GEOLOGIC MAP OF THE AMERICUS 30′ × 60′ QUADRANGLE, GEORGIA AND ALABAMA

By Juergen Reinhardt, J. Stephen Schindler, and Thomas G. Gibson

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INTRODUCTION

The Americus 30′ × 60′ quadrangle is located along the northeastern margin of the Gulf Coastal Plain. The area extends from the Flint River in the east to the Chattahoochee River, the boundary between Georgia and Alabama, in the west. The stratigraphic units underlying the Americus quadrangle are predominantly unconsolidated deposits of the eastern Gulf Coastal Plain. Upper Cretaceous deposits unconformably onlap deeply weathered Paleozoic crystalline rocks of the Piedmont and are in turn overlain by unconsolidated lower Tertiary, upper Tertiary, and Quaternary deposits. The Cretaceous and lower Tertiary units are sedimentary deposits that accumulated landward and seaward of a migrating shoreline in the early Late Cretaceous to the early Tertiary. The changing shoreline position was the result of the nearshore sediment budget, eustatic changes in sea level, tectonics in the adjacent and underlying Appalachian orogen, and subsidence along the passive southeastern margin of the North American continent.

The Coastal Plain deposits in the Americus quadrangle dip gently to the south and southeast at 6 to 9 m/km (30 to 50 ft/mi). Locally, dips are steeper close to the Fall Line, especially in interfluves between the major rivers. West-trending flexures and a few high-angle faults offset the strata. Soft-sediment deformational features are abundant locally at certain stratigraphic levels within the Cretaceous and lower Tertiary and are thought to result from both paleoseismic activity in the region and differential compaction of sedimentary deposits (Reinhardt, 1983).

Our ability to interpret the distribution of lithofacies within the Upper Cretaceous and lower Tertiary units is strongly affected by their present outcrop pattern. Late Tertiary dissection of the Coastal Plain by the Chattahoochee and Flint Rivers and their tributaries followed a prolonged episode of subsidence along the northeastern margin of the Gulf of Mexico basin. Downcutting of the river valleys removed considerable volumes of Upper Cretaceous and lower Tertiary sediment, commonly creating good exposures and thereby revealing updip-downdip facies relations within stratigraphic units. Left in place of the eroded strata are terrace deposits, which constitute a fragmentary record of late Tertiary and Quaternary fluvial sedimentation.

Mapping of the Americus sheet began in 1976 and continued through 1982 as part of a project to assess neotectonics in the southeastern United States. Work was then continued as part of a regional surface and shallow subsurface geologic mapping project in the Coastal Plain of western Georgia and eastern Alabama. Shallow cores, auger holes, and water well information were used to supplement the available outcrops along roads, in areas of disturbed land (mines, construction sites), and around natural drainages. All lithologic and structural data were plotted on U.S. Geological Survey (USGS) 1:24,000 quadrangles and compiled at 1:100,000 when the Americus quadrangle became available. Although most of the mapping in this quadrangle is based on new field work, previous 1:48,000 mapping of Tertiary units in the Springvale and Andersonville mining districts (Clark, 1965; Zapp and Clark, 1965; Zapp, 1965) and the 1:24,000-scale mapping of Upper Cretaceous units on the Fort Benning Military Reservation (Ray, 1957) were used as starting points for the mapping in those areas.

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STRATIGRAPHY OF CRETACEOUS, TERTIARY, AND QUATERNARY DEPOSITS

Tuscaloosa Formation

The Upper Cretaceous Tuscaloosa Formation (Kt) is the oldest unit cropping out in the eastern Gulf Coastal Plain. Along the Fall Line at the northwestern margin of the Americus quadrangle, the Tuscaloosa rests unconformably on crystalline rocks traditionally placed within the Paleozoic Uchee belt (see Hanley, 1989). Higgins and others (1988) have reinterpreted these rocks as mélange slices and have assigned them to the Macon Complex (Late Proterozoic to Middle Cambrian). A notable feature of the contact zone is the local preservation of a paleosol or fossil soil on the crystalline rock surface, indicating a long period of subaerial exposure and land surface stability for the Piedmont rocks prior to the deposition of the Tuscaloosa (Sigleo and Reinhardt, 1985).

Within the outcrop belt and in the shallow subsurface of the Americus quadrangle, the Tuscaloosa is 50 to 150 m (165 to 495 ft) thick; the unit pinches out to the east (Prowell and others, 1985), and it thickens to the southwest to about 300 m (1,000 ft) in the subsurface of southwestern Alabama (Copeland, 1974). The texture and composition of the Tuscaloosa indicate that it is an immature sandstone locally derived from erosion of the adjacent Piedmont rocks and their associated regolith (Frazier, 1987). The

Tuscaloosa was deposited as a series of laterally discontinuous, fining-upward sequences, generally 3 to 6 m (10 to 20 ft) thick. Each sequence is marked by a sharp, scoured base and grades from a sandy conglomeratic facies through cross-stratified arkosic sand to massive or mottled sandy to silty clay at the top. Extensive alluvial paleosols have been described in the fine-grained tops of these sequences (Smith, 1984; Reinhardt and others, 1986).

Primary sedimentary features characteristic of the Tuscaloosa sand bodies include planar tabular and trough crossbedding, scour and fill structure, and cross lamination. Locally abundant olive-green to brick-red clay clasts derived from adjacent massive mudcracked sandy clays are major components in sand beds.

In the Americus quadrangle, the Tuscaloosa Formation contains only a sparse record of a Late Cretaceous flora and fauna. In the western part of the quadrangle, local accumulations of leaves, silicified and lignitized wood, moderately abundant root traces, and networks of back-filled burrows (*Muensteria*) are most commonly preserved within the clayier parts of the formation. The only biogenic remains useful for dating the deposits are palynomorphs, which strongly suggest a late Cenomanian to early Turonian (Eaglefordian) age (Christopher, 1980; 1982). The lithofacies and biofacies of the Tuscaloosa in the Americus quadrangle are more limited than the type Tuscaloosa Group in western Alabama, which is thicker and more complex. There, the Tuscaloosa is composed of a lower unit (Coker Formation), including both continental and marine facies, and an upper unit (Gordo Formation) composed largely of fine-grained continental deposits (Monroe and others, 1946; Szabo and others, 1988).

The primary sedimentary structures, the lateral lithofacies relations, and the preserved biogenic features all indicate deposition in a continental environment dominated by sandy, low-sinuosity streams. The conglomeratic and crossbedded sand facies were deposited as channel fills and migrating bars. Locally, broad, stable flood plains developed and became repositories for fine-grained overbank sedimentation during and following periods of flood.

Eutaw Formation

The Eutaw Formation (Ke) is separated from the Tuscaloosa Formation by an erosional unconformity; locally, manganese oxide staining, color mottling, and an intensely burrowed surface mark the top of the Tuscaloosa. Commonly, the boundary is at a sand-on-clay contact. The hiatus between the Tuscaloosa and the Eutaw probably encompasses most of the Turonian, the entire Coniacian, and part of the Santonian—a 3 to 4 m.y. gap in sedimentation. The onlap, and apparent overlap, of the Tuscaloosa during Eutaw deposition represents a major marine transgressive event during the Santonian.

The Eutaw has not been considered mappable in outcrop east of the Flint River because it appeared to be indistinguishable from the underlying Tuscaloosa Formation (Eargle, 1955). The difficulty in separating the nearshore sedimentary units mapped in the Americus quadrangle from the equivalent continental deposits updip has led to a different stratigraphic terminology in central and eastern Georgia. In that area, all upper Cretaceous deposits were called Buffalo Creek Formation by Pickering and Hurst (1989).

The Eutaw is 30 to 60 m (100 to 200 ft) thick in the Americus quadrangle and shows extremely abrupt coarse to fine lithofacies changes both laterally and vertically. Coarse-grained facies makes up most of the updip exposures of the unit along the northern part of the outcrop belt in the Americus and the adjacent Thomaston quadrangles. This facies consists largely of cross-bedded, moderately well rounded, medium to coarse quartz sand with local heavy-mineral laminae and is characterized by abundant *Ophiomorpha*. The fine-grained facies is characterized by bioturbated fine quartz sand, clayey sand, and clay with abundant invertebrate remains, and by locally abundant carbonaceous debris.

Within a 20 km (12 mi) area present beneath Fort Benning (see cross section *D–D'*), lateral interfingering of the Eutaw consists of a complex vertical sequence of marginal marine deposits. The base of the unit is characterized by crossbedded, coarse-grained quartz sand, that contains substantial amounts of reworked Tuscaloosa sediment. The basal sand is truncated by a poorly sorted and poorly bedded, clayey and pebbly sand interpreted as a ravinement or transgressive lag deposit. The basal Eutaw is overlain by fine-grained deposits composed of quartz and muscovite, fine to very fine sand, and smectitic clay that contains locally abundant cristobalite. These fine-grained deposits of the lower Eutaw are interpreted as lower shoreface deposits. The molluscan faunas from this part of the section have been described in detail by Stephenson (1956).

The upper part of the Eutaw in the western part of the Americus quadrangle was deposited in a variety of back barrier environments (Frazier, 1987). Bioturbated, carbonaceous fine sand and clay constitute the upper part of the Eutaw in much of western Georgia, while thick beds of *Ostrea cretacea* Morton dominate the middle part of the Eutaw along the Chattahoochee River and in eastern Alabama.

Along the northeastern margin of the quadrangle, the marginal marine deposits of the Eutaw become fluvial and deltaic. Clay beds change from laminated and massive smectite to massive kaolin with mottled coloration. Sand intervals become less well sorted with increasing amounts of clay matrix. Bioturbation of fine-grained deposits and *Ophiomorpha* in the crossbedded sand intervals are rare in updip areas. Except for pollen (Christopher, 1982), biogenic remains are absent. The sedimentary and biological indicators listed above and the apparent thickening of the Eutaw (uK1 and uK2 unit abbreviations of Prowell and others, 1985) toward a depocenter in central Georgia are consistent with a change from a linear to a deltaic shoreline east and northeast of the Americus quadrangle.

Blufftown Formation

The Blufftown Formation (Kb) is separated from the Eutaw Formation by an erosional unconformity; the hiatus is shorter than the zones of the major biostratigraphic groups studied in the region. The contact is most commonly quartz sand on slightly weathered clay; the weathering may be either from subaerial exposure or ground water leaching along the base of the sand in the Blufftown. The arrangement of coarser and finer lithofacies is similar to the Eutaw, but the fine-grained lithofacies are different compositionally. Most of the Blufftown along the Chattahoochee River consists of clayey, fine sand to silt composed primarily of quartz, glauconite, muscovite, and highly variable amounts of calcite and aragonite fossil debris.

Along the northern and eastern boundaries of the Americus quadrangle, the basal sand of the Blufftown thickens and only locally are thin carbonaceous clay beds and lenses interbedded with medium to coarse, crossbedded sands. Placement of the sand-on-sand Eutaw-Blufftown boundary is difficult in the drainage divide between the Chattahoochee and Flint Rivers and becomes impossible east of the Flint River. The upper boundary with the Cusseta Sand is equally cryptic in the northeastern part of the Americus quadrangle. To the west, the Blufftown becomes a fine glauconitic sand and marl that intertongues with the Mooreville

Chalk (Monroe, 1941; Skotnicki and King, 1986).

Within the Chattahoochee River valley, the outcrop belt of the Blufftown is at its widest, and the unit is 100 to 130 m (330 to 430 ft) thick. The formation has been informally divided into a lower and an upper part (Reinhardt, 1980; 1986) based on an interpretation of two depositional cycles (see middle of cros ssection *B–B'*).

Unconsolidated crossbedded sands about 50 m (165 ft) thick in the basal Blufftown form prominent north-facing cuestas (see cross section *A–A'*). Slightly downdip, near the type area along the Chattahoochee River, the lower part of the Blufftown contains only a 6 m (20 ft) basal quartz sand, which is truncated by a transgressive disconformity or ravinement. The ravinement is marked by a 50-cm (20-in.)-thick, very poorly sorted clayey sand with sparse quartz pebbles and is abruptly overlain by 70 m (245 ft) of dark micaceous clay, marl, and glauconitic, calcareous fine sand containing a rich and diverse molluscan and calcareous microfossil fauna. Exposures of the lower Blufftown are characterized by massive bedding, abundant concretions, and water-worn specimens of the robust oyster *Exogyra ponderosa*. A thin, carbonaceous, micaceous silt and clay unit is locally present at the top of the lower part of the Blufftown. Updip exposures are dominated by crossbedded quartz sand containing abundant *Ophiomorpha*.

The transition from the lower to the upper part of the Blufftown is marked by a second ravinement or transgressive lag, which is difficult to trace updip from exposures along the Chattahoochee River. The upper part of the Blufftown is generally fine grained and calcareous but more carbonaceous than the lower part of the unit. The upper part of theBlufftown, which shoals upward to the contact with the Cusseta Sand, is locally characterized by oyster bioherms and bone lag accumulations (Schwimmer, 1986).

Except for relatively thin stratigraphic intervals at the boundaries of the two sedimentary cycles, the downdip Blufftown was deposited below wave base, probably in mid- to inner-shelf environments. Updip, the coarse quartz sands are the result of high-energy sedimentation around barrier islands and are probably dominated by tidal inlet fillings.

Based on both molluscs and calcareous nannofossils (Sohl and Smith, 1980), the bulk of the Blufftown is of early Campanian age. The age of the base of the Blufftown is uncertain and may be either latest Santonian or early Campanian.

Two sedimentary cycles are present in the Blufftown resulting from separate transgressive events (Reinhardt, 1986; Reinhardt and Gibson, 1980). Based on their work in central and eastern Alabama, Skotnicki and King (1986) have suggested that three sedimentary cycles can be recognized in the Blufftown.

Cusseta Sand

In the type area near Cusseta, Ga., and throughout most of the Chattahoochee River valley, the Cusseta Sand (Kc) abruptly overlies the Blufftown Formation. The basal Cusseta contains crossbedded coarse quartz sand and pebbles; the base scours fine sand and silty clay at the top of the Blufftown.

In eastern Alabama, the Cusseta has traditionally been assigned as the lower member of the Ripley Formation (Szabo and others, 1988), while in Georgia the Cusseta holds formational status (Eargle, 1955). Skotnicki and King (1989) have proposed raising the Cusseta to formational rank in Alabama; their convention is followed here. The difference in stratigraphic treatment of the Cusseta resulted both from the perspective of previous workers and from the distribution of facies. West of the Americus quadrangle in eastern Alabama, the basal sand becomes quite thin and highly bioturbated; the overlying fine sand and thinly bedded marl gradually merges with the Demopolis Chalk in central Alabama and a comparable lithology in the subsurface. Conversely, east of the Americus quandrangle (east of the Flint River), the crossbedded sands of the Blufftown and Cusseta are indistinguishable. The distribution and composition of the Cusseta sands throughout the Americus quadrangle were described in detail by Hester (1968). Our mapping indicates that the Cusseta is 40 to 70 m (170 to 235 ft) thick.

In the updip, the Cusseta is characterized by large-scale crossbedded, coarse quartz sands containing *Ophiomorpha* similar to those that constitute the updip Eutaw and Blufftown Formations. Similarly along the Chattahoochee River valley, the basal sand of the unit forms north-facing cuestas. West of the Americus quadrangle in eastern and central Alabama, the Cusseta is composed of thinly bedded, laterally continuous quartzose, micaceous silt and calcareous clay with some burrows and local shell accumulations. The "Cowickee Prairie" of Monroe (1941) is underlain by this fine-grained facies of the Cusseta.

Based on mollusks, the Cusseta is of late Campanian and early Maastrichtian (?) age (Sohl and Smith, 1980). The unit represents deposition during an interval of relatively stable shoreline configuration following establishment of the coastal barrier complex in the updip beds; the thin carbonaceous clay and sand interval just below the Cusseta-Ripley boundary are interpreted as deposition in a restricted back barrier environment, indicating a terminal regressive phase in the sedimentary cycle.

Ripley Formation

The Ripley Formation (Kr) sharply overlies the Cusseta Sand in updip areas, but the contact is generally poorly exposed. The basal transgressive unconformity is not as well displayed as in the Eutaw or in the two depositional Blufftown cycles. In downdip areas, the contact is marked by a phosphatic lag or simply a change from clayier to sandier calcareous silt and marl. The lower part of the Ripley is a massive, bioturbated, fine to medium, micaceous and glauconitic quartz sand. The upper part of the Ripley is commonly massive, fine sand to silty clay, and coarsens abruptly near the top where it contains a bone and shell lag and becomes well bedded. Calcite-cemented concretions and siderite-cemented beds are locally abundant, especially in the upper part of Ripley.

Diagnostic guide fossils, such as *Exogyra costata*, and lithologic consistency enable the Ripley to be traced with considerable certainty throughout the Americus quadrangle. The unit shows less updip-downdip variation than any of the other Cretaceous units in the eastern Gulf Coastal Plain. In the Chattahoochee River valley, the Ripley ranges from an updip thickness of about 40 m (135 ft) (Eargle, 1955) to a downdip thickness of about 75 m (250 ft) based on our drilling south and west of Eufaula, Ala.

The marine character of the Ripley is maintained along the outcrop belt from western Alabama to the eastern margin of the Americus quadrangle. East of the Americus quadrangle in central Georgia, the Ripley changes from a thoroughly bioturbated, clayey glauconitic sand with thin quartz sand lenses, representing inner shelf deposition, to a crossbedded sand with *Ophiomorpha*, indicating deposition within a barrier island complex.

Based on calcareous nannofossils, the Ripley is of early and early middle Maastrichtian age in the Chattahoochee River valley (Sohl and Smith, 1980). Biostratigraphic resolution at the top of the Ripley has been difficult because of the local erosion between the Ripley and the Providence Sand (Donovan, 1985; Sohl and Koch, 1986). Evidence of abrupt shallowing and subaerial exposure include the abrupt coarsening of particle size and the preservation of poorly developed paleosols (Donovan, 1986).

Providence Sand

The middle to upper(?) Maastrichtian Providence Sand (Kp) is the youngest Cretaceous unit in the Americus quadrangle. Near the type section in the southwestern corner of the map area, the unit can be divided into lower and upper crossbedded sand units separated by a 50-cm (20-in.)-thick sandy clay bed (Donovan, 1985). The sand units are thick to very thickly bedded and composed of medium to coarse quartz sand containing heavy mineral grains (largely ilmenite, zircon, and rutile) and clay granules to clasts. Muscovite is locally abundant. The sandy clay bed is massive and poorly sorted; fine to coarse quartz sand and granules float in a silt and clay matrix.

To the south and west of the map area, the Providence becomes finer grained (abundantly micaceous, carbonaceous, and thinly bedded to laminated) and intertongues with the Prairie Bluff Chalk (actually a marl). In the eastern part of this map, the Providence contains abundant kaolin intraclasts and local kaolin lenses and lacks the *Ophiomorpha* burrows common in the type Providence. East of the Flint River, Eargle (1955) mapped the Providence only as inliers beneath overlapping Tertiary strata. The Providence ranges in thickness from less than 30 m (100 ft) in updip sections to 80 m (270 ft) along the southern margin of the Americus quadrangle. The unit shows extraordinary areal variability in texture and composition from outcrops near the type area to the downdip exposures along the Chattahoochee River south and west of Eufaula, Ala., and into the shallow subsurface.

The stratigraphic revision of the Providence Sand proposed by Donovan (1985) has not been formally adopted but is noted here. Laterally equivalent facies A and B of Donovan (1985) correspond to the fine (downdip) and the coarse (updip) facies as shown on this map and in the cross-section *A-A'*. The most substantial change in nomenclature is rejection by Donovan (1985) of the Perote Member of Eargle (1950) as the basal member of the Providence. Along the Chattahoochee River, Eargle's Perote Member is now considered to be the regressive phase at the top of the Ripley Formation. Another unit, mainly recognized in the subsurface and informally called the Alexander's Landing beds, locally lies between the Ripley and Providence along the Chattahoochee River (Donovan, 1985). These beds pinch out near the Providence type section and are not mappable at the scale of this map. Regional biofacies of the various subunits within the Providence have been discussed by Sohl and Koch (1986).

The Ripley Formation and Providence Sand are separated by an erosional unconformity in the updip; the Providence is separated into unnamed lower and upper members by another transgressive disconformity. The upper contact of the Providence with the Clayton Formation is planar to gently undulating and marks the Cretaceous-Tertiary boundary in the Chattahoochee River valley. Weakly developed paleosols are preserved as root-mottled clay along the boundary of the lower and upper members of the Providence and just below the Cretaceous and Tertiary boundary in updip areas.

Donovan (1985, 1986) identified both deltaic and interdeltaic shorelines along the Providence outcrop belt from central Georgia to central Alabama. Within the Americus quadrangle, most of the coarse facies deposits have been interpreted as mixed-energy barrier systems. The sand bodies that make up coarsening-upward shoreface and fining-upward tidal inlet fills are thought to result from barrier progradation (regression) (Donovan, 1986).

Clayton Formation

The Clayton Formation (Tc) of early Paleocene age is the oldest Cenozoic unit in the eastern Gulf Coastal Plain and represents the highest sea-level stand in the Paleogene (Gibson and others, 1982). Highly fossiliferous limestone and medium to coarse quartz sand are the predominant lithologies. The Clayton strata were deposited in nearshore environments and are now preserved at elevations as high as 200 m (650 ft) above sea level in upland areas adjacent to the Chattahoochee River. The thickness of the Clayton ranges from several meters of silicified or ironstone residuum in updip exposures to 55 m (180 ft) of molluscan-bryozoan limestone along the Chattahoochee River near Fort Gaines, Ga. (Toulmin and LaMoreaux, 1963). Cofer and Frederiksen (1982) reported a thickness of 19 m (62.3 ft) in the Andersonville, Ga., area.

Porous, highly fossiliferous, limestones of the Clayton are karstified, causing variability in thickness and discontinuities in lateral extent along the southern margin of the Americus quadrangle. The irregular karstified top of the Clayton is infilled and locally eroded by deposits of the overlying Baker Hill Formation. Beds of the residual Clayton Formation are composed of coarse quartz sand and olive-brown to dark-orange-red clay; they have a highly contorted fabric and are locally cemented by iron oxides. Strip mining of the Clayton residuum as an iron ore was widespread in western Georgia and eastern Alabama for about a decade from the 1950's into the 1960's. The Clayton is also silicified in a few updip areas; knobby siliceous nodules as much as 15 cm (6 in.) in diameter and well preserved, silicified mollusks, bryozoans, and corals are known from several localities in western Georgia. Within the Americus quadrangle and in adjacent parts of eastern Alabama, a thin sequence of green to dark-gray clay as much as 10 m (33 ft) thick is locally preserved at or near the top of the Clayton. The clay is thought to represent the partially coeval Porters Creek Formation of western and central Alabama. In this compilation, the clay is mapped with the Clayton Formation.

Although calcareous nannofossils indicative of lower Paleocene Zones NP1, NP2, and NP3 are present in downdip Clayton sections to the west and in the subsurface section at Albany, Ga., about 65 km (40 mi) south of Plains, only strata as old as Zone NP3 (middle Danian) crop out in the Americus quadrangle. The upper clay unit contains nannofossils characteristic of the upper Danian Zone NP4 (Bybell, 1980).

Limestones in the Clayton contain mollusks and bryozoans that are considered common in shallow marine, inner neritic environments. Some updip exposures contain carbonaceous beds with sporomorph and dinoflagellate assemblages that indicate lagoonal or coastal swamp environments (Gibson and others, 1980).

Baker Hill and Nanafalia Formations

The Baker Hill Formation (Gibson, 1982a) (Tb) consists primarily of crossbedded sand and massive kaolin deposits. These beds were formerly assigned to the age-equivalent, downdip marine Nanafalia Formation (Tn). The Baker Hill is separated from the underlying strata by an erosional unconformity. The hiatus in deposition represents a major low stand of sea level. In the Americus quadrangle, the strata are mostly fine to coarse, micaceous, quartz sand that contains abundant kaolinite clay clasts as much as 15 cm (6 in.) across. Sand intervals are crossbedded and contain abundant clay drapes. Clay intervals are commonly massively bedded and pale gray to white; locally the clay is finely laminated, carbonaceous, and contains well-preserved spores and pollen.

Within the Americus quadrangle, the formation is best exposed in clay pits near Andersonville, where commercial-grade kaolin deposits are actively being extracted. Lensoid masses of sandy clay and clay between lenses of medium to coarse, micaceous, quartz sand locally contain thin pisolitic bauxite pods. The thickness of the Baker Hill in the Andersonville area is from about 12 to 27 m (40 to 90 ft) according to Zapp (1965). The unit thins to 6 to 12 m (20 to 40 ft) toward the southwestern margin of the quadrangle before it again thickens south of Eufaula, Ala.

The late Paleocene age of the Baker Hill can be established by its equivalency with the Nanafalia Formation. The unconformities that bound the Nanafalia connect with the updip boundaries of the Baker Hill. Further, pollen and dinoflagellates from the Baker Hill both within the Americus quadrangle and the Eufaula bauxite district southwest of the quadrangle indicate a late Paleocene age (Gibson, 1982a).

In the Americus quadrangle, the Baker Hill was deposited in freshwater environments based on the absence of dinoflagellates and burrows. Sedimentation in a highly channelized fluvial system with intervening clay-rich subenvironments, including flood plains and ponds, is suggested based on the distribution of sand and clay lithofacies.

Tuscahoma Formation

The contact of the upper Paleocene Tuscahoma Formation (Ttu) with the underlying Baker Hill Formation is slightly undulating and represents a major transgressive surface. The basal meter of the formation consists of fine to medium sand, that contains abundant coarse glauconite grains, small quartz and phosphate pebbles, carbonaceous debris, and reworked clay clasts up to 15 cm (6 in.) across. The formation consists largely of interbedded and interlaminated clay with very fine quartz sand and silt. More commonly, laminae are lensoid and very discontinuous but may be planar and very continuous; locally, flaser bedding is well developed. Laminated intervals contain abundant carbonaceous debris and muscovite on partings between beds.

The Tuscahoma shows remarkable lithologic consistency across the outcrop belt, as well as updip and downdip. Although the thickness of the unit changes from 3 to 6 m (10 to 20 ft) north of Plains, to about 18 m (60 ft) along the southern margin of the quadrangle, the unit maintains its lithologic characteristics much farther downdip where its thickness exceeds 30 m (98 ft). A few miles east of Plains, the Tuscahoma either pinches out or is cut out by the channeled base of the Tallahatta Formation.

Mollusks, dinoflagellates, and calcareous nannofossils from the Tuscahoma in the Americus quadrangle indicate a late Paleocene age; nannoplankton are all indicative of Zone NP9 (Bybell, 1980). Except for the basal transgressive deposits suggesting inner shelf deposition, the laminated Tuscahoma sediments represent deposition within a restricted, marginal marine environment, such as a tidal flat or shallow lagoon (Gibson and others, 1980).

Hatchetigbee Formation

The Hatchetigbee Formation (Th), as redefined by Gibson (1982b), includes noncalcareous lower Eocene strata located along the southern margin of the Americus quadrangle. It is the equivalent of the glauconitic and highly fossiliferous Bashi Formation located farther downdip. The Hatchetigbee is predominantly massively bedded, well sorted, fine to very fine sand with interlaminated clay and silt. The contact with the underlying Tuscahoma is planar and slightly undulating. The unit thins from about 8 m (25 ft) at the southern margin of the quadrangle to become completely absent east and north of Plains, Ga.

The basal beds of the unit are massively bedded, clayey fine sand containing scattered, coarse quartz and glauconite grains. Above the massive basal sand are small (10- to 20-cm (4- to 8-in.)-high), low-angle crossbedded sand. The crossbedded interval is composed of fine, subangular, moderately well-sorted quartz sand with sparse glauconite; sand laminae are separated by thin clay drapes. Interbedded with the crossbedded sand are lenses of laminated and thinly bedded clay.

Ophiomorpha and thin, 1- to 5-cm (0.4- to 2-in.)-thick, lenses of silicified molluscan material are the main biogenic components of the Hatchetigbee in these updip exposures. Palynomorphs establish the age of the Hatchetigbee as earliest Eocene (Frederiksen, 1980). The beds are interpreted as having been deposited in nearshore to shallow inner neritic environments.

Tallahatta Formation and younger Paleogene units, undivided

The early and middle Eocene Tallahatta Formation (Tta) is separated from the underlying Hatchetigbee Formation by a hiatus of as much as 1 m.y. (Gibson and others, 1982). The base of the Tallahatta is highly undulatory on the top of the Hatchetigbee (see dashed structural contours on map, especially north of Plains and near Andersonville) and in updip areas has channeled out entire underlying units (Hatchetigbee and Tuscahoma Formations). Local relief on the base of the unit exceeds 5 m (16.5 ft). The Tallahatta is composed mostly of fine to coarse quartz sand; quartz gravel, locally in beds up to 0.3 m (1 ft) thick, is common near the base of the unit. The sand fraction is well to poorly sorted and subangular. Sand intervals are commonly crossbedded (sets are up to 1 m (3 ft) thick) but are massively bedded in many sections. Clay clasts up to 15 cm (6 in.) in diameter are common in the lower part of the unit, as are clay drapes over crossbeds and thin discontinuous clay beds. Although a thickness of 30.5 m (100 ft) is reported southeast of Andersonville (Zapp and Clark, 1965), truncated sections of 3 to 6 m (10 to 20 ft) are more typical in the map area.

Most sections of the Tallahatta probably represent nonmarine deposition because sporomorphs are the only fossils that have been found in the Americus quadrangle (Frederiksen, 1980). In downdip marine sections, basal Tallahatta has been placed in nannoplankton Zone NP12, coincident with the base of the Claibornian Stage; the top of the Tallahatta is in Zone NP14 (Bybell and Gibson, 1985). Sandy and cherty residuum of uncertain age overlies the Tallahatta in the southeastern part of the Americus quadrangle. These deposits are included with the Tallahatta and may represent weathered equivalents of the middle Eocene Lisbon Formation or younger Paleogene marine and marginal marine deposits.

Neogene and Quaternary Deposits

Dissection of the Coastal Plain deposits began during the late Tertiary. The change from aggradation to degradation probably resulted from a combination of uplift in the Appalachian orogen and a major drop in sea level. Isolated outliers of Cretaceous and Tertiary sediment north of the Fall Zone indicate that the Coastal Plain extended considerably farther north prior to development of the Chattahoochee and Flint River drainage networks (Reinhardt and others, 1984). Information about the nature and age of surficial deposits just south and west of the map area is available in Wait (1962) and Markewich and Christopher (1982), respectively.

Upland deposits

In the broad drainage divide between the Chattahoochee and Flint Rivers, Neogene and Quaternary surficial deposits overlying the Cretaceous units are irregularly distributed. Massive- to thick-bedded quartz sand extends across much of the upland up to the Fall Line in the adjacent Talbotton quadrangle. These upland deposits are shown as a red overprint on the Cretaceous deposits only where they are over 3 m (10 ft) thick.

Most commonly, the friable, well-sorted, medium sand exhibits false bedding created by subhorizontal layers of centimeter-thick, clay-coated quartz grains. Locally, high-angle crossbeds are preserved in thick-bedded intervals. Highly contorted, oxidized sandy clay and carbonaceous, dark-gray clay beds are rarely preserved beneath a 3- to 5-m (10- to 16.5-ft)-thick mantle of massive, friable sand. The sandy clays have yielded pollen suggesting that the deposits are no older than Miocene (N.O. Frederiksen, USGS, written commun., 1980). Locally, substantial amounts of Atlantic White Cedar, *Chamaecyparis thyoides* (Cliff Hupp, USGS, written commun., 1981), have been preserved in isolated pods close to the Fall Zone in the Talbotton 7.5-minute quadrangle just north of the Americus quadrangle.

The massive and crossbedded, clean, well-sorted sands are considered to be of eolian origin; the false bedding resulting from pedogenesis as clay is translocated (eluviated) downward in the soil profile. The organic-rich sandy clay deposits are considered to be bog or swamp environments between dunes or adjacent to secondary drainages.

Terrace deposits (Ttr, Qth, Qtl)

The oldest terrace deposits generally contain the highest percentage of coarse quartz and quartzite gravel. The amount of well-sorted, fine to medium quartz sand increases in the younger terrace deposits. The amount of clay is variable but, as poorly sorted sandy clay, is common in deposits associated with the major river terraces. Preservation of organic material in the terrace deposits is highly variable throughout the quadrangle. High alluvial terrace deposits contain no unweathered clays or identifiable woody material. Abundant wood and dark-gray clay is locally abundant in low alluvial terrace deposits along the Chattahoochee River.

The terrace deposits of the two major river systems have not been precisely dated, but the oldest terraces on the Flint River have sparse vertebrate material indicative of an early or middle Pliocene age (Voorhies, 1970). The youngest mapped terrace deposits on the Chattahoochee are Pleistocene, based on pine, grass, sedge, oak, and tupelo pollen assemblages (T.A. Ager, USGS, written commun., 1979) but yield C^{14} ages of greater than 40,000 years B.P. (Myer Rubin, USGS, written commun., 1984).

Terrace deposits of secondary drainages have yielded more definitive age dates. A single vertical sequence through alluvial deposits associated with Sweetwater Branch and the Andersonville fault, northeast of Andersonville, Ga., contains wood and organic debris dated from base to top as 21,300 ± 400, 15,840 ± 300, and 10,570 ± 250 years B.P. (Myer Rubin, USGS, written commun., 1977, 1978).

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