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OPEN FILE REPORT NO. 45

THE GEOMORPHOLOGY AND GEOLOGY OF DIXIE COUNTY, FLORIDA

BY

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FLORIDA GEOLOGICAL SURVEY
Tallahassee
1991

The geomorphology and geology of Dixie County, Florida

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GEOMORPHOLOGY

Dixie County is situated in Florida's Big Bend area, along the northern edge of the Central or Midpeninsular geomorphic zone of White (1970). This zone extends down the Florida peninsula from an approximate line connecting the cities of Perry in Taylor County, Gainesville in Alachua County, and St. Augustine in St. Johns County, southward to the Caloosahatchee River. In Dixie County, the Central Zone is represented by a broad geomorphic subzone named the Gulf Coastal Lowlands (Figure 1).

Gulf Coastal Lowlands

All of Dixie County lies within an extensive geomorphic subzone named the Gulf Coastal Lowlands (White, 1970). This zone is characterized as a low, flat, frequently swampy and gently seaward sloping sandy plain. Surface slope ranges between 1 and 4 feet per mile seaward. Limestone, covered by a thin veneer of unconsolidated sand, forms the near-surface substrate in most of the county. The Gulf Coastal Lowlands extend from the modern shoreline inland to approximately the 100 feet above

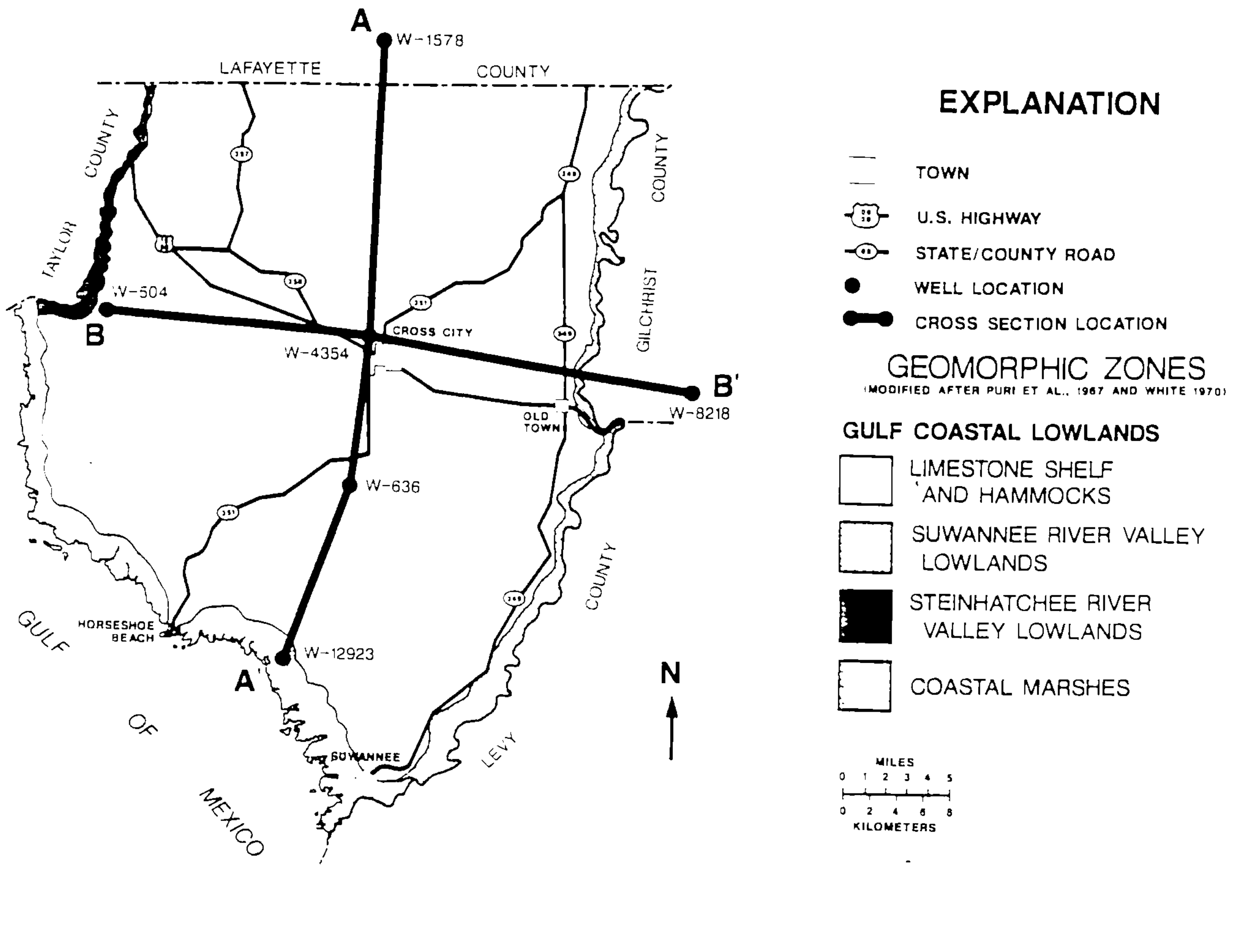

Figure 1: Geomorphic and cross section location map of Dixie County.

mean sea level (MSL) elevation line. In Dixie County, the maximum elevation attained is about 60 feet above MSL in the northeastern portion of the county. Most of the lowlands area is ancient marine terrace terrain. Pleistocene seas alternately flooded and retreated from this region, depositing a step-like series of marine terraces, which generally parallel the modern coastline. Healy (1975) recognizes three marine terrace elevation zones in the county, including the Silver Bluff Terrace (less than 10 feet above MSL), the Pamlico Terrace (8 to 25 feet above MSL), and the Talbot Terrace (25 to 42 feet above MSL). Imposed on the terraces are numerous relict Pleistocene marine features such as bars, dunes, and beach ridge systems. Such relict features, composed principally of white quartz sand, may be observed stranded far inland from the modern coastline.

The present Gulf shoreline in this area is classified as a low-wave energy drowned karst coast, which is characterized by having very low wave activity, a general lack of sand beaches and an irregular outline. A series of small islets, or keys, comprised of limestone pinnacles or alluvial sand, are common offshore. Coastal salt marshes are common at the land-sea interface.

The Gulf Coastal Lowlands zone in Dixie County is, in turn, subdivided into a series of geomorphic subzones based on topographic elevation and terrain type. These subdivisions include the Coastal Marshes, the Limestone Shelf and Hammocks, and the River Valley Lowlands (Figure 1).

Coastal Marshes

Extensive coastal salt marshes are developed along the seaward edge of Dixie County. These comprise the Coastal Marsh Zone (White, 1970), which typically extends from the shore inland to approximately the five feet MSL contour. Most of these marshes are comprised of *Juncus* and *Spartina* grasses rooted in shallow organic-rich silts and sands lying on limestone. In many areas, the marshes are dissected by small tidal streams and creeks, some of which drain freshwater seeping out of the shallow limestones of the Floridan aquifer system.

Limestone Shelf and Hammocks

Most of Dixie County is comprised of a flat-lying, highly karstic, erosional limestone plain overlain by sand dunes, ridges, and coast-parallel paleo-shoreline sand belts associated with several Pleistocene sea level highstands. This terrain has been named the Limestone Shelf and Hammocks by Puri et al. (1967). The irregular, highly karstic Eocene limestone underlying this area is masked by a blanket of Pleistocene sands. Near the coast, the limestone shelf merges seaward into the Coastal Marshes, and continues offshore onto the continental shelf. Inland, the limestone rises gently to an elevation of nearly 60 feet above MSL in the northeastern corner of Dixie County. Most of the area is forest or agricultural land. Small artesian springs flow from the near-surface limestone, and during periods of heavy rainfall, much of the region may flood to form a shallow swamp. Drainage from the coastal hammocks is sluggish, and occurs through a number of small creeks and sloughs, which empty into the coastal marshes.

River Valley Lowlands

The Suwannee and Steinhatchee Rivers are the two major streams flowing in Dixie County. The Suwannee River forms the eastern county boundary between Dixie and adjacent Levy and Gilchrist Counties. It flows in a dissolutional valley, formed in the near-surface Eocene limestones. The lowlands immediately adjacent to the river, covered by a thin veneer of Holocene sediments over limestone, comprise the Suwannee River Valley Lowlands geomorphic subzone (Vernon, 1951). The broadly-meandering valley is less than one mile wide over most of its course, broadening to about two and a half miles wide as it approaches the Gulf coast. Valley floor elevations average about five feet MSL. Along its lower stretch, the river valley is drowned and obscured by the coastal marshes.

The Steinhatchee River forms the northwestern county boundary with Taylor County. It is a deeply incised stream flowing in a narrow solution valley. Lowlands associated with the Steinhatchee River are generally less than one-half mile wide. A one-mile stretch of the river flows through an underground cavern near U.S. Highway 19, and then reemerges west of the highway.

STRATIGRAPHY

The oldest rock commonly penetrated by water wells in Dixie County is marine limestone of the Eocene age Avon Park Formation. Undifferentiated Pleistocene to Holocene age surficial sands, clayey sands, and alluvium are the youngest sediments present. Figures 2 and 3 illustrate the shallow stratigraphy of the county. The Avon Park Formation and the younger overlying limestone units are important freshwater aquifers, and the following discussion of the geology of Dixie County is confined to these Eocene and younger sediments.

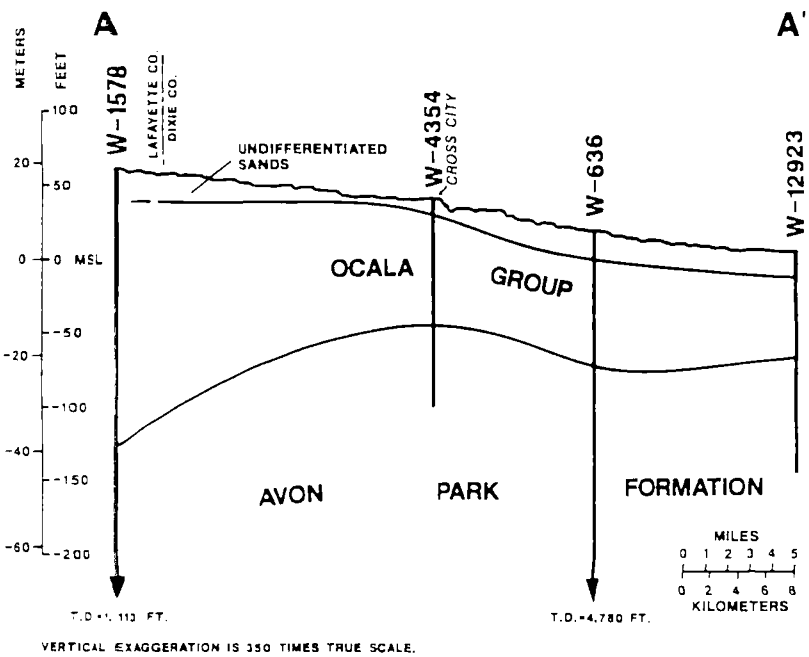

Figure 2: Geologic cross section A-A'.

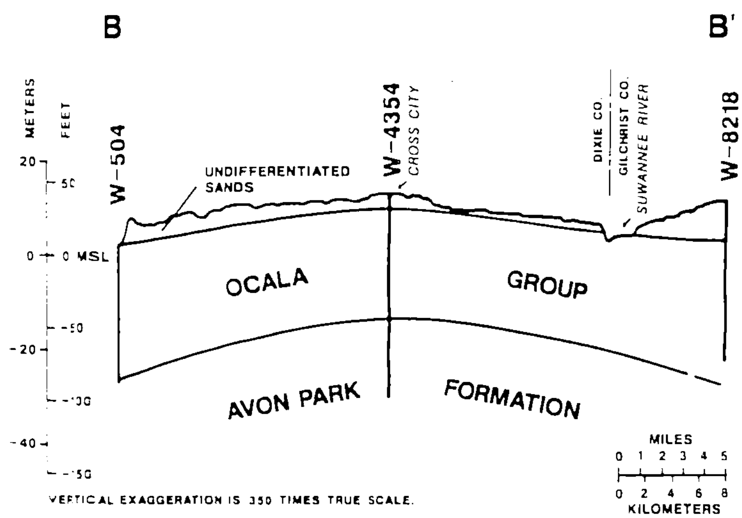

Figure 3: Geologic cross section B-B'.

Eocene Series
Avon Park Formation

The Avon Park Formation (Miller, 1986) is a lithologically variable Middle Eocene carbonate unit underlying all of Dixie County. It is typically a tan to buff to brown dolomite, commonly interbedded with white to light cream to yellowish gray limestones and dolomitic limestones, and containing varying amounts of peat, lignite, and plant remains (Florida Geological Survey in-house well files). Mollusks, echinoids, and foraminifera, where preserved, are the principal fossils present. The top of the Avon Park Formation varies in depth from approximately 50 feet below land surface (bls) in southern Dixie County to about 150 feet bls in the northern portion of the county. Surface exposures of Avon Park occur to the south in Levy County, over the crest of the Ocala Platform. Deep oil test well data indicate that the Avon Park Formation ranges from approximately 800 to 1200 feet thick under Dixie County (Florida Geological Survey in-house well files).

Ocala Group

Marine limestones of the Ocala Group (Puri, 1957) unconformibly overlie the Avon Park Formation under all of Dixie County. The Ocala Group is comprised of three formations; in ascending order they are the Inglis Formation, Williston Formation, and the Crystal River Formation. These formations are differentiated on the basis of lithology and fossil content. Typically, the lithology of the Ocala Group grades upward from alternating hard and soft, white to tan to gray fossiliferous limestone and dolomitic limestone of the Inglis and lower Williston Formations into white to cream colored, abundantly fossiliferous, chalky limestones of the upper Williston and Crystal River Formations (Crane, 1986). Foraminifera, mollusks, bryozoans, and echinoids are the most abundant fossils occurring in this unit. Thickness of the Ocala Group sediments under Dixie County averages about 100 feet. It generally thins against the structurally high Avon Park Formation toward the crest of the Ocala Platform in the southern and eastern portions of the county. Depth to the irregular and highly-karstic top of the Ocala Group is generally less than 50 feet. It commonly crops out in the limestone shelf and hammocks and coastal marsh zones. In western Dixie County and offshore of the modern coastline, a thin blanket of quartz sand covers the Ocala Group limestone and exposures in the form of limestone boulders and pinnacles are common.

The highly permeable and cavernous nature of the Ocala Group limestones make them important freshwater bearing units of the Floridan aquifer system. Many drinking water wells in Dixie County withdraw water from the upper units of this group.

Pleistocene-Holocene Series

Undifferentiated Pleistocene marine quartz sands and clayey sands form a thin veneer over all of Dixie County. They are generally less than about 40 feet thick county-wide, and thin to less than 20 feet thick near the coast. They directly overlie the karstic limestones of the Ocala Group. Many of the larger and higher sand bodies in Dixie County are relict dunes, bars, and barrier islands associated with various Pleistocene sea level high stands.

A white to gray, fossiliferous freshwater marl commonly occurs along the banks and in the valley of the Suwannee River. This marl contains an abundant Holocene freshwater mollusk fauna, and may attain a thickness of three to four feet (Vernon, 1951; Puri et al., 1967).

GROUND WATER

Ground water is water that fills the pore spaces in subsurface rocks and sediments. This water is derived principally from precipitation within Dixie and adjoining counties. The bulk of Dixie County's consumptive water is withdrawn from ground water aquifers. Two aquifer systems are present under Dixie County, the surficial aquifer system and the Floridan aquifer system.

Surficial aquifer system

The surficial aquifer system is the uppermost freshwater aquifer in Dixie County. This non-artesian aquifer is present only within the thicker portions of the Pleistocene undifferentiated sands and clays. It is thin or absent in much of Dixie County, but may occur sporadically in the northern portion of the county. The surficial aquifer system, where present, is unconfined and its upper surface is the water table. In general, the water table elevation fluctuates with precipitation and conforms to the topography of the land surface. Recharge to the surficial aquifer system is largely through rainfall percolating downward through the unconsolidated surficial sediments, and to a lesser extent, by upward seepage from the underlying Floridan aquifer system. Water naturally discharges from the aquifer by evaporation and downward seepage into the Floridan aquifer system. The surficial aquifer system is not used as a source of consumptive water in Dixie County.

Floridan aquifer system

In Dixie County, the Floridan aquifer system is comprised of hundreds of feet of Eocene marine limestones, including the Avon Park Formation and the Ocala Group. It is the principle source of drinking water in the county. The Floridan aquifer system exists as an unconfined, non-artesian aquifer in most of Dixie County, where porous quartz sand directly overlies the limestone. Depth to the top of the Floridan aquifer system generally corresponds to the depth of limestone, and varies from less than five feet in the coastal marshes and Suwannee River Valley to nearly 50 feet under the larger relict Pleistocene sand bodies. The potentiometric gradient is south-southwestward.

Recharge to the Floridan aquifer system in Dixie County is obtained from lateral inflow from the north and, to a lesser extent, from local rainfall percolating downward through the permeable surficial sands. The highest recharge by percolation occurs in the highly karstic limestone plain in northwestern Dixie County (Stewart, 1980).

Water leaves the Floridan aquifer system through natural movement down-gradient and subsequent discharge through numerous springs and seeps. These springs generally occur in the Suwannee River Valley Lowlands, portions of the Limestone Shelf and Hammocks zone, and along the coastal marshes, where the potentiometric surface of the Floridan aquifer system is at or above land surface.

MINERAL RESOURCES

Dixie County contains deposits of several economic mineral commodities. The most important of these is limestone. Other commodities of lesser potential include dolomite, sand, clay, phosphate and peat. Each commodity and its economic potential are summarized below.

Limestone

Limestones of the Ocala Group occur near the surface under most of Dixie County. The economic grade may vary considerably from one area to another. High purity, road base quality rock is principally concentrated in the Chiefland Limestone Plain area of eastern Dixie County. Aggregate and secondary road base grades occur over much of the rest of the county. Limestone has been mined extensively in Dixie County in the past, particularly from quarries along U.S. Highway 19 (Schmidt et al., 1979). Most was used for road construction, but at least two quarries produced building stone (Puri et al., 1967). Although mining potential remains high, no companies currently mine limestone in the county.

Dolomite

Near-surface dolomitized Ocala Group sediments are present in western Dixie County in a band paralleling the Gulf coast. The dolomite ranges from about 2 to 10 feet thick, making it uneconomical for mining as crushed stone (Puri et al, 1967). Future potential for additional this commodity is therefore low in Dixie County.

Sand

A number of shallow private pits in Dixie County are worked for fill sand. Pleistocene quartz sand deposits occur as thin veneers over most of the county. Since there is insufficient local demand for sand products, the potential for commercial mining is low at this time.

Clay

Clay sporadically occurs as a component of the undifferentiated surficial sediments covering Dixie County. Due to the impure nature of this clay, it is not an economic commodity in the county.

Phosphate

Several thin, discontinuous deposits of hard rock phosphate have been recorded in quarries near the community of Hines in Dixie County (Puri et al., 1967). These deposits are generally developed at the top of the Ocala Group limestone in isolated pockets, and are generally less than 5-feet thick. Due to the limited thickness and discontinuous nature of the phosphate deposits, they are not sufficient to maintain an economic mining operation in the county.

Peat

Peat forms in a wet, reducing environment when accumulation of organic materials exceeds the decomposition rate of that material. Shallow wetlands in the limestone shelf and hammocks areas of Dixie County provide potential peat formation sites. However, while no peat surveys have been conducted within the county, studies in adjacent counties indicate that the peat formed in such areas is too thin to be of economic interest (Davis, 1946; Bond et al., 1986). Therefore, the potential for peat mining in Dixie County is low.

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