

REFERENCE

c. 2

State of Florida
Department of Natural Resources
Tom Gardner, Executive Director

Division of Resource Management
Jeremy Craft, Director

Florida Geological Survey
Walt Schmidt, State Geologist and Chief

Open File Report 17
Geology of Bradford County, Florida
by
Frank R. Rupert

Florida Geological Survey
Tallahassee, Florida
1987

BRADFORD COUNTY

GEOMORPHOLOGY

Bradford County lies in the Northern Highlands physiographic province of White (1970). This province spans north Florida from the eastern edge of Bradford County westward into Alabama. Characterized by a series of topographically high and gently rolling clayey sand hills, this province is thought to be a stream-dissected remnant of a once more extensive highland plain covering much of the Gulf Coastal Plain (White, 1970).

Skirting the eastern edge of Bradford County is a topographic feature named the Trail Ridge (see Figure 1). The Trail Ridge is an elongate, north-south trending series of quartz sand hills rising abruptly above the swampy plain of eastern Bradford County and reaching nearly 220 feet above mean sea level (MSL). Its crest roughly parallels the Bradford-Clay county line, and the ridge on average extends less than one mile into Bradford County (Clark et al., 1964). The bulk of the Trail Ridge lies in neighboring Clay County, where it reaches 10 miles in width.

Elsewhere in Bradford County, land surface elevations vary from approximately 50 feet MSL in the swampy Santa Fe River Valley in the westernmost tip of the county, to 175 feet MSL in southeastern Bradford County east of the town of Hampton. Over most of the county, the terrain is generally flat, with large swampy areas and shallow lakes. Creeks and streams are numerous but sluggish, and flow in poorly-defined channels. The predominant surficial sediments are quartz sands and clayey sands. Along the Santa Fe River at the southwestern edge of the county and along the New River bordering the western edge, the tributary streams are more deeply incised in the surrounding terrain. Here, tributary streams flowing into the larger river valleys have cut ravines into the resistant clayey

sands. Steep-sloped bluffs also border the wide valley floors of both the Santa Fe and New rivers in western Bradford County.

The Santa Fe River is the largest stream in the Bradford County area and forms the Bradford-Alachua county boundary. The river begins in Santa Fe Lake, a large shallow body in southeastern Bradford County and northeastern Alachua County. Flow is westward, where it receives flow from Hampton Lake, the Sampson River, draining Lake Sampson, and from the New River which comprises the Bradford-Union county line. The New River forms at the confluence of numerous small creeks in northern Bradford County, and drains the highland areas in the northern and western portions of the county.

STRATIGRAPHY

Bradford County is underlain by hundreds of feet of marine sands, clays, limestones and dolomites (Clark et al., 1964). The oldest rock penetrated by water wells is limestone of the Eocene age (37 to 54 million years before present, B.P.) Avon Park Formation. Undifferentiated surficial sands and clays of Pliocene to Holocene Age (5 million years old and younger) are the youngest sediments present. The Avon Park Formation and the younger overlying limestone units are important freshwater aquifers, and this discussion of the geology of Union County will be confined to these Eocene age and younger sediments. Figure 1 shows the stratigraphic cross section locations, and Figures 2 and 3 illustrate the underlying stratigraphy of Bradford County.

EOCENE SERIES

AVON PARK FORMATION

The Avon Park Formation (Miller, 1986), as it occurs under Bradford

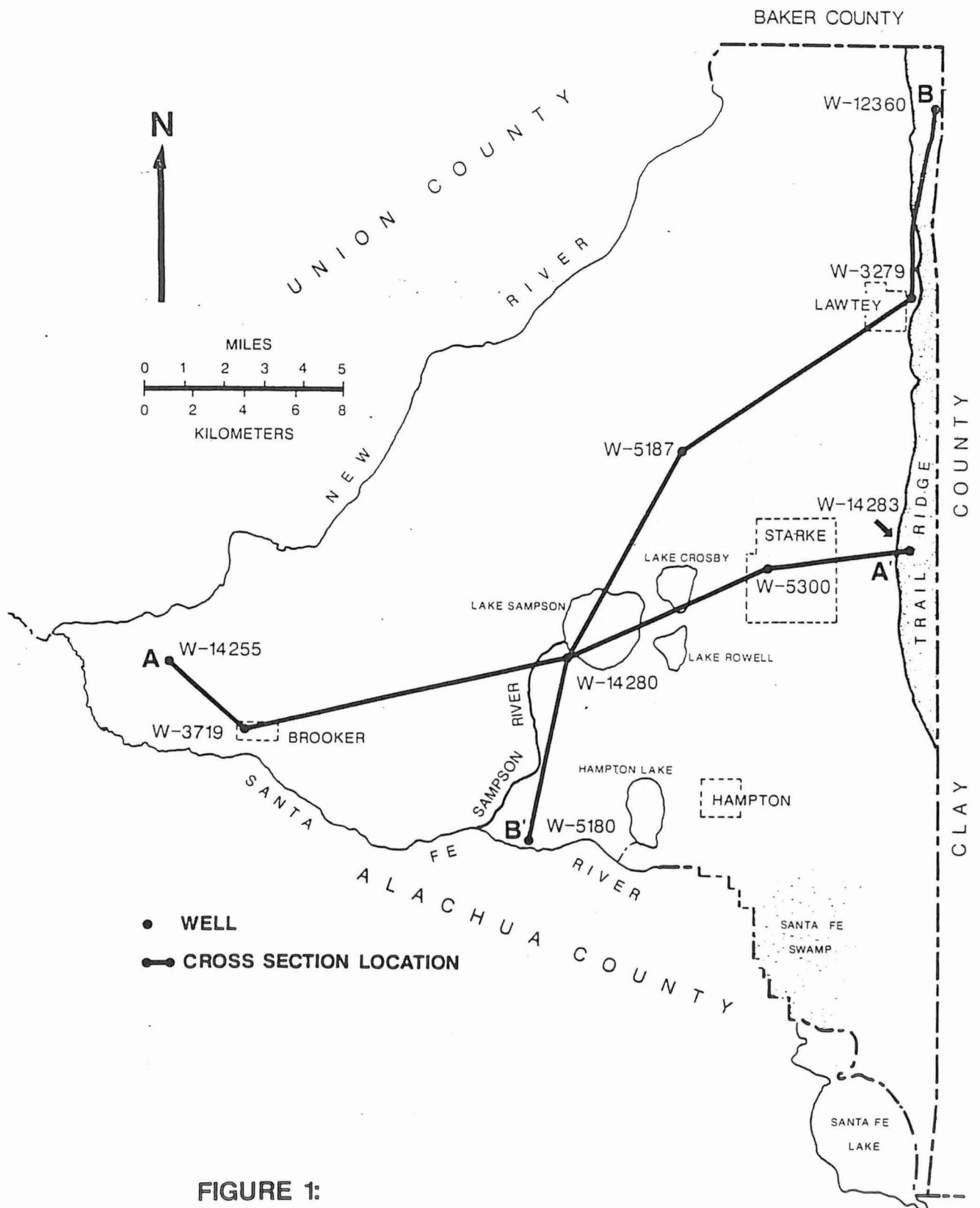


FIGURE 1:
BRADFORD COUNTY GEOLOGICAL CROSS SECTION LOCATIONS

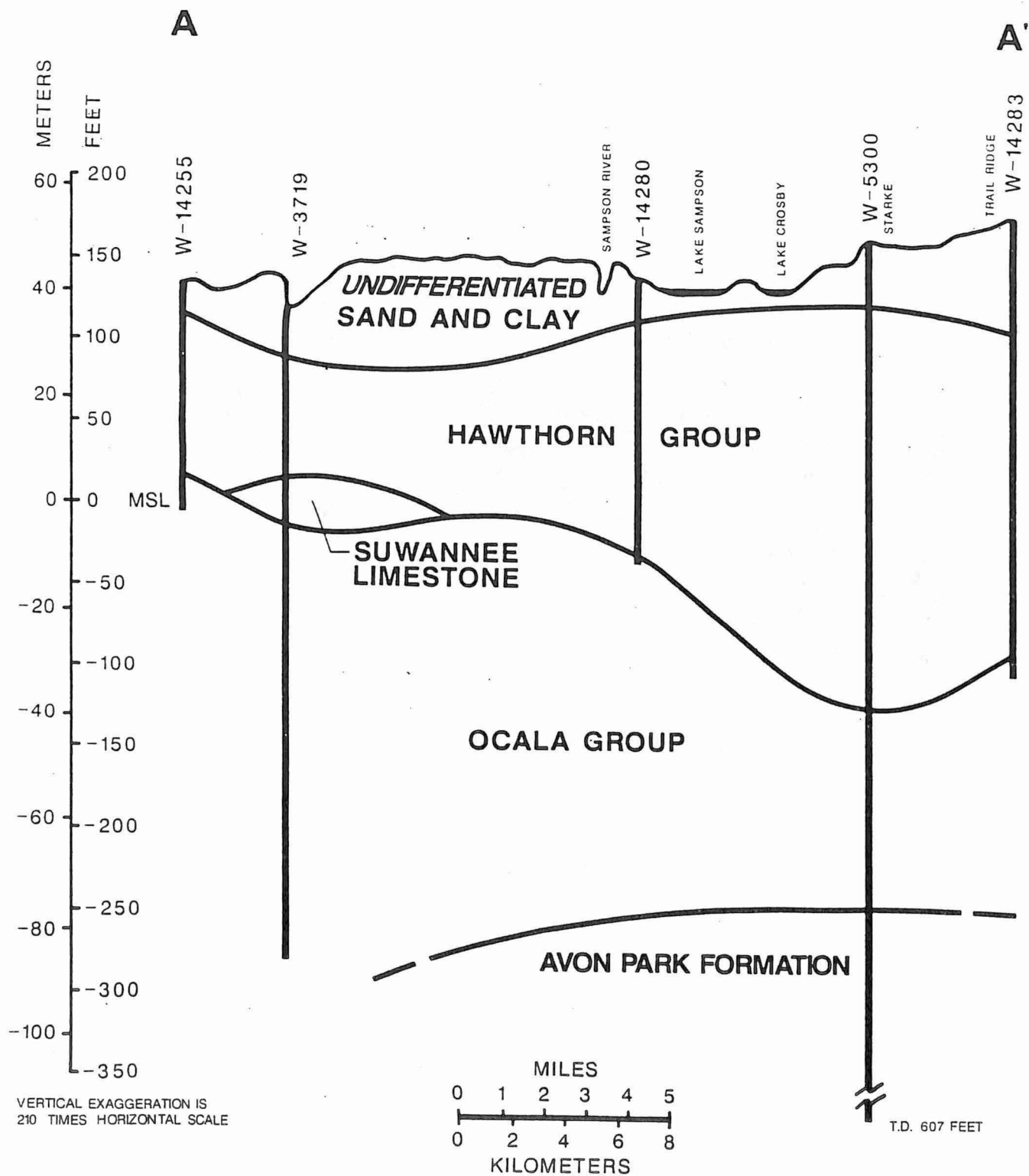


FIGURE 2: GEOLOGICAL CROSS SECTION A - A'

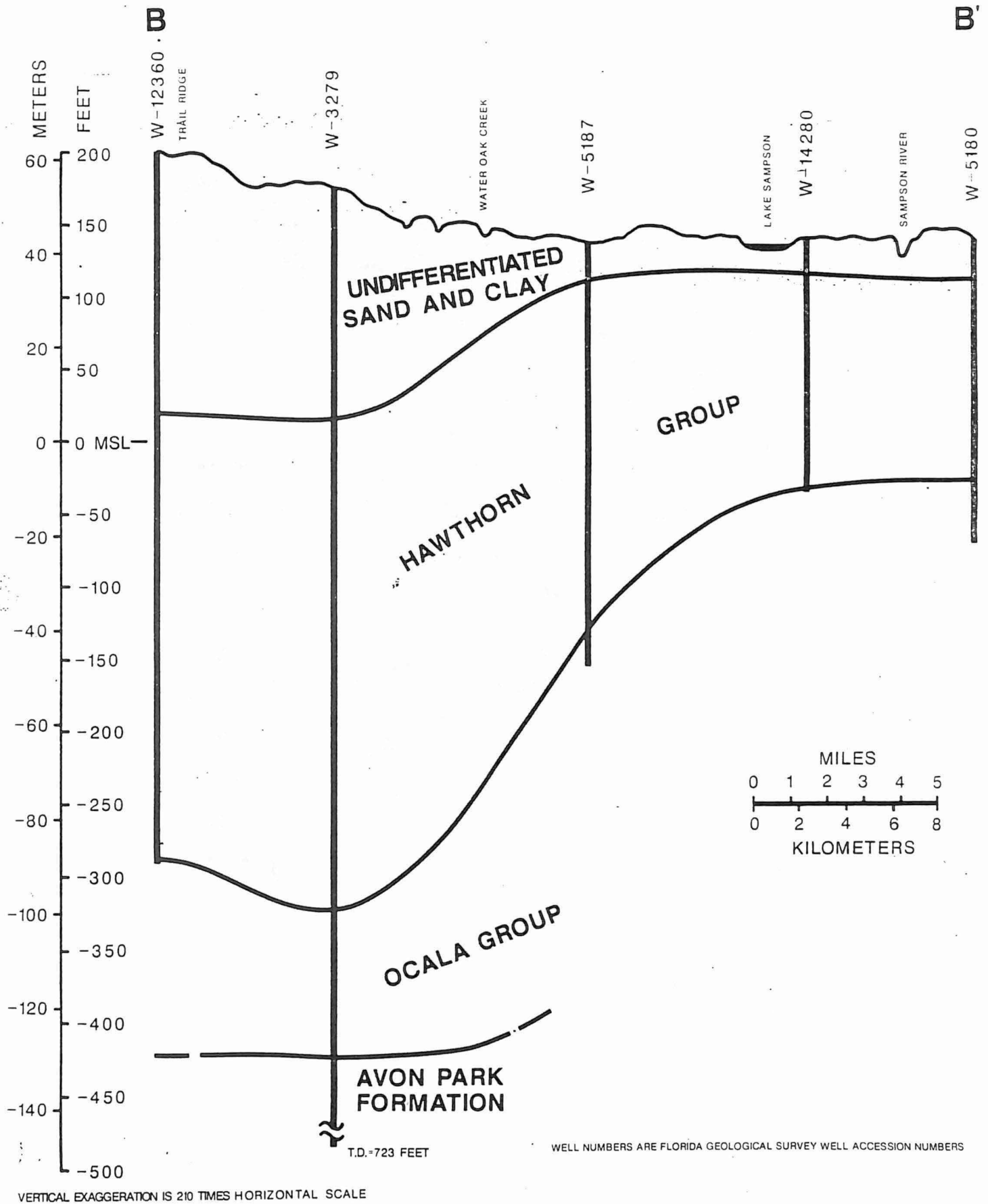


FIGURE 3: GEOLOGICAL CROSS SECTION B - B'

County, is typically a dense, tan to dark brown, porous dolomite, frequently interbedded with tan, gray, or cream-colored limestones and dolomitic limestones of varying hardness (Clark et al., 1964). Foraminifera are the dominant fossils present, although dolomitization has destroyed or altered many of the contained fossils. The Avon Park Formation is a component of the Floridan aquifer system, and the top of this unit underlies Bradford County at depths ranging from 400 to 700 feet below land surface (Clark et al., 1964; Florida Geological Survey in-house well data).

OCALA GROUP

Marine limestones of the Ocala Group (Puri, 1957) unconformably overlie the Avon Park Formation under all of Bradford County (Clark et al., 1964). The Ocala Group is comprised of three formations; in ascending order, these are the Inglis Formation, the 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, fossiliferous limestone and dolomitic limestone of the Inglis and lower Williston Formations into white to pale orange, abundantly fossiliferous, chalky limestones of the upper Williston and Crystal ^{River} Formations. Foraminifera, mollusks, bryozoans, and echinoids are the most abundant fossil types occurring in the Ocala Group sediments. Thickness of the Ocala Group sediments under Bradford County average about 250 feet. The permeable and cavernous nature of the Ocala Group limestones make them important fresh-water-bearing units of the Floridan aquifer system. Many drinking water wells in Bradford County withdraw water from the Crystal River Formation.

OLIGOCENE SERIES

SUWANNEE LIMESTONE

The Oligocene age (24 to 37 million years B. P.) Suwannee Limestone (Cooke and Mansfield, 1936) occurs as discontinuous erosional remnants overlying the Ocala Group sediments under the extreme western tip of Bradford County from the town of Brooker westward (Clark et al., 1964; Florida Bureau of Geology in-house data). In general, the Suwannee Limestone consists of tan, white, or cream-colored marine limestone, frequently dolomitic and coquinoïd in portions and varying considerably in hardness. In some wells, the Suwannee Limestone is lithologically similar to the Ocala Group limestones, and is identified primarily on the last occurrence of the foraminifera Dictyoconus. The thickness of the Suwannee Limestone ranges between 20 and 40 feet, and the beds may be discontinuous in the subsurface; this unit is not known in wells east of Brooker (Clark et al., 1964). In north Florida, the Suwannee Limestone is a freshwater-bearing unit of the Floridan aquifer system.

MIOCENE SERIES

HAWTHORN GROUP

Phosphatic quartz sands, clays, limestones and dolomites of the Miocene age (5 to 24 million years B. P.) Hawthorn Group (Scott, in preparation) unconformably overlies the Suwannee Limestone remnants or Ocala Group in extreme western Bradford County; east of Brooker, the Hawthorn Group sediments lie directly upon the Ocala Group limestones. The Hawthorn Group is predominantly a series of marine deposits, consisting of variable and interbedded lithologies, and characterized by phosphatic and quartz sands, granules and pebbles. Three formations of the Hawthorn Group are distin-

guishable in Bradford County; in ascending order these are: the Penney Farms Formation, interbedded phosphatic quartz sand, clay and carbonate; the Marks Head Formation, thinly and complexly interbedded phosphatic clays, sand, and carbonate; and the Coosawhatchie Formation, a green to tan, phosphatic quartz sand with varying amounts of clay and dolomite. The Hawthorn Group sediments have northeastward dip and range in thickness from about 100 feet in western Bradford County to at least 300 feet in the northeastern corner of the county near the state prison. The thick, relatively impermeable clays within the Hawthorn Group are the primary confining beds for the underlying Floridan aquifer system. Pliocene to Holocene age undifferentiated sands form a veneer over the Hawthorn Group sediments in most of Bradford County, although the larger river valleys in the southern and western parts of the county may cut down into the Hawthorn section.

PLIOCENE TO HOLOCENE UNDIFFERENTIATED

Undifferentiated quartz sands and clays comprise the surficial sediments over most of Bradford County. These unfossiliferous deposits are virtually impossible to age-date, and include the unnamed reddish coarse clastics, the relict Pleistocene (2.8 million to 0.1 million years B. P.) marine terrace sands, and Holocene age (0.1 million years to present) aeolian, lacustrine and alluvial deposits.

GROUNDWATER

Groundwater is water that fills the pore spaces in subsurface rocks and sediments. This water is derived principally from precipitation within Union and nearby counties. The bulk of Bradford county's consumptive water is withdrawn from ground-water aquifers. Three main aquifer systems are present under Bradford County. In order of increasing depth, these are the

surficial aquifer system, the intermediate aquifer system, and the Floridan aquifer system (Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, 1986).

SURFICIAL AQUIFER SYSTEM

The surficial aquifer system is the uppermost freshwater aquifer in Bradford County. Sediments comprising this aquifer are primarily the sands and thin limestone layers in the uppermost part of the Hawthorn Group as well as the overlying Pleistocene marine terrace sands. On average, the surficial aquifer system is about 40-feet thick over most of Bradford County (Clark et al., 1964). The surficial aquifer system is unconfined and its upper surface is the water table. In general, the water table elevation fluctuates with precipitation rate and conforms to the topography of the land surface. Within Bradford County, the water table is normally 10 feet or less below land surface. Recharge to the surficial aquifer system is largely through rainfall percolating downward through the surficial sediments, and to a lesser extent by upward leakage from the deeper aquifers. Water naturally discharges from the aquifer by evaporation, transpiration, springflow, and by downward seepage into the lower aquifers. The surficial aquifer system yields water of suitable quality for consumptive use and is normally tapped by shallow dug or sand point wells. Due to the relatively thin units comprising this aquifer, however, only limited amounts of water are available before local water table lowering occurs.

INTERMEDIATE AQUIFER SYSTEM

The intermediate aquifer system is comprised of deeper water-bearing sand and limestone layers within the Hawthorn Group. Low permeability clays above the sand and limestone layers generally confine the intermediate

aquifer system under artesian conditions and separate it from the overlying surficial aquifer system. Water yield from this aquifer varies locally with the quantity of sand and the porosity and permeability of the limestone; in some areas, the Hawthorn Group limestones are very dense, yielding little water. Recharge to the intermediate aquifer system consists chiefly of downward seepage from the surficial aquifer system and upward seepage from the Floridan aquifer system in areas where the potentiometric surface of the Floridan aquifer system is higher than that of the intermediate system. Numerous rural and domestic wells draw water from the intermediate aquifer system, and as with the surficial aquifer system, the volume of water available depends largely on local thickness of the aquifer units.

FLORIDAN AQUIFER SYSTEM

The Floridan aquifer system is comprised of several hundred feet of Eocene to Oligocene age porous marine limestones, including the Avon Park Formation, the Ocala Group, and the Suwannee Limestone. It is by far the most productive aquifer in Bradford County. The Floridan aquifer system is confined by low permeability clays of the overlying Hawthorn Group, and is under artesian conditions. West of Brooker, discontinuous beds of Suwannee Limestone comprise the upper unit of the Floridan aquifer system. East of Brooker, the Crystal River Formation of the Ocala Group is the uppermost unit. County-wide, depth to the Floridan varies, on average, between 75 and 300 feet (Florida Geological Survey in-house well data). The Floridan aquifer system is an important freshwater source throughout Florida, and many deep domestic wells and most municipal and industrial supply wells draw from this aquifer.

Recharge to the Floridan aquifer in Bradford County occurs primarily as downward leakage through the confining beds from the shallower aquifers (Clark et al., 1964). Water leaves the Floridan aquifer system through natural movement downgradient (northwestward) and subsequent discharge through springs, lakes, and along the Santa Fe River.

MINERAL RESOURCES

At present, no mineral commodities are being mined on a commercial basis in Bradford County. In general, the potential for commercially feasible mineral production in this county is low. The following discussion of the major mineral commodities is intended to provide an overview of the mining potential for each mineral.

SAND

A number of shallow private pits in Bradford County are worked for fill sand. These sand deposits are concentrated in the unconsolidated Pliocene to Holocene age surficial sediments covering most of the County. The unnamed, variably-colored clayey coarse clastics, believed to be equivalent to the Miccosukee and Citronelle formations to the west, characteristically contain fine to coarse grained quartz sand and gravelly sand. Similar unnamed clayey sands are utilized as roadbase material in counties to the south. Commercial production of these sands would require extensive washing to remove the clay matrix; the economics of this procedure would probably preclude commercial mining in Bradford County. White quartz sands of the Trail Ridge fringe the eastern edge of Bradford County. These sands are commercially mined in adjacent Clay County, and may offer industrial potential.

PHOSPHATE

Phosphatic sediments of the Hawthorn Group underlie most of Bradford

County. The phosphate occurs as tan to black sand, granule, and pebble sized phosphorite (P_2O_5). Scott (1983) analyzed the P_2O_5 content of the Hawthorn Group sediments in four Bradford County cores. The composite P_2O_5 percentages were found to range from a low of 0.1 percent to a maximum of 13.5 percent, with a county-wide average of only 3.5 percent (Scott, 1983). Since the minimum economic concentration of P_2O_5 is approximately 28 percent (Cathcart and Patterson, 1983), the phosphate mining potential is low in Bradford County.

HEAVY MINERALS

Economic deposits of heavy minerals, primarily ilmenite, rutile, leuc-xene, staurolite, zircon, and monazite, are presently mined on the Trail Ridge in nearby Clay County. Borehole sample data presented in Spencer (1948) indicate that composite percentages of heavy minerals in the Trail Ridge sands drop from approximately 4.0 percent in the currently-mined area of Clay County, to between 1.0 and 1.5 percent on the western flank of the ridge in Bradford County. These relatively low concentrations in Bradford County preclude economical mining with existing technology.

LIMESTONE AND DOLOMITE

Bradford County is underlain by extensive deposits of Eocene to Miocene age marine limestones. However, the excessive thickness of the overlying Hawthorn Group siliciclastics and the Pliocene to Holocene undifferentiated surficial sediments puts most limestone at too great a depth for commercial mining.

PEAT

Peat is an organic mineral commodity formed from rapid accumulation of

decaying vegetation. This commodity is currently being mined by two companies near Keystone Heights in nearby Clay County (Campbell, 1986). To date, no commercial mining of peat occurs in Bradford County. Although unproven, the areas of highest peat potential are the shallow, swampy regions in central Bradford County and in the Santa Fe Swamp in the southeastern corner of the county (Davis, 1946; Bond et al., 1986).

CLAY

Clay and clayey sand deposits occur in the upper Hawthorn Group sediments as well as the undifferentiated Pliocene to Holocene surficial sediments over most of Bradford County. Except for private borrow pits, there has been no commercial exploitation of these deposits. The suitability of these clays for industrial and commercial use is, as yet, untested. To the east in Putnam County, and in counties to the south, the red, clayey sands and sandy clays formerly referred to as unnamed coarse clastics are used extensively as road material.

REFERENCES

- Bond, P., Campbell, K. M., and Scott, T. M., 1986, An overview of peat in Florida: Florida Geological Survey, Special Publication no. 27, 151 p.
- Campbell, K. M., 1986, The industrial minerals of Florida: Florida Geological Survey, Information Circular 102, 94 p.
- Cathcart, J. B., and Patterson, S. H., 1983, Mineral resource potential of the Farles Prairie and Buck Lake roadless areas, Marion County, Florida: U. S. Geological Survey, Map Series MF-15918.
- Clark, W. E., Musgrove, R. H., Menke, C. G. and Cagle, J. W., 1964, Water resources of Alachua, Bradford, Clay and Union Counties, Florida: Florida Geological Survey, Report of Investigations no. 35, 170 p.
- Cooke, C. W. and Mansfield, W. C., 1936, Suwannee Limestone of Florida (abstract): Geological Society of America Proceedings, 1935, p. 71-72.
- Davis, J. H., 1946, The peat deposits of Florida: Florida Geological Survey, Bulletin no. 30, 247 p.
- Miller, J. A., 1986, Hydrogeologic framework of the Floridan aquifer system in Florida and in parts of Georgia, Alabama, and South Carolina: U. S. Geological Survey, Professional Paper 1403-B, p. 25-27.
- Puri, H. S., 1957, Stratigraphy and zonation of the Ocala Group: Florida Geological Survey Bulletin 38, 248 p.
- Scott, T. M., 1983, The Hawthorn Formation of northeastern Florida, Part II, Characterization and beneficiation of the northeastern Florida phosphate-bearing Hawthorn Formation: Florida Bureau of Geology, Report of Investigation no. 94, p. 41-90.
- _____, (in preparation), The lithostratigraphy of the Hawthorn Group (Miocene) of Florida: Florida Geological Survey, Bulletin no. 59.
- Southeastern Geological Society Ad Hoc Committee on Florida hydrostratigraphic unit definition, 1986, Hydrogeological units of Florida: Florida Bureau of Geology, Special Publication no. 28, 9 p.
- Spencer, R. V., 1948, Titanium minerals in Trail Ridge, Florida: U. S. Bureau of Mines, Report of Investigations 4208, 21 p.
- White, W. A., 1970, Geomorphology of the Florida peninsula: Florida Geological Survey, Bulletin no. 51, 164 p.

39380000147787



FLORIDA GEOLOGICAL SURVEY