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Open File Report 18

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Frank R. Rupert

Florida Geological Survey
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GILCHRIST COUNTY

GEOMORPHOLOGY

Gilchrist County lies along the northern edge of the Mid-peninsular Zone of White (1970). This zone spans the Florida peninsula from the lower edge of the topographically higher Northern Highlands southward to approximately the Caloosahatchee River. The Midpeninsular Zone is comprised of a series of elevationally-differentiated geomorphic subzones. Two subzones occur within Gilchrist County, the Gulf Coastal Lowlands and the Central Highlands (White, 1970).

Gulf Coastal Lowlands

The Gulf Coastal Lowlands geomorphic province parallels the present Gulf Coast of Florida from Ft. Myers northward and westward to the Alabama line. In the vicinity of Gilchrist County, the Gulf Coastal Lowlands extend inland from the present Gulf of Mexico shoreline a distance of some 50 miles, terminating at the western edge of the Brooksville Ridge and High Springs Gap (see Figure 1). The Gulf Coastal Lowlands are characterized by broad flat marine plains, underlain by Eocene limestones, and blanketed by thin Pleistocene (one million to ten thousand years before present) sands, which were deposited by the regressing Gulf of Mexico. Elevations within the province vary from approximately 20 feet above mean sea level (MSL) in westernmost Gilchrist County, to over 100 feet MSL in the eastern portion of the county. Several geomoprhic subdivisions, based on topography, punctuate the Gulf Coastal Lowlands zone in Gilchrist County. These include the Wacasassa Flats, the Bell Ridge, the Chiefland Limestone Plain, and the Santa Fe and Suwannee River Valley Lowlands (Puri et al., 1967).

Wacasassa Flats

Vernon (1951) proposed the name Wacasassa Flats for the low, swampy area about five miles wide and 25 miles long, trending southward through central Gilchrist County. This province originates at the south bank of the Santa Fe River and extends southward, then southeastward into Levy County. Land surface elevations over most of the "Flats" average about 60 feet MSL, although isolated sand hills, possibly associated with the Bell and Brooksville Ridges, reach 90 to 100 feet MSL elevation. A structural low, filled with Miocene (5 to 25 million years B.P.) and Pleistocene siliciclastics underlies the area occupied by Wacasassa Flats. Although there is no apparent relationship between the low and the origin of the Flats, siliciclastics filling the depression may retard downward percolation of groundwater, resulting in the generally swampy conditions throughout this province (Puri et al., 1967). The origin of the flats is uncertain. Vernon (1951) believed that the Wacasassa Flats are either a remnant stream valley, possibly of the ancestral Suwannee River, or are of erosional marine origin. Due to the predominance of relict marine features throughout the area of the Flats, Puri et al., (1967) consider this feature to be marine in origin.

The Bell Ridge

Bordering the eastern edge of the Chiefland Limestone Plain are a 20 mile-long series of irregularily-shaped sand ridges named the Bell Ridge (Puri and Vernon, 1964). The crests of these ridges range from 80 to 100 feet MSL, and while their origin is uncertain, they are most likely part of a relict Wicomico Sea (Pleistocene) barrier island system (Puri et al., 1967). White (1970) believes the Bell Ridge is an outlier of the Brooksville Ridge, to which it is roughly parallel. The sand hills comprising the Bell Ridge directly overlie karstic Eocene age (37 to 54 million years B.P.) limestone, and the former extent of the contiguous ridge system may be obscured by solution and collapse in the underlying limestone (Puri et al., 1967).

The Chiefland Limestone Plain

The western one-third of Gilchrist County is comprised of a flat, sandy terrain lying on eroded and highly karstic Eocene limestone called the Chiefland Limestone Plain (Vernon, 1951; Puri et al., 1967). This province is bordered on the west by the Suwannee River Valley Lowlands, and on the east by the Bell Ridge and Wacasassa Flats provinces. The land surface is generally flat to gently rolling, with elevations ranging from 25 to approximately 65 feet MSL. Surficial sediments are primarily well-drained Pleistocene sands, which average less than 20 feet thick.

The River Valley Lowlands

The valleys of the Santa Fe and Suwannee Rivers have been designated as geomorphic subzones of the Gulf Coastal Lowlands in Gilchrist County by Puri et al., (1967). These topographically low, broad valleys are floored with a thin veneer of Holocene age (10,000 years B.P. to present) siliciclastics over limestone.

The Santa Fe River flows westward from its source in Alachua County, and forms the northern boundary of Gilchrist County. In northeastern Gilchrist County, the river is partially entrenched in a limestone channel, and meanders through a one-half mile wide valley. Elevations in the valley vary between 20 and 30 feet MSL. Along this portion of its course, the Santa Fe is fed by several sluggish creeks flowing out of the surrounding highly solutioned terrain, and by the runs of numerous springs. Northwestward from Cow Creek, as the river enters the Chiefland Limestone Plain, the valley narrows considerably and assumes a more tenuous course. Cow Creek, flowing northward out of Gilchrist County, and numerous smaller creeks draining the

Chiefland Limestone Plain are the primary tributaries. Elevations within the valley decrease to between 10 and 20 feet MSL, and much of the valley is swampy. The Ichtucknee River, flowing southward out of Suwannee County, joins the Santa Fe at the northern tip of Gilchrist County. From the Ichetucknee River westward to its confluence with the Suwannee River, the Santa Fe River flows in a quarter-mile-wide, swampy valley varying in elevation from 8 to 20 feet MSL.

The Suwannee River forms the western boundary of Gilchrist County. Its broadly meandering valley varies from less than one quarter mile wide to nearly one and a half miles wide. Throughout its course along western Gilchrist County, the valley floor elevations average 15 feet MSL. In northwestern Gilchrist County, the 20 feet MSL elevation contour deliniates the extent of the River Valley Lowlands. Southwestward, near the town of Suwannee River, the 10 foot contour deliniates the valley. The Suwannee River flows southward, entrenched in a limestone channel. Valley floor sediments are predominantly reworked Pleistocene and Holocene alluvial sands and muds, punctuated occasionally by outcrops of the Eocene age Ocala Group limestone.

The Central Highlands

The Central Highlands geomorphic province includes a series of localized highlands and ridges as well as intervening lowland valleys, which trend generally coast-parallel down the central peninsula. The Brooksville Ridge and the High Springs Gap, situated at the eastern edge of Gilchrist County, are two subdivisions of the Central Highlands Zone.

The Brooksville Ridge

The northern terminus of the Brooksville Ridge geomorphic province is situated along the eastern edge of Gilchrist County (Puri et al., 1967). This ridge is a topographic highland and extends a total distance of 110 miles southeastward into Pasco County. In Gilchrist County, the ridge sediments rest on karstic Eocene limestone. The core of the ridge is largely comprised of Pleistocene siliciclastics, and is capped by a depression-pocked, rolling plain of Pleistocene marine terrace sand. Bordering the western edge of the ridge is a well-defined marine escarpment at 70 to 75 feet MSL, which is probably associated with the Wicomico (Pleistocene) sea level stand (Puri et al., 1967). Surface elevations attain 100 feet MSL in crests along the eastern edge of Gilchrist County.

High Springs Gap

The High Springs Gap (Puri and Vernon, 1964) is a geomoprhic lowland situated in northeastern Gilchrist County at the northern terminus of the Brooksville Ridge. This lowland provides a drainage egress, via the Santa Fe River, between the northernmost limit of the Western Valley geomorphic zone of the central peninsula and the Gulf Coastal Lowlands zone to the west.

STRATIGRAPHY

The oldest rock penetrated by water wells in Gilchrist County is limestone of the Eocene age Avon Park Formation. Undifferentiated surficial sands and clayey sands of Pleistocene to Holocene age 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 Gilchrist County will be confined to these Eocene age and younger sediments.

EOCENE SERIES

Avon Park Formation

The Avon Park Formation (Miller, 1986) is a lithologically variable Middle Eocene carbonate unit underlying all of Gilchrist County. It is typically a tan to buff to brown dolomite, frequently interbedded with white to light cream to yellowish gray limestones and dolomitic limestones of varying hardness (Puri et al., 1967 and Florida Geological Survey in-house lithologic files). Mollusks and foraminifera, where preserved, are the principle fossils present. The Avon Park Formation is a component of the Floridan aquifer system, and the top of this unit occurs at depths ranging from 115 to 145 feet below land surface (Florida Geological Survey in-house well data). The Sun Oil Company #1 Alto Adams test well, (Permit 5, W-1003) located four miles southeast of Bell, was the only well to penetrate the entire Avon Park Formation section. Core data from this well indicates the Avon Park is 850 feet thick under this part of the county.

Ocala Group

Marine limestones of the Ocala Group (Puri, 1957) unconformibly overlie the Avon Park Formation under all of Gilchrist County (Puri et al., 1967). 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 to gray fossiliferous limestone and dolomitic limestone of the Inglis and lower Williston Formations into white to cream, 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. Thickness of the Ocala Group sediments under Gilchrist County averages about 100 feet. The irregular, karstic surface of the unit varies from five feet below land surface in the Chiefland Limestone Plain province of western Gilchrist County to over 80 feet below land surface in the structural low under the Wacasassa Flats (Florida Geological Survey in-house lithologic files). Erosion has removed the Crystal River Formation in portions of Gilchrist County, resulting in the Williston Formation being the uppermost Ocala Group unit encountered in some wells. In addition, a series of faults postulated in western Gilchrist County, and what is possibly a large graben trending north-south under the Wacasassa Flats may have further modified the karstic Ocala Group surface (Puri et al., 1967).

The 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 Gilchrist County withdraw water from the upper units of this group.

MIOCENE SERIES

Alachua Formation

The Alachua Formation is a complex and little understood unit. Originally defined to include only the sand and clay infillings in older karst depressions or stream channels (Dall and Harris, 1892), the Alachua Formation was later considered to be a mixture of discontinuous interbedded clay, sand, and sandy clay, including commercially important phosphatic sand and gravel deposits (Vernon, 1951; Puri and Vernon, 1964). In Gilchrist County, the Alachua Formation sediments are highly variable in lithology. Typically, this unit is comprised of gray, poorly indurated fine quartz sands in a matrix of phosphatic clay; interbedded with or underlying these sands are pebbles of water-worn flint, erratic limestone boulders, silicified limestone and chert, light blue and green, waxy montmorillonite clay lenses, pebbles and boulders of phosphate rock conglomerate, colloidal phosphate, and occasional concentrations of vertebrate fossils (Puri et al., 1967).

The phosphate rock is a minor constituent of the Alachua Formation, but was economically feasible to mine for many years. Its mode of occurrence in the formation is highly variable, ranging from clay to boulder-size clasts as well as in the form of replacements of limestone and laminated-phosphate (platerock). Since the Alachua Formation was deposited on the eroded, highly karstic, possibly faulted surface of the Ocala Group limestones, its thickness varies considerably over relatively short distances. With the exception of occational deep sinkhole fill deposits, the Alachua Formation is absent in westernmost Gilchrist County. A thick sequence (approximately 80 to 100 feet) of Alachua Formation sediments is present in the structural low in central Gilchrist County, and to the east, a discontinuous series of 10 to 20 foot thick occurrences underlie the High Springs Gap and Brooksville Ridge provinces.

Both the origin and age of the Alachua Formation are uncertain. Cooke (1945) considered it an in situ accumulation of weathered Hawthorn Group (Miocene) sediments. Puri and Vernon (1964) believed it originated as a largely terrestrial deposit, with lacustrine and fluviatile components, and Brooks (1966) suggested that is was deposited in an estuarine environment. More recently, Scott (1988, in press) considers the Alachua Formation to be weathered and possibly reworked Hawthorn Group sediments, although he does not consider it part of the Hawthorn Group.

An age range of Miocene to Pleistocene, based primarily on contained vertebrate fossils, has been postulated for the Alachua Formation. This wide age range tends to support the concept of the Alachua Formation being composed of time-transgressive, reworked sediments, with each successive depositional event incorporating a younger vertebrate fauna into the sediments.

PLEISTOCENE SERIES

Much of the core of the Brooksville Ridge in Gilchrist County is comprised of reddish, clayey coarse sands, lithologically similar to the Citronelle Formation of the panhandle, and the Cypresshead Formation of peninsular Florida, both considered to be lower Pleistocene in age. For the purposes of this report, these variably-colored red, orange, and pink siliciclastics, some containing fossil burrows, are placed in the category of undifferentiated Pleistocene sediments.

Undifferentiated Pleistocene marine quartz sands and clayey sands form a thin surface veneer over all of Gilchrist County. In the western part of the county, these sands are generally less than 20 feet thick, and overlie the Ocala Group limestone directly; in central and eastern Gilchrist County, they cap the reddish coarse clastics and where present, the Alachua Formation. Many of the larger and higher sand bodies in the county are relict dunes, bars, and barrier islands associated with various Pleistocene sea level stands. The higher crests on the Brooksville Ridge, above 100 feet MSL, are associated with the Sunderland/Okefenokee terraces (Healy, 1975). With the exception of the Suwannee River Valley Lowlands, which is part of the Pamlico Terrace, the surficial siliciclastic sediments occurring over the remainder of Gilchrist County are Wicomico terrace deposits (Healy, 1975).

HOLOCENE SERIES

Unnamed Freshwater Marl

A white to gray, fossiliferous freshwater marl commonly occurs along the banks and in the valleys of the Santa Fe and Suwannee rivers. This marl generally contains an abundant Holocene freshwater mollusk fauna, and may attain three to four feet in thickness (Puri et al., 1967).

GROUNDWATER

Groundwater is water that fills the pore spaces in subsurface rocks and sediments. This water is derived principally from precipitation within Gilchrist and adjoining counties. The bulk of Gilchrist County's consumptive water is withdrawn from groundwater aquifers. Two main aquifer systems are present under Gilchrist County, the surficial aquifer system and the underlying 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 Gilchrist County. This non-artesian aquifer is contained within the interbedded sands and clays of the Alachua Formation and the overlying Pleistocene siliciclastics and marine terrace sands in central and southeastern Gilchrist County. In western Gilchrist County, where the Alachua Formation is absent, the surficial aquifer system may occur "perched" in locally thick Pleistocene sands immediately overlying the Ocala Group limestone; in these areas, the surficial aquifer system is separated from the underlying Floridan aquifer system by zones of unsaturated limerock (Meyer, 1962). On average, the surficial aquifer system ranges from 10 to 80 feet thick, with the thicker portions located under the higher geomorphic sand ridges of central and eastern Gilchrist County, and in the structural low under the Wacasassa Flats. 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. Recharge to the surficial aquifer system is largely through rainfall percolating downward through the loose surficial clastic sediments, and to a lesser extent, by upward seepage from the underlying Floridan aquifer system. Water naturally discharges from the aquifer by evaporation, transpiration, spring flow, and by downward seepage into the Floridan aquifer system. The surficial aquifer system may yield quantities of water suitable for consumptive use, but in some areas the concentration of iron and/or tannic acid impart a poor taste and color to the water (Meyer, 1962).

Floridan aquifer system

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 Gilchrist County. The Floridan aquifer system exists as an unconfined, non-artesian aquifer in portions of western, northern, and northeastern Gilchrist County, where porous Pleistocene quartz sand directly overlies the limestone. In areas of central and southeastern Gilchrist County, where clay beds in the Alachua Formation form low-permeability confining units, the Floridan may function as an artesian aquifer. Depth to the top of the Floridan aquifer generally corresponds to the depth to limestone, and varies from less than five feet in the Suwannee and Santa Fe river valleys, to nearly 80 feet under the Wacasassa Flats. The piezometric gradent is generally west-southwestward.

Recharge to the Floridan aquifer system in Gilchrist County is obtained from local rainfall percolating through the permeable surficial sands in the western and northeastern portions of the county. The thick sequence of low permeability clastics under the Wacasassa Flats retards downward percolation, resulting in only low to moderate recharge in this area (Stewart, 1980). Water leaves the Floridan aquifer through natural movement downgradient and subsequent discharge through numerous springs and seeps along the river valley lowlands.

MINERAL RESOURCES

At present, no mineral commodities are being mined on a commercial basis in Gilchrist County. However, both hard rock and colloidal phosphate, as well as high purity limestone have been mined here in the past. 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 Gilchrist County are worked for fill sand. These sand deposits are concentrated in the unconsolidated Pleistocene surficial sands which cover most of the county. Since there is insufficient local demand for sand products, the potential for commercial mining is low at this time.

Phosphate

The phosphatic sands, clays and limestones of the Alachua Formation have been mined in eastern Gilchrist County since the 1900's. Hard rock phosphate, a calcium phosphate - fluorapatite mixture, occurs as a replacement of limestone float contained in basal Alachua Formation sediments and on the top of the Ocala Group. The clays within the Alachua Formation contain colloidal phosphate and phosphorite, and comprise what is termed soft rock phosphate.

No commercial phosphate mines are in operation in Gilchrist

County today. Loncala Phosphate Company operated soft rock phosphate mining operations as late as 1973, in an area just south of Mona. A large area of eastern Gilchrist County, along the Gilchrist-Alachua County line and corresponding to the Brooksville Ridge, has commercial mining potential. Future exploitation of these remaining deposits will depend largely on phosphate market prices and the economic health of the phosphate industry.

Limestone

Ocala Group limestones occur near the surface in western Gilchrist County. These high purity limestones approach 95 percent $CaCO_3$, and extensive, commercially mineable deposits are present. To date, no commercial limestone quarries are in operation in Gilchrist County. However, the Gilchrist County Road Department is currently operating an open pit limerock mine off State Road 49, north of Bell. The rock is mechanically extracted, crushed, and used as roadbase material by the county.

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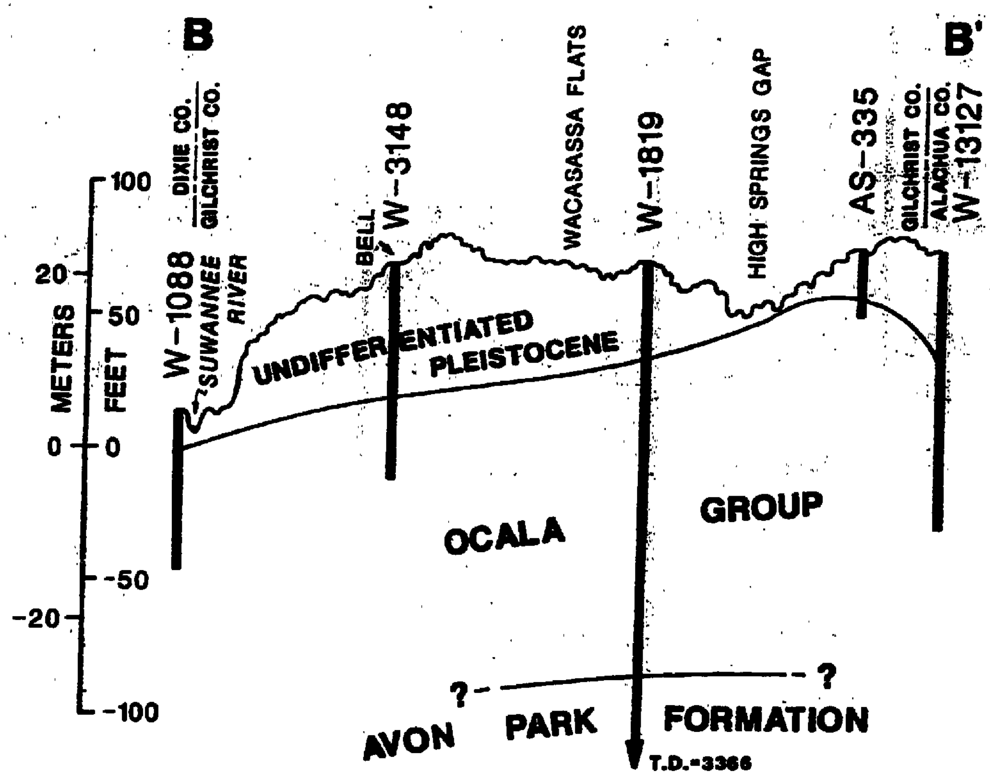
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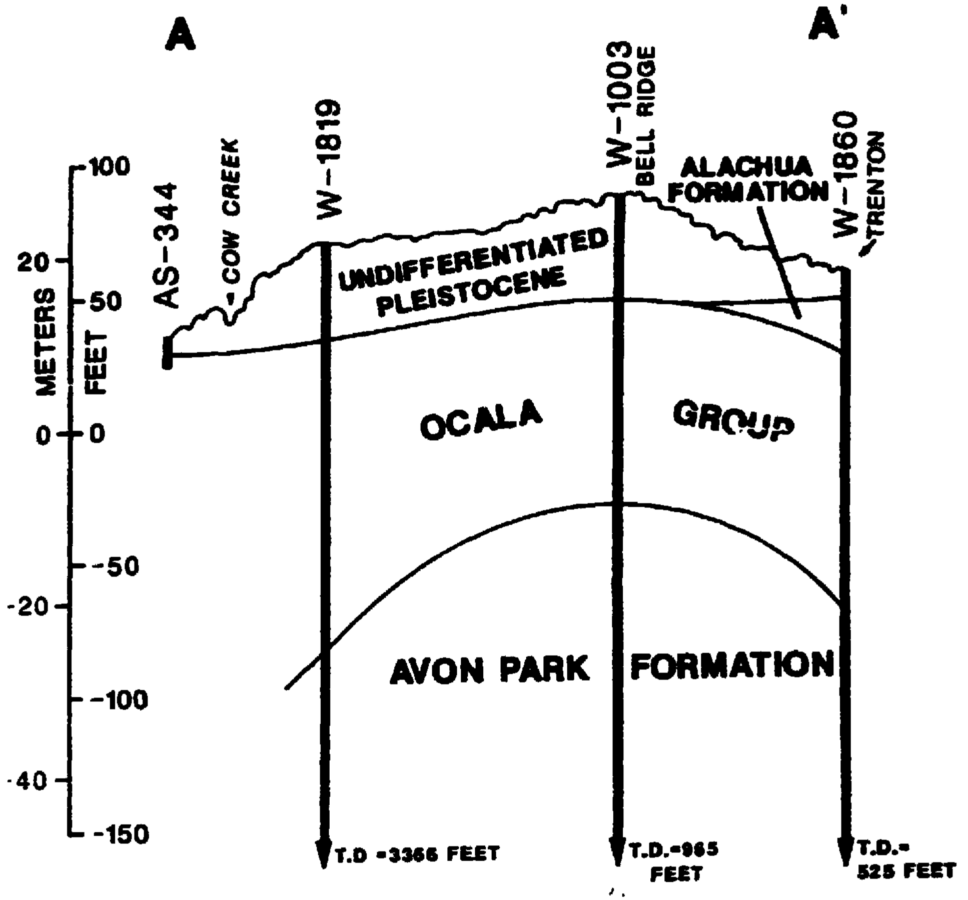

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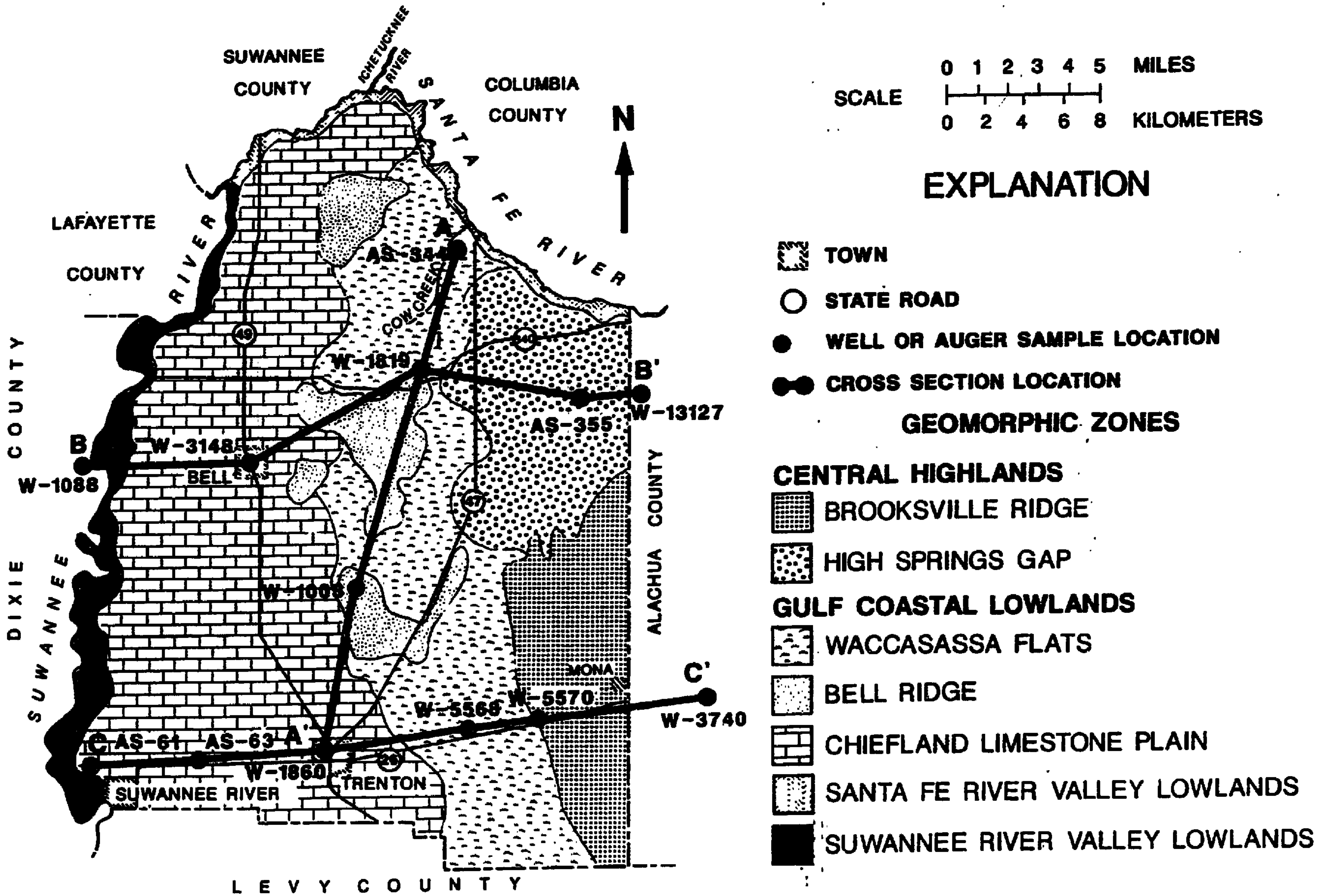
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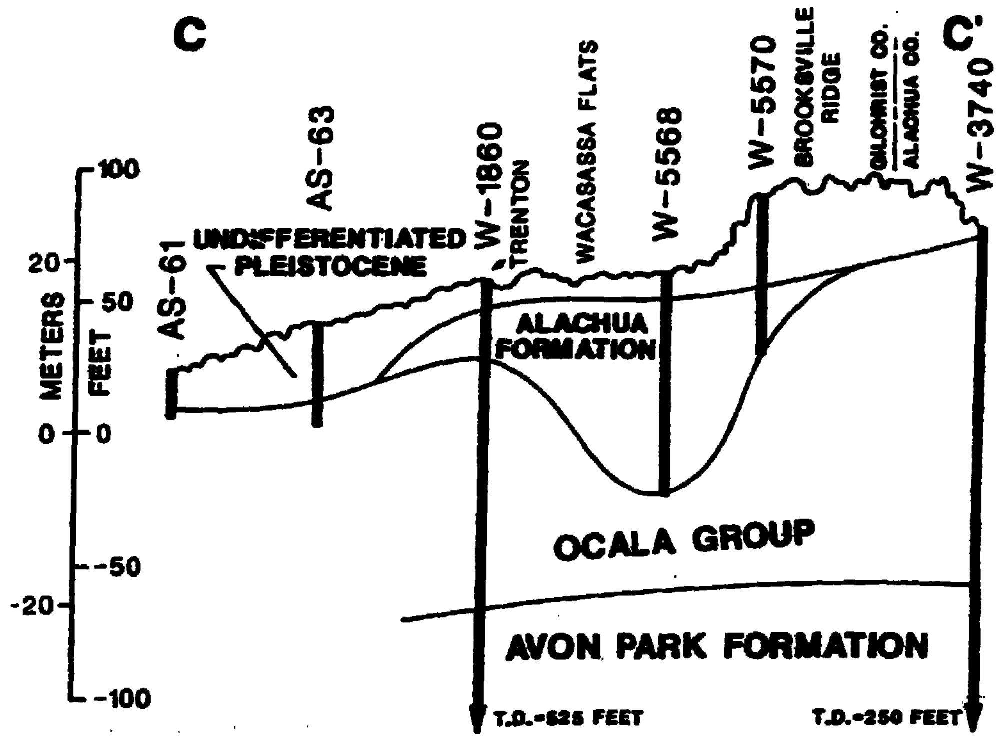
TOWN
STATE ROAD
WELL OR AUGER SAMPLE LOCATION
CROSS SECTION LOCATION
GEOMORPHIC ZONES
CENTRAL HIGHLANDS
BROOKSVILLE RIDGE
HIGH SPRINGS GAP
GULF COASTAL LOWLANDS
WACCASASSA FLATS
BELL RIDGE
CHIEFLAND LIMESTONE PLAIN
SANTA FE RIVER VALLEY LOWLANDS
SUWANNEE RIVER VALLEY LOWLANDS



HORIZONTAL SCALE FOR CROSS SECTIONS A-A', B-B' AND C-C'

0 1 2 3 4 5 MILES

0 2 4 6 8 KILOMETERS

VERTICAL EXAGGERATION IS 310 TIMES TRUE SCALE