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GEOLOGIC ATLAS OF THE VALDOSTA AREA

by

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GEOLOGIC ATLAS 10

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INTRODUCTION

This atlas is one of a series which is being produced by the Georgia Geologic Survey to map ground-water recharge areas in the Coastal Plain Province of Georgia. The atlas covers Lowndes County, Cook County, most of Lanier and Berrien Counties, eastern Brooks County, western Echols County, and southeastern Colquitt County (Plate 1). Earlier geologic maps that included the area, or parts of the area, covered in this atlas include Veatch and Stephenson (1911), Cooke (1939a, 1943), MacNeil (1947), Georgia Geological Survey (1976), Krause (1979), and Miller, 1986). Earlier descriptions of outcropping sediments and rocks, well-cuttings, and other geological interpretations include Veatch and Stephenson (1911), Brantly (1916), Shearer (1917), Cooke (1943), Fortson and Navarre (1959), Herrick (1961), Herrick and Vorhis (1963), Sever and others (1967), Sever (1972), Krause (1979), Miller, (1986), Huddlestun (1988), and McConnell and Hacke (1993). The present geologic map differs from older maps in that stratigraphic units are updated, river terraces are mapped, and Carolina Bays are discussed.

The area is environmentally sensitive, especially east of the Withlacoochee River. It contains a recharge area in the north for the Floridan aquifer. This influences the water supply of Valdosta as well as other minor aquifers used for domestic supply and irrigation (McConnell and Hacke, 1993). In addition, there are extensive wetlands across the eastern part of the area. Most of the atlas area is rural. Land use is primarily agricultural: farming in the western part and forestry products in the eastern part. Valdosta is the largest town in the area.

STRATIGRAPHY

OLIGOCENE

SUWANNEE LIMESTONE

Typical Suwannee Limestone (Cooke and Mansfield, 1936; Cooke, 1943; Huddlestun, 1993) consists of very pale orange (10 YR 8/2), even-textured, medium- to coarse-grained, granular, calcarenitic limestone. The grains generally consist of roughly equidimensional, rounded, calcareous pellets that may be mainly algal or fecal in origin (also see Randazzo, 1972), foraminifera, and fine, nondescript bioclastic debris. The grain size of the pellets ranges from fine (on the Wentworth scale) with much intragranular calcite "micrite", to coarse and relatively well-sorted, with little calcite "micrite". The Suwannee Limestone is soft to indurated and recrystallized, massive-bedded and structureless to crudely but distinctly bedded, and sparingly macrofossiliferous. In outcrop along the Withlacoochee River, the Suwannee Limestone is irregularly bedded with prominent ledges and reentrants which are attributed to differential recrystallization of calcite on and near the weathering surface.

Dolomite, dolostone beds, and intragranular gypsum are present but rare in the Suwannee Limestone. Conspicuous interstitial clay is rare in the formation as a whole. Quartz sand, silt, glauconite or pelletal phosphate are not present in typical Suwannee Limestone. However, McConnell and Hacke (1993) reported the Suwannee to be "ubiquitously phosphatic" to the ammonium molybdate test (Hacke, pers. com., 1996). The limestone of the Suwannee is fairly pure (greater than 98% $CaCO_3$).

The granular quality of the Suwannee Limestone is more pronounced than in other Tertiary limestones in the region. The granularity of the Suwannee Limestone commonly remains evident where the limestone has been entirely converted to chert, leaving only "ghosts" of the pellets and foraminifera within the translucent chert, or where the limestone has been completely recrystallized by calcite and is lacking in porosity.

The Suwannee Limestone characteristically contains few macrofossils, and large sections may be entirely devoid of macrofossils or visible bioclastic debris. In rare and scattered beds, the Suwannee may be moderately macrofossiliferous with scattered concentrations of the sea urchin *Rhyncholampas gouldii* or rich concentrations of molluscan molds (typically with low diversity). *Lepidocyclina* occurs rarely in scattered beds and, where it is present, it occurs in low or moderate frequency. The larger foraminifera *Dictyoconus* occurs locally in abundance. Near the state line on the Withlacoochee River, recrystallized calcitic or siliceous *Kuphus incrassatus* tubes of the boring *Toredo* clam are scattered throughout the outcropping Suwannee Limestone.

The Suwannee Limestone is exposed in the Valdosta atlas area only near the Georgia-Florida state line. Huddlestun (1993) concluded that the age of the Suwannee Limestone is Early Oligocene, Vicksburgian (Rupelian) and is most likely correlative with the Byram Formation of Mississippi.

MIOCENE

ST. MARKS LIMESTONE

The St. Marks Limestone (Puri and Vernon, 1964; Scott, 1988, fig. 62) is largely a subsurface formation in the Valdosta area, but an outcrop of brecciated limestone on the Withlacoochee River near the Florida state line may be St. Marks Limestone. The St. Marks is present in the core City of Valdosta #1 (GGS-3783) taken north of Valdosta. The St. Marks is a finely sandy, finely to coarsely and variably moldic, bioclastic limestone that contains a trace of phosphate and dark minerals (pyrite?). It is calcarenitic, variably granular and fine-grained. It is generally massive-bedded and structureless. However, shell molds and algal sheets are mostly oriented horizontally although some shell molds are oriented randomly. Miliolid foraminifera and the larger foraminifera *Sorites* are common. The limestone is generally very pale orange to pale cream in color.

The St. Marks Limestone is present in the core City of Valdosta #1 (GGS-3783), where it abruptly overlies the Chattahoochee Formation (which does not crop out in the Valdosta atlas area). Based on the stratigraphic cross-sections (Plates 2 and 3), and the absence of St. Marks along most of the lower Withlacoochee River in Georgia, the St. Marks is probably absent across the south-central part of the atlas area.

The St. Marks Limestone grades updip or landward into the Chattahoochee Formation. Huddlestun (1988) estimated the age of the Chattahoochee Formation to be Early Miocene, Aquitanian. Therefore the St. Marks Limestone also is Early Miocene, Aquitanian in age.

HAWTHORNE GROUP

Jumping Gully Formation; new name

The Jumping Gully Formation is a new formation of the Hawthorne Group that is restricted to the area south of the Gulf Trough and north of the Georgia-Florida state line. The Jumping Gully Formation is known to crop out at the type locality near the Withlacoochee River, along the Withlacoochee and lower Little Rivers from several miles above the state line to the vicinity of Troupville, west of Valdosta, (Plate 2) and in Thomas County.

The name Jumping Gully is taken from the name Jumping Gully Creek, a tributary of the Withlacoochee River, in southern Lowndes County, Georgia. The type locality is in road cuts of a paved county road in both valley walls of Jumping Gully Creek, approximately five miles southeast of Clyattville, Georgia. The type locality is found in the southeastern corner of the U. S. Geological Survey, 1:24,000 Clyattville, Ga.-Fla. quadrangle map. The section of Jumping Gully exposed at the type locality is the type section, or unit-stratotype (holostratotype), of the formation. The Jumping Gully Formation is overlain disconformably by the Miccosukee Formation in the eastern valley wall of Jumping Gully Creek.

The Jumping Gully Formation consists primarily of variably siliceous sand, variably siliceous clay, chert in the form of thin layers and nodules, and variably dolomitic sand. Silica is present in most places and is the critical lithic component of the formation. The sand is fine-grained and well sorted. The lower part of the formation primarily consists of variably siliceous Fuller's earth in the southern part of the

Valdosta Atlas, whereas the upper part consists of variably siliceous sand. In the nearby core Colquitt 10 (GGS-3544) on the southern flank of the Gulf Trough in Colquitt County, the entire formation consists of variably siliceous sand. This suggests that the lower part of the formation becomes more argillaceous southward.

Pelletal phosphate and dark minerals occur in scattered concentrations but pelletal phosphate is not known to be present in outcrops along the Withlacoochee River. Small irregular shaped "grains" and variable quantities of dark particles that are not heavy minerals or carbonaceous material may be wad (MnO_2). Other black material that appears to be wad or black, microcrystalline pyrite is associated with clay, and some dark streaks appear to be darker clay material. Dolostone and dolomite are present in the lower part of the formation along the lower Withlacoochee River and scattered throughout the formation in the vicinity of Valdosta.

The Jumping Gully Formation is very thickly bedded with only crude and vague stratification to be seen in outcrop. Some beds appear to be either bioturbated or intraclastic. Siliceous concretions or nodules, though mostly appearing to be randomly distributed, do occur in horizontal bands and along lines that appear to be bedding planes in outcrop. Concentrations of concretions tend to occur within stratigraphic intervals more commonly than along stratigraphic planes. The outcropping sediment is competent and friable, very tough and partially indurated or consolidated.

The Jumping Gully Formation is known to occur along a band from the vicinity of the Ochlockonee River in Thomas County in the west, to the vicinity of the longitude between Valdosta and the Alapahoochee River in the east. It is not present farther south in Florida where the Torreya Formation occupies the stratigraphic position of the Jumping Gully Formation. The Jumping Gully Formation probably grades eastward into the Marks Head Formation east of Valdosta. It appears to grade southeastward into the unnamed dolostone, clay and sand of the Hawthorne Group of Huddlestun (1988)(Marks Head Formation of Scott, 1988).

The Jumping Gully Formation is nonfossiliferous. It is correlated physically with the Marks Head Formation and the Torreya Formation. If the physical correlation is correct, the Jumping Gully Formation is of late Early Miocene (Burdigalian) age.

HAWTHORNE GROUP

Statenville Formation

The Statenville Formation (Huddlestun, 1988; Scott, 1988) is a prominently cross-bedded, argillaceous, dolomitic, phosphatic sand in the lower part, and a crudely- to massive-bedded, variably phosphatic, argillaceous sand in the upper part. Quartz sand is the dominant lithic component, whereas clay, dolomite, dolostone, phosphate, and mica are subordinate lithic components.

In the lower, coarse lithofacies of the formation, the grain-size of the quartz sand is variable, ranging from fine- to coarse-grained. The sorting ranges from well sorted to poorly sorted. Quartz pebbles (some flat pebbles) occur in the coarser, more poorly sorted beds or lenses of the formation. The quartz sand in the upper lithofacies is mainly fine-grained and well sorted.

The occurrence of clay in the lower,

prominently cross-bedded lithofacies of the Statenville Formation is mainly interstitial. On other hand, clay in the upper, fine-grained lithofacies occurs in discrete beds of thinly stratified or laminated finely sandy clay. The clay beds range in thickness from less than 1 foot to more than 8 feet. The massive Fuller's earth clay of Shearer (1917, p. 284-287) is referred to the Statenville Formation of this report. The known clay mineral assemblages of the Statenville Formation include smectite and palygorskite (T. Scott, pers. com., 1983; also compare with Brooks, 1966, p. 82).

Dolomite is characteristically conspicuous in the lower part of the formation and is present both interstitially and in discrete, thin beds. Dolostone beds may be relatively pure (as in beds at the type locality) or sandy, argillaceous, and phosphatic. The bedded dolostone is typically buff to tan, fine-grained, sucrosic, hard, and resistant to erosion. In outcrop the dolostone beds produce prominent ledges. Some beds consist of intraclastic dolostone cemented by dolomite of similar lithology and appearance.

Phosphate is characteristic of and is commonly conspicuous in the Statenville Formation. The phosphate grains include (1) the typical small, rounded, black, brown, to amber-colored, sand-size apatite grains or pellets; (2) irregularly shaped, rounded, black, shiny, sand-size grains or small pebbles; and (3) black, brown, orange, or buff-colored, irregularly shaped pebbles ranging from ½ inch to 2 inches in diameter. The Statenville Formation may be exceptionally rich in phosphate, and thin beds or lenses of phosphatic sediment (or phosphorite) have the color and appearance of wet coffee grounds.

Characteristically the Statenville Formation is prominently bedded with the bedding standing out in bold relief. Bedding styles range from horizontal to undulatory, to planar and trough cross bedded with common cut-and-fill structures. Typically the appearance of the bedding is enhanced at the type locality by thin beds of hard, resistant, fine-grained dolostone that stand out in bold relief as ledges. The softer, sandy sediment occurs in reentrants between the thin dolostone beds. In this lithofacies, most discrete bed units are less than a few inches thick, and many are less than 1 inch thick.

The characteristic, prominently cross-bedded Statenville lithology grades upward, and possibly laterally as well, into a less conspicuously bedded, less dolomitic to carbonate free, variably phosphatic sand with local development of clay beds. This lithofacies is also well-bedded, but the bedding is not enhanced by the presence of resistant, thin, dolostone beds as is the lower part of the formation. Bedding is marked by the distinction between sand and clay beds, by the varying proportions of clay and sand in beds, by the distinction between grain-size between beds, and by the difference in sorting of sand between beds.

The Statenville Formation is very sparsely fossiliferous. Molds and casts of mollusks occur locally and in moderate frequency in the dolostone beds. Fossils with calcitic shells, such as scallops, oysters, and barnacles are very rare. Voorhies (1974) reported a meager assemblage of vertebrate fossils from the type locality of the formation. Vertebrate fossil debris, such as small fish teeth and bones, do occur in the phosphatic beds of the formation, and the trace fossil *Ophiomorpha nodosa* is locally common in sand beds along the Alapaha River.

The Statenville Formation is known

to occur in southwestern Echols County, Georgia (Plate 3). Its northern limit is unknown at this time, but it is known to occur as far north as the vicinity of Stockton in southern Lanier County. Its western limit occurs in eastern Lowndes County, Georgia. Middle Miocene deposits pinch out and are absent west of the type area of the Statenville Formation. Neither the Statenville nor correlative Middle Miocene deposits are present along the lower Withlacoochee River in Lowndes County where the older Jumping Gully Formation is directly overlain by the younger Miccosukee Formation. Northwest of Statenville, however, from at least as far south as the north side of Valdosta, the Statenville Formation grades laterally into the Meigs Member of the Coosawhatchie Formation. At present there is meager information on the thickness of the Statenville Formation. Brooks (1966, p. 76-78) reported 28.8 feet of Miocene sediments (Statenville Formation) at the type locality in Statenville. At the present time, however, only 12 feet of Statenville Formation is exposed there. Plate 3 indicates as much as 130 feet of Statenville occurring in the lower Alapaha River area in southwesternmost Echols County.

The Statenville Formation contains a Barstovian land-mammal fauna at its type locality (Voorhies, 1974; Tedford and Hunter, 1984). According to Tedford and Hunter (1984), the Statenville land-mammal assemblage is early, late Barstovian and its age is approximately 13 million years. This age determination is compatible with the stratigraphically equivalent Coosawhatchie Formation (Huddlestun, 1988)

HAWTHORNE GROUP

Coosawhatchie Formation, *Meigs Member*

The Meigs Member of the Coosawhatchie Formation (Huddlestun, 1988) is an argillaceous, well sorted, fine-grained sand and thinly- to thickly-bedded, variably siliceous, sandy clay. It is mainly a subsurface formation in the Valdosta atlas area but the upper part of the member crops out on the Withlacoochee River north of Valdosta and west of Bemiss. The Meigs Member typically is lithologically heterogeneous. Well-sorted, fine-grained sand is the dominant lithic component of the unit but clay is prominent and is the characteristic lithic component. Other lithic components include chert, silica-cemented sandstone and claystone, dark minerals, and minor pelletal phosphate. The Meigs Member in the core City of Valdosta #1 (GGS-3783) (McConnell and Hacke, 1993) was discontinuously cored. The cored intervals consist of smectitic clay, finely sandy clay, clayey, and well-sorted, fine-grained sand with siliceous clay intraclasts.

The eastern limit of the Meigs Member in the Valdosta atlas area is approximately a north-south zone between the Alapahoochee River and Grand Bay Creek in the east and Valdosta in the west. In that north-south band, there is a facies change from Meigs Member into the Statenville Formation. The southern limit of the Meigs appears to extend from the vicinity of Mud Swamp, southwest of Valdosta, in the east, northward through the west side of Valdosta. It swings to an east-west trend northwest of Valdosta. The southern limit of the Meigs west of the Little River passes somewhere north of Quitman and Thomasville. South of this line, the

Miccosukee Formation disconformably overlies the Jumping Gully Formation.

The Meigs Member is the same age as the rest of the Coosawhatchie Formation. That is, early, middle Miocene, roughly 13 million years (Andrews and Abbott, 1985; Huddlestun, 1988).

ALTAMAHA FORMATION, *Screven Member*

The Screven Member of the Altamaha Formation (Huddlestun, 1988) differs from typical Altamaha Formation in lacking thick sections of poorly sorted, pebbly, clayey sands or sandy clays, and in lacking the indurated phases of the Altamaha.

The Screven Member is predominantly an argillaceous to clayey sand with scattered beds of sandy clay. The sand distribution in the clay is irregular with micro and macro lenses of sand occurring in slight concentrations in the clay. The irregularities in sand distribution do not appear to be due to bioturbation. Other mineral components include some plinthite nodules near the top of the member, fine-grained mica, variable quantities of dark minerals and scattered feldspar grains.

The particle-size of the quartz component of the Screven Member varies from silty and fine-grained to coarse-grained sand and rarely coarse-grained to granully and pebbly in the Valdosta atlas area. Pebbly sand stringers are present locally. The sorting ranges from very well sorted to poorly sorted. Some sand beds contain very little clay, which is unusual for the Altamaha Formation.

The clay content is variable but clay is present throughout the Screven Member. In the upper part of the Screven Member, the clay consists of 100% kaolinite. Lower in the member, kaolinite constitutes about 2/3 of the clay mineral assemblage with illite and smectite evenly constituting the rest of the clay minerals. Concentrations of small to moderate-size tabular clay clasts and irregularly rounded clay clasts occur irregularly. The clay beds consist of tough clay that is waxy and unconsolidated. The clay in these beds breaks with irregular fracture or blocky fracture.

The Screven Member is a prominently and moderately to thickly stratified unit. Bedding ranges from horizontal to undulatory to prominently cross-bedded. In outcrop the Screven Member appears to consist of a mass of lenticular bodies of sand and clay (fluvial channel cut-and-fill structures). The size of the lenses range from small (less than 10 feet across) to large (tens of feet across). The sediment within the lenses tends to be either massive and structureless or prominently trough cross bedded. Stratification contacts within a lens are generally crude, but bedding contacts between the lenses are well-defined. Thin stratification, however, does occur in some beds, especially near their tops.

Some of the lenses contain fining-upward sequences. Where they occur, the lower part of the bed tends to be coarse and poorly sorted whereas, the upper part of the bed is more finely grained, has better sorting and may be thinly layered. However, some beds contain thinly stratified to laminated clay at their bases.

Some lithologies or lithofacies of the Screven overlap with those of the Miccosukee. Where the exposures are small, and especially near the northern pinchout of the Miccosukee, the Screven Member and any coarse phases of the Miccosukee

Formation may be difficult to differentiate. However, no lithofacies of the Screven resemble the thinly interbedded pinkish red to reddish brown, fine-grained sand with white clay streaks characteristic of the Miccosukee, nor are any bioturbation structures or burrows found in the Screven Member. In addition, weathered Screven (sand or clay) commonly is color mottled, whereas the Miccosukee sands most commonly are uniformly moderate reddish brown. Clay lenses in the Miccosukee are also mottled but the stratigraphic position, elevation, and geographic occurrence is sufficient to recognize the clay as Miccosukee.

The environment of deposition of the Screven Member of the Altamaha Formation is probably lower delta flood plain to possibly upper estuarine. There are no trace fossils or sedimentary structures suggestive of a coastal marine or marine environment in the member. However, the occurrence of trace pelletal phosphate in the member indicates that the Screven must have had marine influences at times in the Valdosta atlas area.

The age of the Screven Member of the Altamaha Formation is inferred to be the same age as the rest of the Altamaha, that is, early to middle Miocene, roughly 13 million years old (Huddlestun, 1988).

PLIOCENE

MICCOSUKEE FORMATION

The Miccosukee Formation (Hendry and Yon, 1967; Huddlestun, 1988) typically is a prominently bedded, well-sorted, fine- to medium-grained sand with scattered laminae and partings of white clay. Cross-bedded red sand and white clay layers impart a characteristic and dramatic color contrast.

The lithology of the Miccosukee Formation is dominated by sand, although in some areas, and in some parts of the section, clay is a significant or dominant component of the lithology. Other known lithic components include mica, dark minerals, feldspar and, rarely, wad (MnO_2 dendrites). Limonite is locally present as a weathering byproduct. The clay mineral components of the lithology consist of smectite, kaolinite and illite.

There are several lithofacies in the Miccosukee Formation. The typical, prominently bedded, fine-grained sand Miccosukee consists of thinly bedded to laminated, well-sorted, fine- to medium-grained sand with scattered layers or laminae of white clay. Where the clay layers are absent, the sand generally remains distinctly and thinly layered, fine- to very fine grained and well-sorted. Medium- and, rarely, coarse-grained sand beds are associated with the thinly layered, fine-grained sands. The clay layers typically range in thickness from approximately one foot to 1/16 inch. Thicker beds of clay are rare. Thin beds of intraclastic or intraformational clay breccia are commonly associated with clay beds. Some beds within this lithofacies are bioturbated with incomplete mixing of sediments. Burrows and, rarely, *Ophiomorpha* are locally conspicuous.

Pebbly to gravelly, coarse-grained sand lenses are present locally in the Miccosukee Formation and probably represent tidal channel scour-and-fill deposits. These sediments are conspicuously cross-bedded and sorting commonly is poor. Gravel occurs in stringers. Lithologies intermediate to the thinly bedded, fine-grained sand lithofacies and the pebbly, cross-bedded sand also exist, indicating a wide range of energy levels in the paleo-environment.

In some areas, the Miccosukee is dominated by other lithologies, including massive-bedded, structureless, sandy clay to clayey sand; massive-bedded, structureless, well-sorted, fine- to coarse-grained sand; and vaguely bedded, well sorted to moderately well sorted, fine- to coarse-grained sand.

The Miccosukee Formation is moderately to deeply weathered, and the color of the sands typically range from various shades of pinkish red to reddish brown with some orange and yellowish brown. The thin clay layers, laminae, and bioturbation wisps are white, and the resulting color contrast imparts a dramatic and characteristic appearance to the formation.

The Miccosukee Formation occurs at the tops of the geologic sections in the southern part of the Valdosta atlas area and is the most widespread outcropping formation in the atlas area. It extends from the Florida state line northward to the vicinities of Berlin in Colquitt County and Nashville in Berrien County, north of which it pinches out. Its known eastern limit is the Alapaha River valley. The Miccosukee was apparently removed by erosion during the marine terrace forming events in Echols County in the southeastern corner of the atlas area.

The Miccosukee Formation disconformably overlies various formations of the Hawthorne Group in the atlas area: the Meigs Member of the Coosawhatchie Formation, the Jumping Gully Formation, the Statenville Formation near its southeastern limit in Echols County, and the Screven Member of the Altamaha Formation near its northern limit. It is overlain locally only by various undifferentiated sand and swamp deposits. However, it underlies various marine terraces in Georgia, including the Argyle, Claxton, Pearson, Cecil, and Hazlehurst terraces.

The Miccosukee Formation is distinguished from the underlying formations of the Hawthorne Group by consisting of locally burrowed and bioturbated, fine-grained sand with thin beds or laminae of white clay and with local occurrences of prominently cross-bedded, medium-to coarse-grained, pebbly, channel-fill sands. In contrast, the underlying Hawthorne deposits consist of argillaceous sands and sandy clays that are thick-bedded and massive, variably phosphatic, locally dolomitic and siliceous, and commonly contain magnesium-rich clays. The Miccosukee Formation is always weathered to some degree whereas Hawthorne deposits, due in part to high clay content and occurrence only at topographically low elevations, generally are unweathered or only mildly weathered.

McConnell and Hacke (1993) estimated the maximum thickness to be about 98 feet (30 m) at Bemiss. I estimate the maximum thickness of the Miccosukee to be roughly 112 feet (34 m) near Barney in northeastern Brooks County. It is absent where locally cut out. Most commonly, however, the maximum local thickness of the Miccosukee is between 50 and 100 feet (15 and 30 m). The most likely age of the Miccosukee Formation is late Pliocene (Huddlestun, 1988).

PLEISTOCENE-HOLOCENE

Pleistocene and Holocene sediments consist of swamp deposits and sands that are associated with the major rivers of the atlas area. These include the flood plains of most of the streams, Carolina Bays, sink holes, swamps (such as Mud Swamp southwest of Valdosta), and other poorly drained areas.

Sands occur in the modern flood plain, in river terraces, and in surficial drift sand in the uplands (Teas, 1921; Brackman, 1991). Flood plain sands are found in most of the streams in the atlas area. No sand dunes are present on the eastern side of any of the rivers. However, much of the area is mantled by a veneer of loose, white sand that, at least in part, may be wind drift sand that was deposited during the Pleistocene. The only other sand deposits occur on some of the rims of the larger Carolina Bays in the area.

The Alapaha, Withlacoochee and Little Rivers are bordered by multiple river terraces. All of the particular river terraces are discontinuous and occur along the valley sides. No Pleistocene swamp deposits are known to be associated with the river terrace sand deposits.

The sands in the modern flood plain are mostly massive-bedded, well-sorted and fine-grained (also see Huddlestun, 1988). The river terrace sands, however, are coarser grained with scattered occurrences of pebbles and cross-bedding. Both flood plain sand and terrace sand contain only minor clay, either interstitially or in beds. The river terrace sand also contains a variety of sedimentary structures, ranging from parallel bedding to various kinds of cross-bedding.

All of the river terraces are Pleistocene in age and are not found at very high elevations above the modern flood plains. Also, the head waters of all of the streams in the map area are located in the Tifton Upland and drain the Miocene Altamaha Formation. All of the rivers except the lower-most Withlacoochee are incised in Miocene deposits (Altamaha Formation or Hawthorne Group). It is only near the Florida state line that the Withlacoochee River is incised in the Oligocene Suwannee Limestone.

STRUCTURAL SETTING

There are four geologic structures in the Valdosta atlas area: the Gulf Trough, Suwannee Channel, Ocala Arch, and Peninsular Arch. The Gulf Trough (Huddlestun, 1988, 1993) lies immediately to the north of the Valdosta atlas area. However, it has influenced the Miocene stratigraphy of the study area in that it appears to have acted as a sediment trap for the coarser siliciclastics eroded from the Piedmont. As a result, most of the marine Miocene formations in the study area are dominated by clay and finer sands.

The east-west axis of the Suwannee Channel (Applin and Applin, 1944; Rainwater, 1956; Hull, 1962; Huddlestun, 1993) passes across the southern part of the atlas area. However, the channel was completely filled by the end of the Middle Eocene and, therefore, is not known to influence the geologic framework of the atlas area during the subsequent Oligocene to Holocene.

The Ocala Arch (Cooke, 1945; Puri and Vernon, 1964, Winston, 1976; Huddlestun, 1988, 1993) has been reported as far north as the southern part of the Withlacoochee River valley in Georgia. However, this northern extension of the

Ocala Arch is largely an artefact due to the relatively deep incision of the Withlacoochee River and its entrenchment into the Suwannee Limestone. The elevation of the top of the Suwannee Limestone, which exhibits substantial topographic relief [50 to 110 feet above mean sea level (MSL)], remains constant in Brooks County and southwestern Lowndes County. This suggests that the true extension of the Ocala Arch in Georgia is the large block of structurally flat terrain between the Gulf Trough to the north and west, and the Peninsular Arch to the east (see Huddlestun, 1993, pls. 3 and 5).

The Peninsular Arch (Applin, 1951; Toulmin, 1955; Puri and Vernon, 1964; Maher, 1965; Huddlestun, 1988, 1993) is the one structure that appears to have maintained a geologically continuing influence in the Valdosta atlas area. The Peninsular Arch is a subtle structural feature in Georgia. The Suwannee Channel has overprinted much of the arch in southern Georgia so that its presence is difficult to detect. The crest of the arch is a broad, diffuse, north-northwest--south-southeast trending structural high that underlies Echols, eastern Lowndes, western Lanier, and Berrien Counties. For the purposes of this atlas, the western limit of the Peninsular Arch may be taken as the western limit of the outcropping Statenville Formation. In addition, east of this western limit the Suwannee Limestone dips eastward below sea level. The Peninsular Arch also appears to have influenced depositional patterns in the region. No pre-Suwannee Oligocene deposits occur east of the arch and all Oligocene deposits are absent along the crest of the arch in northern Florida.

PHYSIOGRAPHY

Four physiographic districts of the Georgia Coastal Plain are recognized in this atlas: the Tallahassee Hills District (Cooke, 1939b; Puri and Vernon, 1964) in the southwestern part of the atlas, the Tifton Upland District (Cooke, 1925; Clark and Zisa, 1976) in the western part of the atlas, the Bacon Terraces District of Clark and Zisa (1976)(here referred to as the Bacon District) over most of the atlas, and the Lake Park Karst District (new name) in the south-central part of the atlas. These districts are not sharply bounded but merge over a distance of several miles.

Cooke (1925) included the Valdosta atlas area in the Okefenokee, Claxton and Hazlehurst terraces. Clark and Zisa (1976) included the entire Valdosta atlas area in the southeastern part of their Tifton Upland District.

The Tallahassee Hills (Cooke, 1939b; Puri and Vernon, 1964) are recognized in the Valdosta map area as a hilly region with isolated, rounded hills or ridges separated by flat swampy lowlands. In the atlas area, drainage is karst dominated and mostly interior with some irregular, external drainage. Runoff water in external drainage leaves the system mostly by runoff through swamps. There are scattered sink holes throughout the district. Interfluves consists of irregular, somewhat disconnected ridges and isolated, hummocky hills. The uplands are broadly and irregularly rounded, and moderately dissected. The uplands and interfluves merge where the Tallahassee Hills passes into the Tifton Upland District. Topographic relief ranges mostly around 40 to 80 feet with a maximum relief of 120 feet in the atlas area. The total elevation ranges from 100 feet MSL to 220 feet MSL. The regional slope is mostly north to south.

The western edge of the Withlacoochee River valley marks the eastern boundary of the Tallahassee Hills District. U.S. Highway 84 is a convenient northern boundary of the Tallahassee Hills District. It separates this district from the Tifton Upland District to the north. The Cody escarpment and marine terraces between the Ochlockonee and Apalachicola Rivers in Florida are the southern boundary of the Tallahassee Hills District, and the Pelham escarpment in Georgia and Florida is the western boundary of the district.

The Tifton Upland District is a region north of the Tallahassee Hills with gently rolling topography and dendritic to modified trellis drainage patterns. Remnants of older, marine terrace surfaces that survived erosion and dissection locally occur in the southern and southeastern part of the Tifton Upland. Drainage in the Tifton Upland District of the atlas area is submature. It ranges from linear to dendritic to linear-modified dendritic with some local trellis drainage. Through-flowing stream valleys on the dissected marine terraces are relatively straight. These linear streams possibly originated in the low topographic relief of the ancient upland surface and high marine terraces. The streams flow in a southerly to southeasterly direction, reflecting the original regional slope of the ancient upland surface and marine terrace surfaces. Interfluves are broadly rounded with some flat, terrace surface remnants. The maximum topographic relief in the atlas area is 110 feet but the relief is mostly 50 feet or less. The elevations range from 320 feet MSL in the north, to approximately 105 feet MSL in the south

The western valley wall of the Little River is a convenient eastern boundary of the Tifton Upland District in the Valdosta atlas area, separating it from the Bacon District to the east. East of the Little River the topography is more subdued and gently rolling to flat. The land between the Little River and the Withlacoochee River in the atlas area is basically transitional between the Tifton Upland District to the west and the Bacon District to the east. U.S. Highway 84 approximates the southern boundary of the Tifton Upland District, and the Pelham escarpment and Bacon District define its western and northern boundaries west and north of the atlas area.

The Tifton Upland District differs from the Tallahassee Hills in (1) lacking the flat swampy areas between hills, (2) absence of karst features, (3) more prevalent dendritic drainage patterns, and (4), containing less topographic relief. The upland summits are about the same altitude north and south of U.S. 84. However, the streams are not as deeply incised in the Tifton Upland District as in the Tallahassee Hills.

The Bacon Terraces District, proposed by Clark and Zisa (1976), lies east of the Tifton Upland District. It is a region of flat, upland surfaces and mildly to deeply incised streams. The name Bacon Terraces District is here modified to Bacon District. The reason for the recommended change is that marine terraces are irrelevant to the physiography of the district. The flat upland surface of the Bacon District extends far northwest of the highest marine terrace in the district. Therefore, the origin of the flat upland surface is irrelevant and the word "Terraces" in the district name is superfluous. The Bacon District is here expanded to include much of the Valdosta atlas area between the Alapaha and Withlacoochee-Little Rivers. The Bacon District in the Valdosta atlas area consists of flat to gently rolling, interfluve uplands that are separated by incised tributaries of the Suwannee River: the Alapaha River, Withlacoochee River, New River, Little River, and their larger tributaries.

The drainage in the Bacon District is immature. The stream valleys of the Bacon District in the Valdosta atlas area are mostly linear and some are curvi-linear or broadly arcuate. Some of the drainage is modified linear, trending toward dendritic patterns. There are some local trellis drainage patterns in small streams. Some of the larger stream valleys zig-zag in reaches varying from southwestward to southeastward. The rivers in these larger valleys tend to meander but where the river is known to flow on bedrock, the river courses appear to be structurally controlled (especially the lower Withlacoochee River where it flows on Suwannee Limestone and variably resistant Jumping Gully Formation). Where the topographic relief is very low, especially less than 10 feet, the drainage is largely disorganized and the terrain consists mostly of wetlands. For the most part, the drainage patterns in the Bacon District in the Valdosta area appear to be controlled mainly by original topographic relief on the marine terraces and the subsequently exposed marine terrace surfaces. The interfluves in the Bacon District are generally flat, with the exception of west of the Withlacoochee River where the interfluves range from flat to gently rolling. The uplands are more dissected and rolling near the larger rivers. There is a maximum topographic relief of 130 feet, but the relief is mostly less than 50 feet and much is less than 10 feet. The range of elevations in the Bacon District is from 320 feet MSL to roughly 140 feet MSL. The elevation of the valley floor of the Alapaha River in the southeastern corner of the atlas area is less than 90 feet MSL. The regional slope of the Bacon District in the atlas area varies from eastward to southeastward.

As expanded here, the Bacon District surrounds the Okefenokee Basin District on the north and west in Georgia. It extends to the Lake Park Karst District south and west of Valdosta, and to the Florida-Georgia state line southeast of Valdosta and east of the Lake Park Karst District. Its western limit is the western valley wall of the Little River, to the west of which is the Tifton Upland District. The eastern limit of the Bacon district in Georgia is the Okefenokee Basin District.

The Lake Park Karst District is a northern extension of the karst region in Florida that is referred to there as the Central Highlands (Puri and Vernon (1964). The karst region is extensive in Florida but it extends only a few miles to the north into Georgia. There are two subequal lobes of the Lake Park Karst District in Georgia. The eastern lobe is a half ellipse-shaped area extending from the bend in the Withlacoochee River, at the Georgia-Florida state line, northeastward through the vicinity of Lake Park and Twin Lakes. The western lobe is the larger of the two lobes and extends northwestward up the Withlacoochee River valley to the vicinity of the US 84 bridge over the Withlacoochee River. It is confined approximately to the Withlacoochee River valley and its fluvial terraces. Solution of carbonates in the shallow subsurface has resulted in karstification of the district and the presence of many lakes and sink holes.

Drainage in the Lake Park Karst District is irregular. Much of the drainage is interior into lime sinks and lake-filled sinks. The few through-flowing streams (or swamps - organized drainage is not apparent in swamps) are generally linear to arcuate and not noticeably dendritic. On the other hand, the course of the Withlacoochee River appears to be controlled by bedrock structure. Other drainage (mostly swamp lowland) also appears to be controlled by structure. There are numerous lake-filled sinks near Lake Park, and lake levels diminish in elevation southwestward toward the Withlacoochee River. Interfluves are mostly flat uplands on the Miccosukee Formation or river terraces along the Withlacoochee River. There are some broadly rounded interfluves where adjacent streams are closely spaced. The maximum topographic relief between uplands and stream valleys or swamps is 130 feet but most topographic relief is 50 feet or less. The highest elevations in the karst district approach 200 feet MSL and the lowest are near 80 feet MSL on the valley floor of the Withlacoochee River near the Florida state line. Regional slope along the western lobe is toward the southeast whereas the slope along the eastern lobe is toward the southwest.

In terms of karst features such as sink holes, the district boundaries are rather vague. Some sink holes can be found as far east as the Alapahoochee River in Echols County, on the flood plain and river terraces of the Withlacoochee River north of Valdosta, and in the Tallahassee Hills. The Bacon District lies to the north and east of the Lake Park Karst District and the Tallahassee Hills District lies to the west. The eastern valley wall of the Withlacoochee River demarcates the western limit of the Lake Park Karst District.

MARINE TERRACES

Six marine terraces are present in the Valdosta atlas area (Figure 1). From highest altitude to lowest altitude, these terraces are: the Hazlehurst, Cecil (new name), Pearson, Claxton, Argyle, and Waycross terraces.

The Hazlehurst terrace (Cooke, 1925; Huddlestun, 1988) is the oldest, most extensive, and most degraded marine terrace in Georgia. It is a simple marine terrace (Huddlestun, 1988) and is constrained by low scarps at roughly 275-280 feet MSL (Hazlehurst scarp) and 240-245 feet MSL (Cecil scarp)(Plate 2). Typical elevations on the Hazlehurst terrace in the Valdosta atlas range from approximately 250 feet to 270 feet. The Hazlehurst scarp at 275-280 feet defines the inner limit of the marine terraces. In most places it is deeply dissected but can be seen in the far northern part of the atlas area south of Alapaha, Berrien County. West of the Little River, the Hazlehurst terrace is severely degraded and little of its original continuous, flat, upper surface is left unbroken. West of Ellenton in Colquitt County, even the summit elevations of interfluves have been reduced. The only occurrence of the Hazlehurst scarp west of the Little River is at Spence Air Force Field near Moultrie, immediately west of the atlas area.

The Cecil scarp at approximately 240-245 feet MSL can be distinctly seen north to southwest of Cecil in Cook and northern-most Lowndes Counties (Figure 1). Elsewhere the scarp is indistinct, as it is in most of the higher marine terraces. The Cecil scarp has a scalloped pattern due to erosion by streams passing through the scarp. It is deeply incised by drainage near the Withlacoochee River and west of the Little River. There appear to be remnants or outliers of Hazlehurst terrace east of the Cecil scarp within the Cecil terrace. The outliers of Hazlehurst surface suggest that the Hazlehurst was more aerially extensive at one time than it is now, and it was subsequently modified by the Cecil terracing event. Extensive tracts of undissected Hazlehurst terrace are to be found in the northeastern corner of the Valdosta map, north and east of Nashville, Berrien County.

Huddlestun (1988) reasoned that the Hazlehurst terrace is no older than the youngest Pliocene. However, it most likely was constructed during the early part of the Pleistocene because the Hazlehurst scarp at 275-280 feet MSL is cut into the upper Pliocene Miccosukee Formation across much of southwestern Georgia.

The Cecil terrace is named here for the lower part of the Hazlehurst terrace of Huddlestun (1988). Because the main part of the Hazlehurst terrace at Hazlehurst, Jeff Davis County, is 240 feet to 260 feet MSL, I consider that elevation span to be typical for the Hazlehurst. The Cecil terrace displays more geomorphic variety than the other high terraces in the Valdosta area. It consists of an emergent barrier island, here called the Valdosta ridge, and a back-barrier tract. The elevation range of the Cecil back-barrier ranges from 210 to 240 feet MSL.

The Valdosta ridge is interpreted here to be a severely degraded Cecil barrier island. The ridge is named for the city of Valdosta, the northern part of which is built on the degraded southern part of the ridge. The Valdosta ridge extends almost unbroken from Big Creek, northwest of Lakeland in Lanier County, southwestward to Cherry Creek, near Bemiss in Lowndes County (Figure 1). North of Big Creek, it extends in a broken line to the vicinity of Reedy Creek in the southeastern corner of Berrien County, north of which it disappears and appears to merge with the Hazlehurst terrace. The southern part of Valdosta ridge, south of Cherry Creek, is fragmentary due to headward erosion of tributaries of the adjacent Withlacoochee River. The southern end of the ridge appears to fan out west of the vicinity of West Valdosta. From the vicinity of Ousley in the southwest to Reedy Creek in the northeast, Valdosta ridge is roughly 36 miles long and 2.5 miles across at its widest. Georgia Highway 125, the Central of Georgia Railroad, the communities of Bemiss and Barretts, and Moodys Air Force Base lie on the summit of the ridge northeast of Valdosta, indicating its topographic significance for the area. The summit elevation of the Valdosta ridge typically is between 240 feet and 260 feet, too high for a Pearson barrier island and too low for a Hazlehurst barrier island. The Valdosta ridge is penetrated by only one gap, which is now occupied by Big Creek near Lakeland in Lanier County. This gap may have been, originally, a tidal channel between the open sea and the Cecil back barrier. After the withdrawal of the sea, the gap was occupied by Big Creek which drained the hinterland. There are no other gaps in the ridge other than Cherry Creek which appears to have cut through the ridge by headward erosion.

The Pearson terrace is a simple terrace (Huddlestun, 1988). Its surface elevations typically range from 205 feet to 220 feet MSL. The Pearson terrace is bounded on the west by the Valdosta ridge or by the Pearson scarp at roughly 225 feet MSL and on the east by the Claxton scarp at roughly 200 feet MSL. Well-developed Pearson terrace is present in the Valdosta atlas area only northeast of Valdosta (Figure 1). The city of Valdosta, south of Onemile

Branch, is on the Pearson terrace but the terrace narrows and pinches out in the vicinity of West Valdosta, a few miles southwest of the Interstate 75/U.S. 84 interchange. The Pearson terrace extends northeast of Valdosta to the Alapaha River at Lakeland. The Alapaha River cuts through the terrace at an oblique angle, and there are no sand ridges or back-barrier features associated with the river on the Pearson terrace.

The Claxton terrace (Cooke, 1925; Huddlestun, 1988) is a better developed marine terrace in the Valdosta atlas area than the Pearson terrace (Figure 1). The Claxton terrace surface elevations are mostly between 180 and 195 feet MSL. The Claxton terrace is bounded on the west side by the Claxton scarp at roughly 200 feet MSL and on the east by the Argyle scarp at roughly 175 feet MSL.

The Claxton terrace extends in the southwest from the vicinity of Clyattville and Jumping Gully Creek northeastward to the vicinity of Naylor near the Alapaha River, all in Lowndes County. The Claxton terrace is wide in its southwestern part and narrow in the northeast. It abruptly narrows in the vicinity of the Valdosta Municipal Airport and the community of Dasher, and it is only a few miles wide northeast of Mud Creek. The Claxton terrace also appears to have been present in southernmost Brooks County south of Piscola Creek but its summit elevations occur only on isolated hill tops.

The Claxton terrace appears to contain a system of ancient beach ridges in its southwestern part, here called the Clyattville ridges. The Clyattville ridges are included in the Claxton terrace because their summit elevations are between 200 and 215 feet MSL. The summit elevations are too high for Argyle terrace sand ridges (projected to be 175 to 190 feet MSL), and too low for Pearson terrace sand ridges (projected to be 225 to 240 feet MSL. These ridges are very subdued and discontinuous, broken by the lateral erosion of streams flowing in the swales between the ridges. The ridges are capped by fine-grained, well-sorted sand. The sand veneer is thin, probably due to eolian processes over extended periods of geologic time. The most prominent ridge extends from the vicinity of the Georgia Highway 31/Interstate 75 interchange southward past Clyattville. New Clyattville Road (Georgia Highway 31) is on the crest of the ridge.

The Clyattville ridges extend from the south and southwest side of Mud Swamp and Mud Creek in the north, to a short distance east of the Georgia Highway 31 sand ridge. They appear to be more prominent in the south and become more subdued northward. The higher elevations on the southern part of the ridges suggest that the sand is from a southern source, the Withlacoochee River. Mud Swamp and Mud Creek appear to have formed in a back-barrier tract that was subsequently modified, possibly by karst. East of the Clyattville ridges, the Claxton terrace is simple in morphology. Its eastern escarpment, the Argyle scarp, is deeply scalloped in the vicinity of Twin Lakes and Dasher, which reflect the antiquity of the terraces and the agents of erosion modifying the terraces. The narrowness of the Claxton terrace northeast of Mud Creek may be the result of terrace destruction prior to or concurrent with the construction of the younger Argyle terrace.

The Argyle terrace (Huddlestun, 1988) is a simple marine terrace in the Valdosta atlas area and the terrace surface elevation is mostly between 155 and 170 feet MSL. It is bounded on the west by the

Argyle scarp at roughly 175 feet MSL and on the east by the Waycross scarp at roughly 150 feet MSL. It extends from the vicinity of Lake Park in Lowndes County, northeastward to the vicinity of Stockton, Lanier County, east of the Alapaha River. The Alapaha River passes across the Argyle terrace at an oblique angle. As with the higher marine terraces, there is no evidence of the Alapaha River being a sand source for beach ridge construction during the building of the terrace.

The Argyle terrace is narrow from the vicinity of Lake Park and Long Pond southward to the Florida state line, being only a few miles wide. North of the vicinity of Lake Park, the seaward edge of the terrace abruptly swings to a more east-west direction and passes immediately north of Statenville. The trace of the landward limit of the terrace retains a northeastward direction, and, as a result, the terrace abruptly widens from a few miles across to more than 10 miles across in the vicinity of Statenville and Mayday in Echols County (Figure 1).

The seaward scarp of the Argyle terrace is moderately scalloped. The abrupt change in breadth of the terrace in the atlas area may be due to erosion and destruction prior to or during the construction of the seaward Waycross terrace.

The Waycross terrace (Huddlestun, 1988) is a simple marine terrace in the Valdosta atlas area. The terrace surface elevation is mostly between 130 and 140 feet with maximum elevations up to 150 feet. It is bounded on the west by the Waycross scarp at roughly 150 feet. It is found only in the southeastern corner of the Valdosta Atlas, in the vicinity of the Alapaha and Alapahoochee Rivers. Statenville and Jennings, Hamilton County, Florida, 1 mile south of the Georgia-Florida state line, lie on the Waycross terrace. The landward edge of the Waycross terrace bends from a northeast-southwest direction in the vicinity of Lake Park in Lowndes County, to a more east-west direction through Echols County in the Valdosta atlas area.

PRE-MARINE TERRACE LAND SURFACE

The highest land surface in the Valdosta atlas area is an interfluve, plateau-like surface with surface elevations greater than 275 feet MSL. Because there are no shoreline escarpments above 275 feet MSL, the high surface appears to be either a plain of aggradation or a peneplain, and was formed prior to the construction of the marine terraces. This old surface rises uniformly and more steeply to the northwest than does the marine terrace surfaces.

The earliest that the old surface still existed as an intact, regional plain was during the deposition of the Miccosukee Formation during the Late Pliocene. If there had been erosion or stream incision events (due to low stands of the sea) prior to the Late Pliocene, the stream valleys must have been filled in during the Late Pliocene high stand of the sea. Because there is no evidence of valley-filling events prior to the Late Pliocene in the Valdosta atlas area, it is likely that the land surface higher than 275 feet MSL is ancient. It may have been constructed during the deposition of the youngest formation underlying the surface (i.e., the Middle Miocene Altamaha Formation).

RIVER TERRACES

River terrace sands are associated with the major streams of the area: the Alapaha, Withlacoochee, New, and Little Rivers and, to a lesser extent, Okapilco Creek. Four river terraces can be recognized: 10-15 feet above the modern flood plain (AMFP), 20-30 feet AMFP, 40-50 feet AMFP, and 60-70 feet AMFP. The elevations of the terrace surfaces are somewhat variable, possibly due to the presence of old river channels and sand dune fields.

The lowest river terrace, at 10-15 feet AMFP is barely higher than the flood plains. On those quadrangles where the contour interval is 10 feet, the 10-15 feet terrace is partly obscured because of the close vertical spacing of the flood plain and terrace. However, the terrace is locally well-preserved in all of the streams. The terrace at 20-30 feet AMFP is the most widely occurring terrace. It is found in the valleys of all major streams, including Okapilco Creek. The terrace at 40-50 feet AMFP is generally fragmentary along the Alapaha and Withlacoochee Rivers and is the least developed of the higher terraces in the atlas area. A terrace at 60-70 feet AMFP is well-developed along the Withlacoochee River east of Hahira and north of Valdosta. It is fragmentary elsewhere. Remnants of the 60-70 ft terrace are present along the lower Withlacoochee River in Lowndes and Brooks Counties. It is always deeply eroded and fragmentary in the lower Withlacoochee River area.

In the atlas area, all the river terraces are constructed on marine terraces and, therefore, must be younger than the associated marine terrace. Huddlestun (1988) suggested the oldest marine terrace, the Hazlehurst terrace, was probably constructed during the early Pleistocene. Therefore, the river terraces probably are all younger than early Pleistocene. The highest river terraces in the atlas area, at 40-50 feet and 60-70 feet AMFP, overlie the Pearson terrace on the lower Withlacoochee River. Therefore the 60-70 feet river terrace is younger than the Pearson marine terrace.

SAND DUNES

There is some irregularly undulating terrain in the flood plains of the Alapaha River and the lower part of the Withlacoochee River, south of the US 84 bridge, that occur at the same elevation as the lowest terrace. However, the elevations of these tracts within the flood plains are commonly irregular and hummocky; these sand bodies are interpreted as remnant, probably early Holocene, sand dunes. There are no sand dunes or relatively thick mantles of eolian sand on the eastern side of the river valleys (as along the Ohoopee River in eastern Georgia) as has been reported (Teas, 1921).

CAROLINA BAYS

GENERAL COMMENTS

Carolina Bays are elliptical, or spoon-shaped, wetland depressions that are aligned roughly north-northwest--south-southeast (Prouty, 1952). They occur across all of the Valdosta atlas area but are very rare west of the Withlacoochee-Little Rivers. There are four clusters of Carolina Bays in the Valdosta atlas area: a rather diffuse cluster in eastern Lowndes County, a tight, small cluster of large bays near Lakeland, a cluster of bays near Adel, and a cluster in Berrien County between Nashville and Willacoochee. The bays are wetlands and are commonly filled with swamp deposits. Some Carolina Bays are completely, or in part, water-filled and are now lakes. Within the Valdosta atlas area there may be as many as 100 Carolina Bays.

The origin of Carolina Bays has been controversial. There have been two kinds of postulated processes for their formation: terrestrial and astronomical, i.e., a meteorite swarm infall (for a complete discussion of the various postulated origins, see Prouty, 1952). The terrestrial origins fall under several categories: (1) wind and current action generated (Cooke, 1933), (2) rotary current generated (Cooke, 1940), (3) sink-hole or solution generated, (4) artesian spring generated (Johnson, 1942), and (5) shoals of fish generated (Grant, 1945). Prouty (1952) dismissed all of the proposed terrestrial origins and showed that all of the characteristics of the bays and bay fields can be explained through a swarm of incoming meteorites (similar to the breakup of Comet Levy-Shumaker and the impact of the various fragments of the comet on the planet Jupiter in 1994) at an angle of 30° to 35° to the horizontal. The reason the meteorites did not produce typical meteorite craters is that the meteorites were small and the excavation of the bays was caused by atmospheric shock waves (similar to the Tunguska event in Siberia in 1908) accompanying the meteorites, which produced much larger depressions than the primary craters.

Prouty (1952) believed that the various proposed terrestrial origins for Carolina Bays are untenable. He pointed out that there are no known geological processes capable of producing their consistent geometric shapes and consistent orientations across much of eastern North America. All of their characteristics can be explained by meteoritic impact on flat sand surfaces without regard for the many different kinds of underlying stratigraphic associations.

THE SOUTH GEORGIA BAY FIELD

The Carolina Bays in the Valdosta atlas area comprise the western two thirds of a large bay field called the South Georgia Carolina Bay field in this atlas. The South Georgia bay field is centered in the vicinity of Lakeland and Ray City in southern Georgia (Plate 1) and extends southward into northern-most peninsular Florida.

The vast majority of Carolina Bays in the south Georgia bay field occur in concentrations or clusters of various sizes. The largest concentration of Carolina Bays in the South Georgia bay field occurs east of the Alapaha River, outside the Valdosta atlas coverage. Generally there is one or more large to moderate size Carolina Bays within each cluster. Few bays occur singly outside of the clusters. Within the South Georgia bay field, there are no areal geometric patterns displayed between the various bays as there are elsewhere. That is, there are no clear linear, en echelon, or curved patterns, and the bays occur randomly within the clusters.

Carolina Bays generally occur on flat upland surfaces or drainage divides or, less commonly, on broad, flat, river terrace surfaces. The surficial material found in the near vicinity of all Carolina Bays is unconsolidated, loose, mostly fine-grained, quartz sand. Typical Carolina Bays are shallow depressions, no more than 5 to 10 feet below the surrounding land surface.

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or lakes (such as Banks Lake) outside of the Lake Park Karst District may have formed as Carolina Bays but their margins were subsequently modified by karst processes.

Prouty (1952) was of the opinion that Carolina Bays all formed in one event. In the classical Carolina Bay fields in South and North Carolina, the bays are not generally degraded and they do appear to have occurred at roughly the same time. This is not so obvious in the western part of the South Georgia bay field where geological processes have degraded many of the bays. Some of the south Georgia bays appear to be relatively old. However, based on the good preservation of the Carolina Bays elsewhere in south Georgia, it is likely that the south Georgia Carolina Bays were also formed at approximately the same time.

Carolina Bays in the South Georgia Bay field are generally connected to the regional surface water drainage. That is, bays commonly occur at the headwaters of small drainage systems or they occur along drainage paths (creeks and swamps) of small drainage systems. This is in contrast to sink-holes, where the drainage is interior. One of the main criteria used in this study to discriminate between Carolina Bays and round sink holes is the presence of external drainage. If a bay-like feature has external drainage, it is considered here to be a Carolina Bay.

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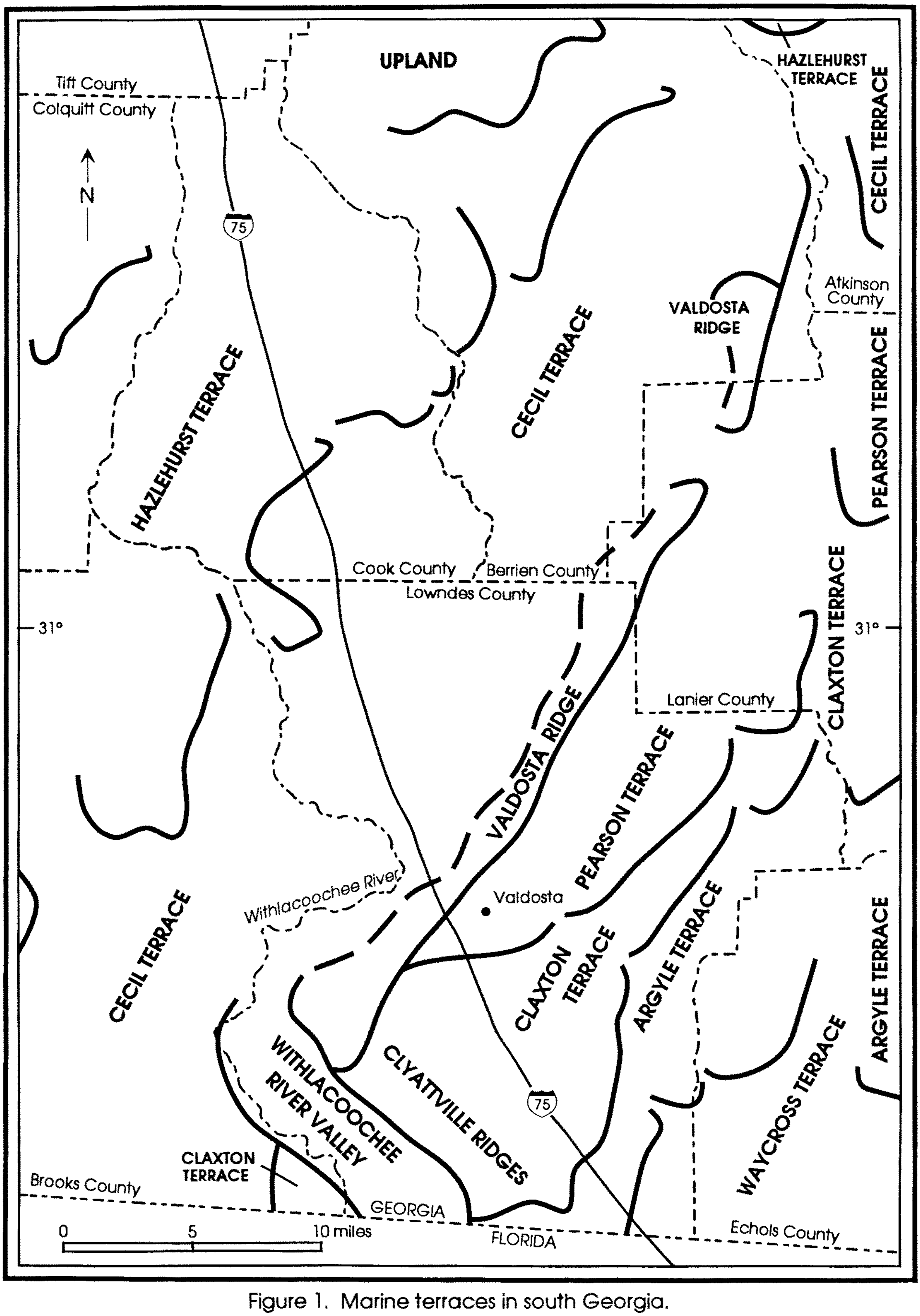

Figure 1. Marine terraces in south Georgia.

Publications Coordinator: Donald L. Shellenberger

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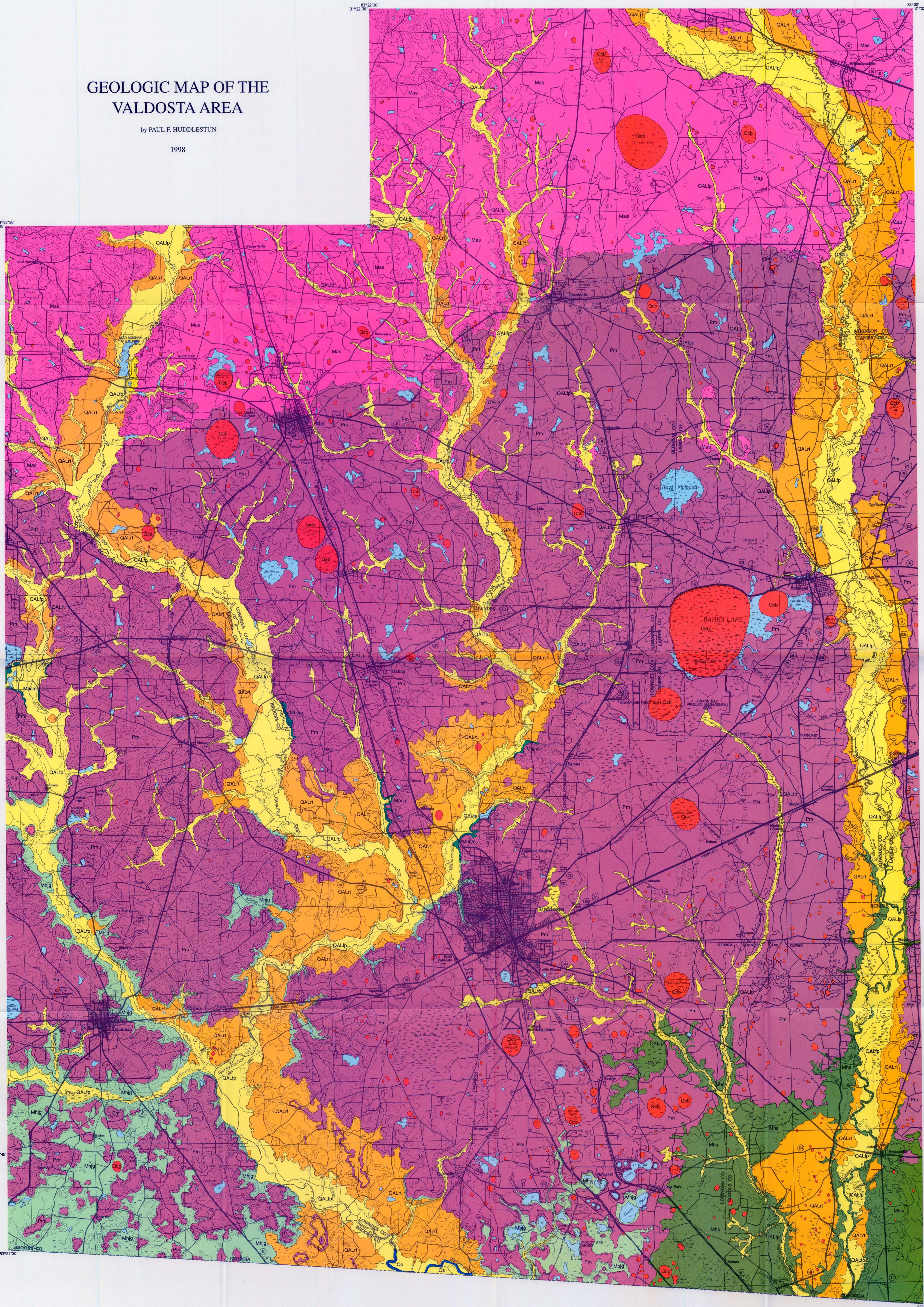
GEOLOGIC MAP OF THE VALDOSTA AREA

by PAUL F. HUDDLESTUN

1998



EXPLANATION

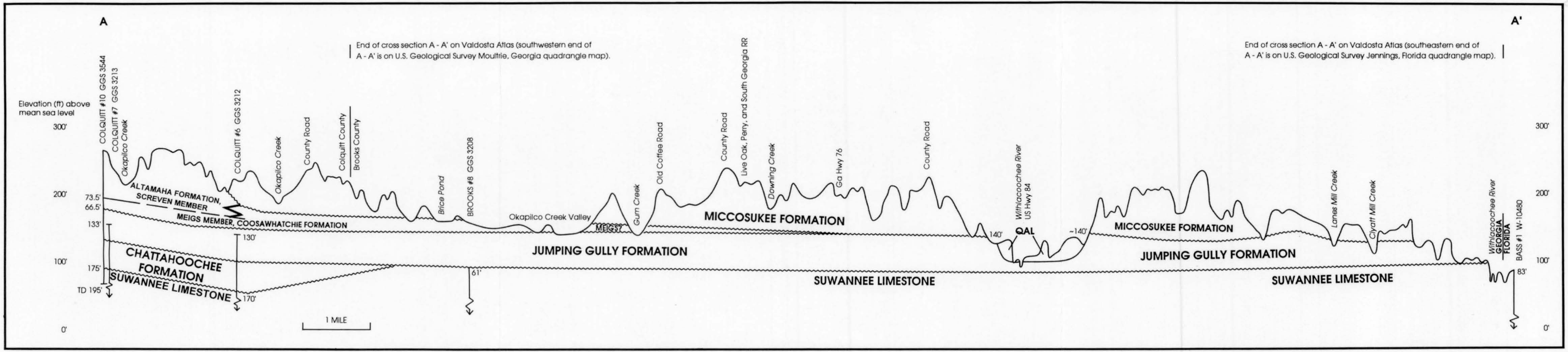
QALfp	**Quaternary Alluvium Flood Plain Deposits-** Sand in the larger streams; sand, mud, and organics in small streams and creeks. Sand is mostly fine and well-sorted and mostly massive and structureless with some crude, very vague stratification.
QALrt	**Quaternary Alluvium River Terrace Deposits-** Sand, fine to medium, moderately well-sorted to well-sorted, some poorly sorted, coarse sand with quartz granules, massive and structureless but crudely bedded with some cross-bedding where coarse and poorly sorted.
Qcb	**Quaternary Alluvium Carolina Bay Deposits-** Organic-rich muds to muddy peat, wetland, swamp deposits.
Pm	**Pliocene Miccosukee Formation-** Sand, variably argillaceous, some scattered, thick clay beds or lenses; sand is mostly fine and well-sorted; prominently bedded, bedding is characteristically laminated, thin to medium with white clay laminae characteristically defining stratification; thin to medium bioturbated beds are characteristic, scattered burrows such as *Ophiomorpha nodosa*; sand is weathered to a moderate reddish brown.
Mas	**Miocene Altamaha Formation, Screven Member-** Sand, variably argillaceous and micaceous, clay mostly interstitial; prominently bedded, bedding is mostly undulatory and cross-bedded, channel cut-and-fill structures are absent.
Mhcm	**Miocene Coosawhatchie Formation, Meigs Member-** Clay, finely sandy, siliceous, with some clay intraclasts, trace to absent phosphate, no carbonates.
Mhs	**Miocene Statenville Formation-** Sand, clay, variably dolomitic with locally common thin to medium beds of fine-grained dolostone, variably phosphatic, some reported land mammal bones; prominently bedded in the lower part with thin to thick beds of sand, clay, and dolostone, bedding is horizontal to undulatory to cross-bedded, upper part is massive argillaceous sand to sandy clay, thinly and indistinctly bedded on close examination.
Mhjg	**Miocene Jumping Gully Formation-** Sand to clay, siliceous with chert nodules, thin to medium chert layers, and opaline claystone, variably dolomitic and phosphatic; lower part consists mainly of clay, opaline claystone, chert with some phosphate and dolomite and dolostone; thinly bedded to laminated, to medium bedded, clay and claystone intraclasts locally abundant; crops out on lower Withlacoochee River from confluence of Little and Withlacoochee rivers almost to Florida line; upper part consists of apparently massive but indistinctly stratified, argillaceous, siliceous fine sand with chert nodules that occur randomly or, in some places, along stratification.
Os	**Oligocene Suwannee Limestone-** Granular and mealy textured, calcarenitic limestone, rare and scattered fossiliferous lenses or beds, silicified tubes of *Kuphus incrassatus*; crudely stratified in outcrop but apparently massive and structureless where unweathered.

Formation contacts

Approximate positions of formation contacts

SCALE 1:100,000
1CENTIMETER ON THE MAP REPRESENTS 1 KILOMETER ON THE GROUND
CONTOUR INTERVAL 5 METERS

KILOMETERS 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
MILES 1 0 1 2 3 4 5 6 7 8 9 10


A
A'
End of cross section A - A' on Valdosta Atlas (southwestern end of A - A' is on U.S. Geological Survey Moultrie, Georgia quadrangle map).
End of cross section A - A' on Valdosta Atlas (southeastern end of A - A' is on U.S. Geological Survey Jennings, Florida quadrangle map).
Elevation (ft) above mean sea level
300'
200'
100'
0'
COLQUITT #10 GGS 3544
COLQUITT #7 GGS 3213
Okapilco Creek
COLQUITT #6 GGS 3212
Okapilco Creek
County Road
Colquitt County
Brooks County
Brice Pond
BROOKS #8 GGS 3208
Okapilco Creek Valley
Gum Creek
Old Coffee Road
County Road
Live Oak, Perry, and South Georgia RR
Downing Creek
Ga Hwy 76
County Road
Withlacoochee River
US Hwy 84
Lanes Mill Creek
Clyatt Mill Creek
Withlacoochee River
GEORGIA
FLORIDA
BASS #1 W-10480
73.5'
66.5'
133'
175'
TD 195'
130'
170'
61'
140'
~140'
83'
ALTAMAHA FORMATION, SCREVEN MEMBER
MEIGS MEMBER, COOSAWHATCHIE FORMATION
MEIGS?
MICCOSUKEE FORMATION
MICCOSUKEE FORMATION
QAL
CHATTAHOOCHEE FORMATION
JUMPING GULLY FORMATION
JUMPING GULLY FORMATION
SUWANNEE LIMESTONE
SUWANNEE LIMESTONE
SUWANNEE LIMESTONE
1 MILE


A
D
B
End of cross section A - B on Valdosta Atlas (northwestern end of A - B is on U.S. Geological Survey Moultrie, Georgia quadrangle map).
End of cross section A - B on Valdosta Atlas (southeastern end of A - A' is on U.S. Geological Survey Jennings, Florida quadrangle map).
Elevation (ft) above mean sea level
300'
200'
100'
0'
COLQUITT #10 GGS 3544
COLQUITT #7, GGS 3213
COLQUITT #6 GGS 3212
Berlin
Okapilco Creek Valley
Ga Hwy 94
Barney
Little River
Franks Creek
I-75
US Hwy 41
Withlacoochee River
VALDOSTA #1 19F01
Cherry Creek
Pearson Terrace
US Hwy 221
US Hwy 84
Seaboard Coastline RR
Georgia Southern RR
Claxton Terrace
Ga Hwy 94
Mud Swamp Creek
Swilley Hill Church
Argyle Terrace
Carolina Bay
Caney Branch
Enoch Creek
Carolina Bay
Kinsey Branch
Waycross Terrace
Long Branch
GEORGIA
FLORIDA
BETTY #1 W-15121
73.5'
86.5'
133'
175'
TD 195'
195'
130'
170'
TD 202'
ALTAMAHA FORMATION, SCREVEN MEMBER
MEIGS MEMBER, COOSAWHATCHIE FORMATION
JUMPING GULLY FORMATION
CHATTAHOOCHEE FORMATION
SUWANNEE LIMESTONE
MICCOSUKEE FORMATION
QAL
MICCOSUKEE
FORMATION
QAL
MEIGS MEMBER, COOSAWHATCHIE FORMATION
MEIGS MEMBER, COOSAWHATCHIE FORMATION
JUMPING GULLY FORMATION
CHATTAHOOCHEE FORMATION
MICCOSUKEE FORMATION
MEIGS MEMBER, COOSAWHATCHIE FORMATION
JUMPING GULLY FORMATION
CHATTAHOOCHEE FORMATION
?
?
ST MARKS FORMATION
SUWANNEE LIMESTONE
STATENVILLE FORMATION
UNNAMED DOLOSTONE, CLAY, AND SAND FORMATION
1 MILE