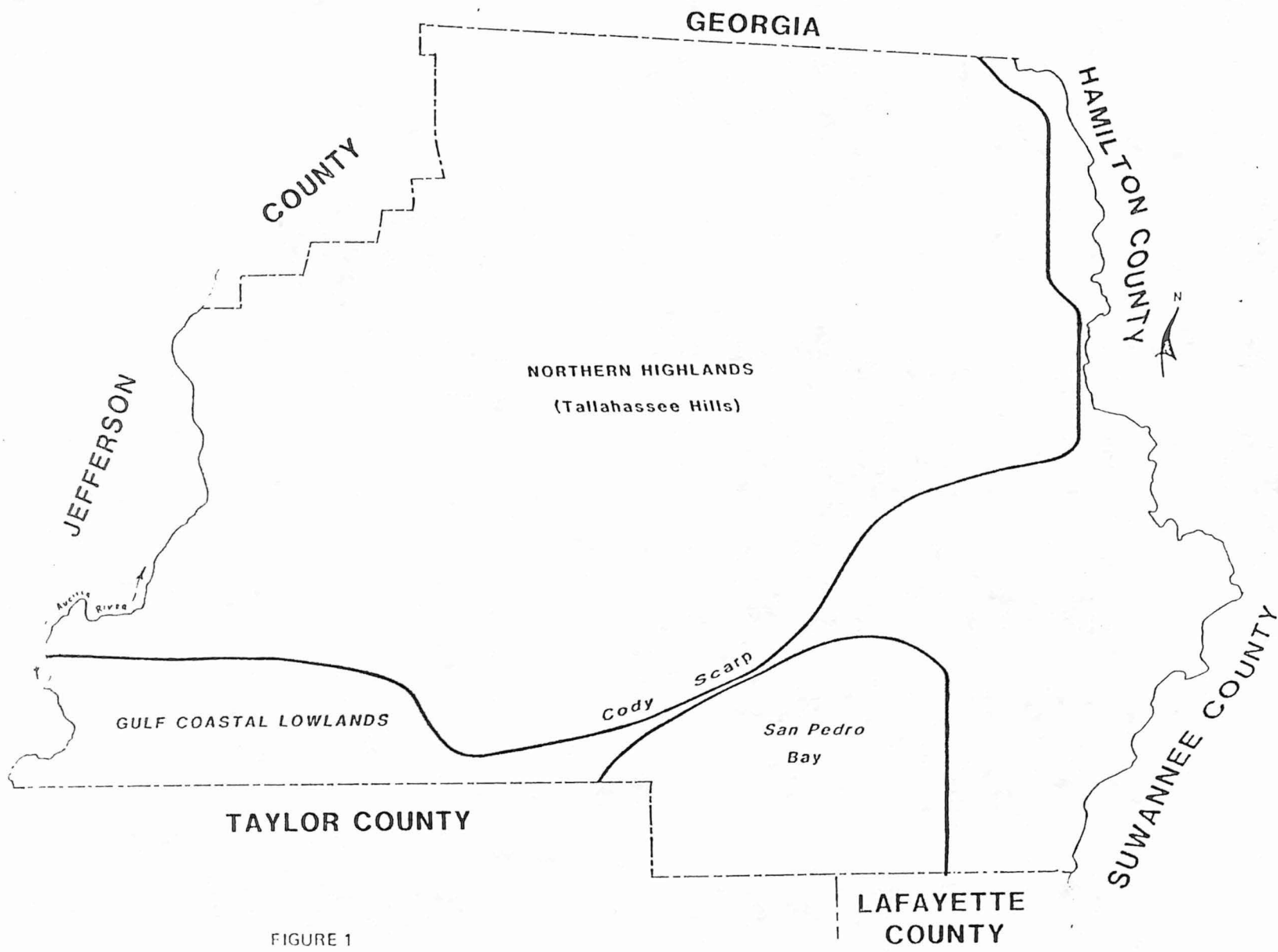
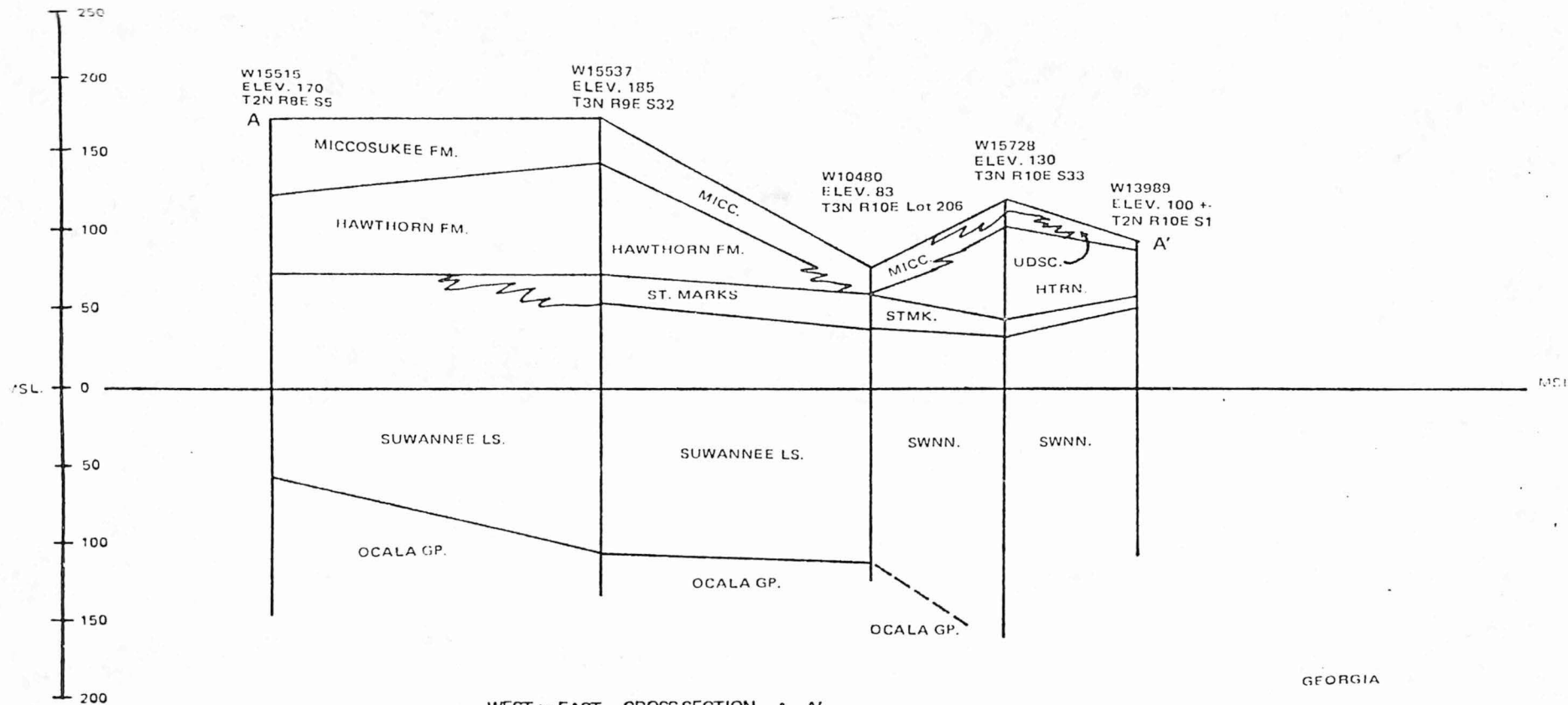
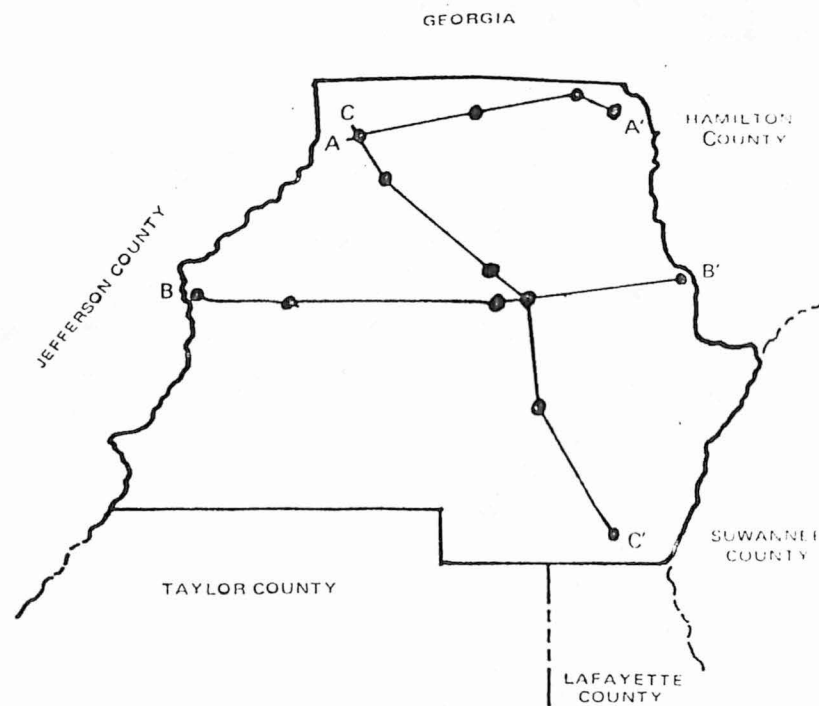


FIGURE 1



WEST to EAST CROSS SECTION A-A'

FIGURE 2



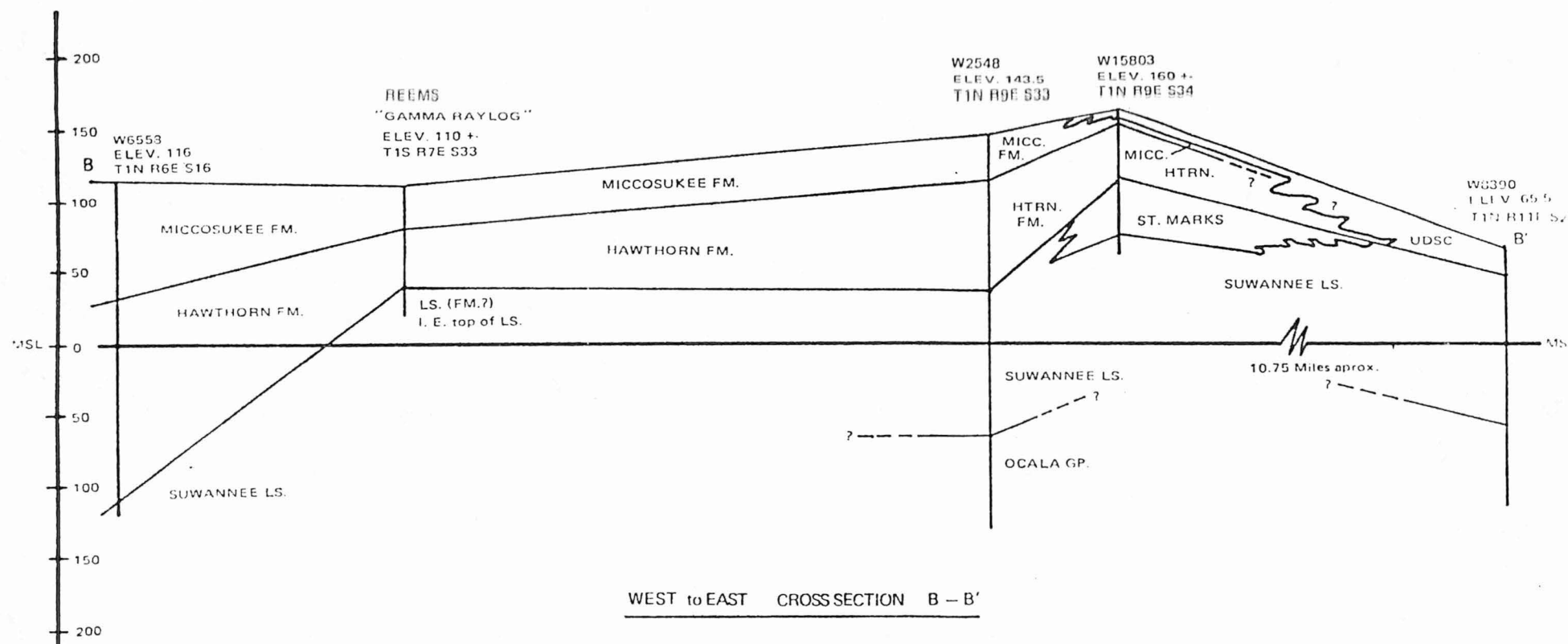


FIGURE 3

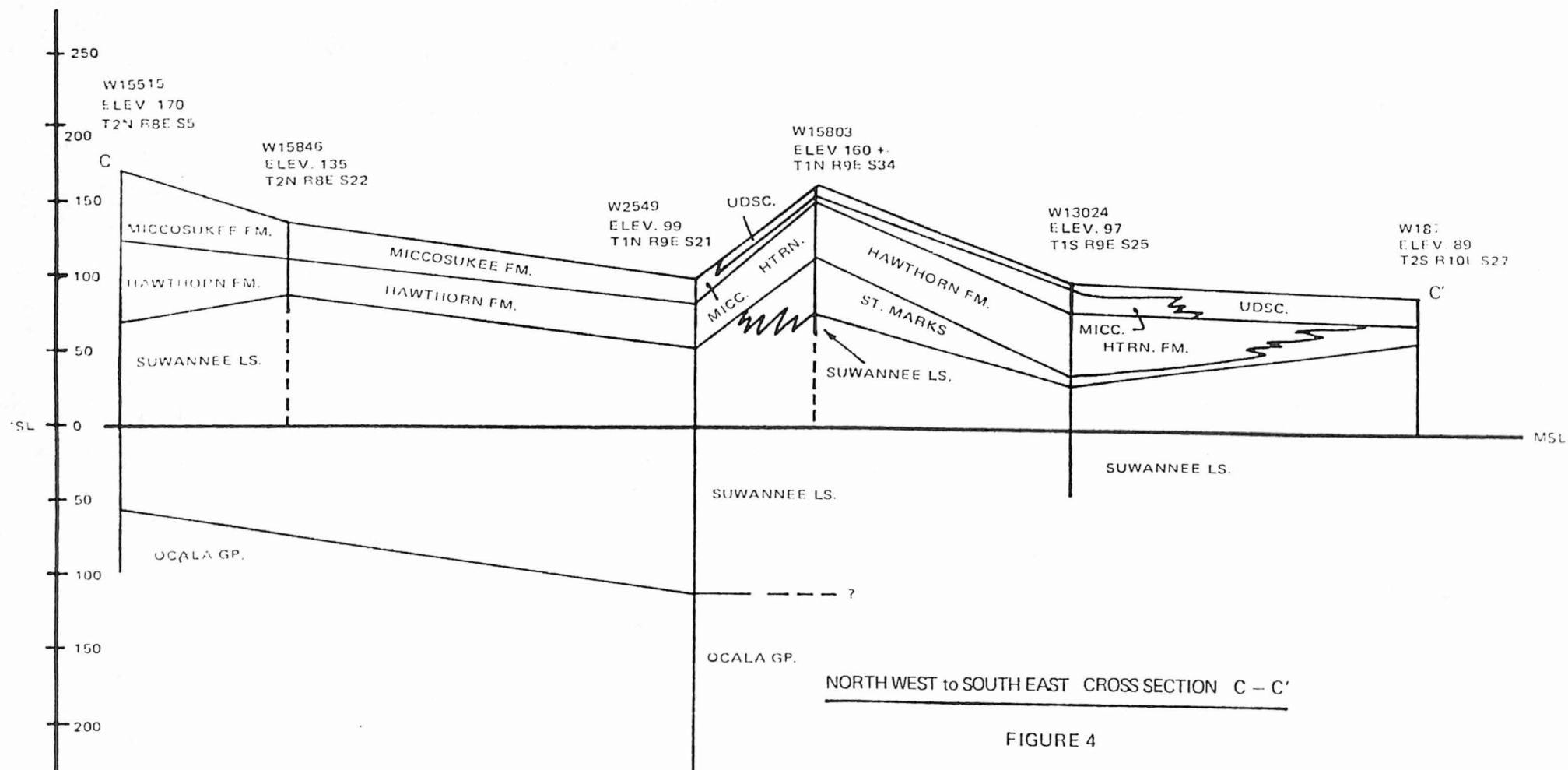


FIGURE 4

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FLORIDA GEOLOGICAL SURVEY