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Open File Report 3

Notes on the Geology of Walton County

by

Walter Schmidt

Florida Geological Survey
Tallahassee, Florida
1984

NOTES ON THE GEOLOGY OF WALTON COUNTY

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WALTER SCHMIDT
FLORIDA GEOLOGICAL SURVEY

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GEOLOGY

PHYSIOGRAPHY

The United States has been divided into physiographic provinces based on the origin and physiographic expression of the underlying sediments (Fennemen, 1938). Fenneman (1938, p. 1-83) placed the Atlantic and Gulf Coastal areas in the Coastal Plain Province, and described them as a sequence of sedimentary strata laid down, for the most part, in a marine environment and limited to formations of Cretaceous or younger age.

He noted significant differences in the Coastal Plain Province which enabled him to erect subdivisions called the Atlantic Coastal Plain and the Gulf Coastal Plain. Though the transition from the Atlantic portion to the Gulf portion was subtle he separated it along a line that divides the drainage to the Atlantic Ocean from that to the Gulf of Mexico.

The Gulf Coastal Plain is divisible into eastern and western portions based on the width of the outcrop pattern of formations and in the character of the outcrop area of these formations, notably in resistance to erosion. The entire area of Walton County lies within the East Gulf Coastal Plain of Fenneman (1938).

Cooke (1939, p. 14-18) first classified Florida topography, erecting two major divisions, of which three are highlands and two are lowlands. His basis of separating the highlands and lowlands was the general nature of relief of the surface and whether they lay above or below the 100-foot contour. He called that area in west Florida above 100 feet in elevation the Western

Highlands and that below 100 feet in elevation the Coastal Lowlands.

On the basis of origin Vernon (1951, p. 16) also divided the physiography of Florida into two primary groups (highlands and lowlands), and he further subdivided them into two secondary units. These secondary divisions are the Delta Plain Highlands, the Tertiary Highlands, the Terraced Coastal Lowlands, and the River Valley Lowlands. He defined his highlands either as "... sediments formed as a part of a high-level, widespread, aggradational delta plain or of Tertiary land masses rising above this plain." His lowlands were described as being formed by either marine erosion and deposition along coast lines or by alluviation and erosion along stream valleys.

The physiography of Florida has been further revised and described in detail by White, Vernon and Puri (Puri and Vernon 1964, p. 7). They continued the use of highlands and lowlands as primary divisions, with their highlands divided into the Northern Highlands and Central Highlands, and their lowlands divided into the Atlantic Coastal Lowlands, Intermediate Coastal Lowlands, and the Gulf Coastal Lowlands.

Using the above classification, and based on topographic expression, Walton County can be divided into the following major geomorphic divisions: 1) the Northern Highlands, 2) the Gulf Coastal Lowlands, and 3) the River Valley Lowlands (see figure 1).

Northern Highlands

The Northern Highlands is a discontinuous area of relatively high land that extends from Alabama and Georgia into Florida across the northern portion of the state. Its southern terminus is 30-40 miles south of the state line and is generally marked by a prominent seaward-facing escarpment called the Cody Scarp (Puri and Vernon, 1964, p. 11). Cooke (1939, p. 14-22) called these highlands the Western Highlands, the Tallahassee Hills, and the Central Highlands (in part).

These highlands have been described as the remnant of a large delta plain made up of small coalescing subdelta plains (post-Miocene clastics) that blanketed the older Miocene deposits in post-Late Miocene to early Pleistocene time (Vernon, 1951, p. 15).

In Walton County the Northern Highlands is composed of a Pliocene-Pleistocene delta (Citronelle Formation) whose surface has been dissected by streams exposing underlying Miocene clastics, and has been further modified by dissolution of subsurface calcium carbonates (limestones). The topography is characterized by erosional remnant hills with relief up to 100 feet. The highest hills reach elevations in excess of 340 feet near the state line and slope to elevations of about 150 feet in the southern portion of the county where the Pleistocene marine terrace deposits overlap them. These hills are composed of a heterogeneous mixture of grayish to yellowish-orange silts, quartz sands and gravels that are poorly indurated with clays and iron oxide, massive clay beds, and post-depositional limonite.

Sellards and Gunter (1918, p. 27) described a feature that is characteristic of the highlands area of west Florida. At the head of many small creeks or streams a spring emerges at the base of a steep-walled, semicircular bluff. Sellards called these features "steepheads." He described their origin as " . . . due to the fact that indurated sands and sandy clays overlie slightly indurated sands and clays and shell marls. The surface waters pass into the earth and, upon reaching the underlying clay or marl beds, emerge as springs. The indurated sandy clays near the surface stand up vertically, while the softer sands, at a greater depth where the springs emerge, wash easily. The result is the formation of a nearly vertical bluff, at the base of which springs emerge supplying small streams. These bluffs or stream heads assume in time a semi-circular form, which is the 'steephead'. The steephead thus formed is retained by the stream as it gradually extends its way back into the plateau. The depth of the steephead from the plateau is usually from 50 to 60 or more feet, depending upon the depth at which the ground waters emerge as springs." There are many steepheads in Walton County.

Other notable features that commonly occur in the highlands area of Walton County are the flat surfaced, swampy areas that are locally called "bays." These features range in size from a few acres to over a square mile in area. The terrain immediately surrounding the bays is steep and the bay floors are usually 60 to 80 feet lower than the surrounding highlands. The bays are frequently interconnected with small creeks. Their outlines are very irregular and some of the larger bays have hills within their broader limits.

As no large streams are responsible for the erosion of these bays they obviously are the result of dissolution of subsurface calcium carbonate deposits with subsequent surface lowering.

Though sinkholes occur in this fashion and are present in the area, the bays are unlike classical sinkholes in that they are large in area with irregular outlines, have flat swampy bottoms, and are apparently forming at a slower rate.

The occurrence of these bays in Walton County is limited to the area north of U. S. Highway 90 and extend eastward to the Marianna Lowlands in

Holmes County. Probably the Marianna Lowlands have been formed and extended westward somewhat in this manner, and these bays likely exemplify a very early stage of lowland development.

The continued westward migration of the bays is greatly retarded or even prevented due to the increased depth to carbonate strata caused by the southwestern dip of the limestone. This dip increasingly prevents the acid-charged percolating ground water from affecting these strata containing or composed of calcium carbonate.

GULF COASTAL LOWLANDS

During the Pleistocene Epoch or "Great Ice Age" there were worldwide fluctuations of sea level which were tied in with the formation and dissipation of the polar ice caps. The major advances of the ice caps are referred to as glacial stages. These glacial advances required vast quantities of water supplied from the seas which resulted in lowered sea levels. When the ice caps receded large quantities of water were released to the seas resulting in higher sea levels. Since each advance and recession of the ice caps was of a different magnitude the resultant lowering or rise in sea level was different.

During the period of time when the ice caps were in an interglacial stage the higher sea levels encroached upon the land. At these high stands the seas eroded the inundated sediments and redeposited them in the form of a sloping plain or terrace. At the landward margin or shoreline of the seas there often was cut a bench or notch called an escarpment. Therefore, for each stand of the sea there may exist a terrace with its shoreline escarpment.

The Gulf Coastal Lowlands are a series of coast-parallel plains or terraces composed of clastics which extend from the coast to successively higher levels in a landward direction, with each terrace separated from the next by an escarpment or gentle slope. In the southern portion of Walton County plains lying almost parallel to the present coastline which are bounded by escarpments are recognized. The landward elevation of these terraces occur at approximately 150 feet (Okeefenokee), 100 feet (Wicomico) and 35 feet (Pamlico) above the present sea level (see figure 2). An escarpment at 10 feet (Silver Bluff) is present but poorly preserved, and its alignment is too uncertain to depict except along the lower reaches of the Choctawhatchee River.

River Valley Lowlands

River Valley Lowlands is the terminology used by Vernon (1951, p. 16) for the flood plain deposits of streams and their associated valleys. Many streams in the Coastal Plain are old enough to have originated well back into the Pleistocene Epoch, and the geomorphology of their river valley lowlands reflects the Pleistocene sea level fluctuations as do the coastal marine terraces.

Rivers in their life history pass through a period of downcutting or erosion and alluviation. The younger the stream the more vigorous the erosion and the more irregular and steep is its longitudinal profile or slope. Gradually, with time, a valley is cut and the flood plain sediments are deposited within it, with a condition of equilibrium being approached. That is, the stream has acquired a profile just sufficient to permit transportation of its load, and it now meanders back and forth across its flood plain. However, a change in any aspect of the stream system is reflected in a readjustment of the entire system by either renewed downcutting or renewed alluviation within its valley. Consequently, during the life of streams that originated during the Pleistocene Epoch there exists for each lowering of base level (sea level) a fluvial terrace that was formed as a flood plain of the river. Along streams in the Coastal Plains Province fluvial terraces above the modern flood plain are common.

There are five areas within Walton County that can be classified as river valley lowlands. Four (Alaqua, Bruce, Pea and Shoal rivers) of these are within the Western Highlands area and the fifth (Choctawhatchee River) is within the Gulf Coastal Lowlands along the southeastern boundary of the county. In addition to these five there are other stream areas that are not treated in detail in this report.

The flood plain alluviums associated with the streams smaller than the Choctawhatchee are only narrow bands parallel to the stream courses. Though these streams are in a youthful stage of development their eroded valleys are prominent and on a detailed physiographic map they could be depicted as broad valleys along each side of the stream courses. Several smaller streams are present within the county, which have cut valleys; however, only the ones chosen for discussion are important to an understanding of the geology of the area.

Choctawhatchee River Valley Lowlands

The Choctawhatchee River Valley Lowlands is the area included in the eroded valley of the river. In addition to the modern flood plain there occurs at higher elevations at least two fluvial terraces identifiable by both the nature of the sediments and by the fluvial escarpments that separate them from the Western Highlands. In the lower 18 miles of the river, only the modern flood plain is discernible as the higher fluvial terraces are coincident with the marine terraces of the Silver Bluff and Pamlico stands of the sea.

The Choctawhatchee River Valley Lowlands are about four-miles wide at the point where the river enters the county. This includes the modern flood plain plus the higher fluvial terraces associated with the Silver Bluff and Pamlico sea levels. Near the mouth of the river only the modern flood plain is shown and it is about three-miles wide (figure 1).

Pea River Valley Lowlands

The Pea River does not flow within the boundary of Walton County, but its valley lowlands do extend into the northeast portion of the county. The small tributaries to the Pea and an earlier higher stage of the river have reduced the elevation of the northeast corner of the county through erosion. This area can be seen depicted on the geologic map (figure 2) as the area where Miocene sediments (Alum Bluff Group Undiff.) are exposed because the overlying Citronelle sediments have been eroded.

Alaqua Creek River Valley

The Alaqua Creek River Valley Lowlands occur from just south of U. S. Highway 90 southward to Choctawhatchee Bay. It is a north-south valley in the south-central portion of the county. Alaqua Creek with its tributaries has removed the surficial Citronelle sediments and exposed Miocene clastics (Alum Bluff Undiff.) in a valley that in places is several miles wide. This area is depicted on the geologic map (figure 2).

Bruce Creek River Valley Lowlands

Bruce Creek, tributary to the Choctawhatchee River, has cut a large valley through the Citronelle sediments into underlying deposits. It occurs to the east of Alaqua Creek and joins the Choctawhatchee River Valley Lowlands. Alaqua Creek, Bruce Creek and the Choctawhatchee River have removed almost all Citronelle deposits in the southeast quarter of the county.

Shoal River Valley Lowlands

The Shoal River Valley Lowlands encompasses the area along each side of the Shoal River that have been exposed by erosion of the river. It trends east-west along the north side of U. S. Highway 90 on the western side of the county. No recent flood plain or higher fluvial terraces were mapped, but this lowlands is delineated on the geologic map as the Alum Bluff Group Undifferentiated mapped along the river course.

MAJOR RIVERS

There is only one major river in the county from the standpoint of size that is discussed here. However, there are discussed elsewhere a number of small streams that through erosion have exposed geologic outcrops that are important to the understanding and interpretation of the geologic history of the area.

Choctawhatchee River

The Choctawhatchee River is the largest stream in the county. It heads up in Barbour County, Alabama, about 50 miles north of the Alabama-Florida state line, and flows generally in a south-southwesterly direction to its junction with Choctawhatchee Bay in Walton County. Within Florida it flows across Holmes County and forms a common boundary with Washington County along the eastern side of Walton County. The Choctawhatchee is a mature stream which meanders throughout its broad flood plain. Along its flood plain, which averages about two miles wide, may be found natural levees and oxbow lakes (features of a mature stream). The gradient of the river from the state line to Choctawhatchee Bay is less than 1.5 feet per mile.

STRATIGRAPHY

Introduction

Stratigraphic units in the Western Florida Panhandle have been extensively described (Vernon, 1942; Marsh, 1966; Schmidt and Clark, 1980). By studying cuttings from deep oil tests and numerous water wells, many geologic formations have been mapped. The deepest unit penetrated in Walton is a granite, at 14,480 feet below the surface. Above that are several thousand feet of shales and sandstones of Mesozoic age. Next higher in the section are about 2,000 feet of clays and calcareous sands. Still higher are one or two thousand feet of sandy limestones and calcareous glauconitic sands. Nearing the surface are hundreds of feet of dolomitic limestones, sandy clayey limestones and finally shell beds, clayey sands and sands. Only the upper three units, those which are exposed at the surface in Walton County, will be expanded on here.

ALUM BLUFF GROUP UNDIFFERENTIATED

History

The name Alum Bluff beds was used by Dall (1892) to describe the sands and clays between the Chipola Marl and the upper fossiliferous beds at Alum Bluff on the Apalachicola River. Since that time numerous authors have redefined and described these "Miocene" sediments. Some of the major contributions were by Gardner (1926); Cooke and Mossom (1929); Cooke (1945); Puri (1953); and Puri and Vernon (1964). Huddlestun in 1976 renamed these marine deposits of the central Florida Panhandle. He included in his Alum Bluff Group five formations: the Chipola Formation; the Oak Grove Sand; the Shoal River Formation; the Choctawhatchee Formation; and the Jackson Bluff Formation.

This package of clayey, sandy, shell beds in the central Florida Panhandle has been predominantly described using biozones, lithofacies, and chronostratigraphic units which are poorly defined and confusing. Recently these deposits have been mapped as Alum Bluff Group Undifferentiated in the Walton and Okaloosa counties area (Clark and Schmidt, 1982). This lithologic unit is the mapped interval recognized in this report.

Definition and Distribution

The Alum Bluff Group sediments extend in a wide band across the Florida Panhandle from Leon County on the east to Okaloosa County on the west. The sediments are generally covered by the younger Citronelle Formation; as a result, exposures are limited to areas where the Citronelle sands have been removed, mostly stream bluffs and in river valleys.

In Walton County several "classic" outcrops exist, and have been described in the geologic literature. They include: 1) W. D. McDaniel's farm east of Red Bay, where 10-12 feet of a blue-gray, clayey, shell bed is exposed in the western flank of the Choctawhatchee River Valley; 2) the "White Creek Beds" located just east of the creek on Rt. 280. Here about 15 feet of gray-to-greenish clayey sands are exposed with occasional molds and casts of mollusks; 3) C. H. Spence farm southwest of DeFuniak Springs where about 12 feet of gray, sandy clay with abundant mollusks is exposed; 4) A. H. Cosson's farm near Cosson Mill Creek where at a springhead seven feet of a greenish-gray, sandy clay with mollusks is exposed; 5) at the old Godwin Bridge over the Shoal River, where 8-10 feet of the shell beds are visible and; 6) Shell Bluff about one-half mile east of the Godwin Bridge on the north side of the Shoal River, which exposes 35-40 feet of slightly fossiliferous, greenish, sandy clays and sands.

The outcrop pattern can be observed on the geologic map (figure 2). All exposures occur in stream valleys and bluffs where the overlying sands and gravels have been removed.

These shells beds of the Alum Bluff Group were deposited in a shallow water (inner neritic) marine environment. Some locations contain fauna characteristic of brackish waters whereas other outcrops have representatives of open sea conditions. This fauna is indicative of shallow water inland bays often washed by tidal action.

General Lithology

The Alum Bluff Group sediments in the Walton County area are composed of quartz sands, clays and shell beds. The lithology ranges from a sandy clay or clayey sand, to a shell marl, to a pure sand or clay. Accessory minerals may include phosphate, glauconite, various heavy minerals, pyrite and mica. The clay minerals of the Alum Bluff sediments are dominated by montmorillonite but also contain minor amounts of kaolinite and illite. The clay beds are usually gray in color but may be dark gray to black to greenish-gray. Limestone is a minor component of the Alum Bluff lithology, except where it occurs in discontinuous lenses or beds.

The sediments of the Alum Bluff Group are usually massive-bedded to coarsely-bedded; fine-bedding, lamination, and cross-bedding usually not being apparent. Bioturbation is occassionally present and is indicated by incomplete mixing of sandy and clayey sediments. The Alum Bluff sediments are often abundantly fossiliferous. The shells and tests of calcareous organisms are seldom altered or leached and the preservation is often excellent. In the updip areas shell beds and shelly sands predominate. Downdip the units all grade into richly microfossiliferous clastic deposits and fossiliferous limestones. These subsurface time equivalent units (downdip) have been named the Bruce Creek Limestone and the Intracoastal Formation. The Bruce Creek does have one known surface outcrop; it is just downstream of the county road bridge over Bruce Creek in T1N, R18W, north-half of section 2 in Walton County (Schmidt and Clark, 1980). The Intracoastal Formation is entirely subsurface in the Walton County area.

Thickness and Structure

The Alum Bluff Group sediments dip to the southwest in Walton County. They are highest in elevation in the northeast part of the county, where elevations in excess of 230 feet are encountered. The sediments dip away from this high area to where they are below minus-50 feet mean sea level (msl) in the vicinity of Choctawhatchee Bay (See figure 3). This yields a general dip of about five feet per mile, although it is an uneven surface.

The Alum Bluff sediments rest unconformably on a dolomitic limestone ranging in age from Oligocene to Middle Miocene. The average thickness determined from 30 core holes in Walton County is 108 feet.

CITRONELLE FORMATION

History

The Citronelle Formation was named and extensively described by Matson (1916, p. 167-192) for the red, orange, and yellow, clayey, quartz sand and gravel deposits that occur from eastern Texas into western Florida. These deposits were named for the town of Citronelle, Alabama, where the type area was designated because of excellent exposures of the formation.

Numerous authors have discussed the lithology and age of the Citronelle Formation. A few of them include: Berry (1916); Doering (1935); Vernon (1942); MacNeil (1949); Marsh (1966); and Isphording and Lamb (1971).

Definition and Distribution

All surface deposits in the northern two-thirds of Walton County that occur stratigraphically above the Alum Bluff Group sediments are assigned to the Citronelle Formation. This includes the interstream divides, but in most cases not the stream valleys as the Citronelle deposits have been removed by the eroding streams exposing the Alum Bluff strata.

The southern third of Walton County is veneered by Pleistocene marine terrace sands which lap up on the edge of the Citronelle deposits. Citronelle deposits were observed in several quarries near the north edge of Choctawhatchee Bay where the thin marine terrace cover was breached. Samples from core holes and water wells near the coast reveal no Citronelle deposits. Probably early Pleistocene seas eroded the seaward extremities of the Citronelle.

The diverse nature of the Citronelle sediments, both in grain size and intraformational structure, indicates changing conditions of sedimentation due to varied directions and velocities of transporting currents. This suggests they probably were deposited as coalescing fluvial sediments by aggrading streams in a deltaic and pro-deltaic environment. Also, the lack of fossil shells suggests that either they were never present or that the aragonite shells have been removed through leaching by percolating ground water. There do occur burrows which indicate an estuarine or littoral environment for a portion of these sediments. These data suggest an environment that would be expected as a delta encroached upon the marine environment.

General Lithology

The Citronelle deposits range from clay through gravel, though sands are the most common size fraction. There are numerous small quarries throughout the county where 5-15 feet of the Citronelle may be observed, and not uncommonly all size fractions and admixtures thereof are represented in a section only a few feet thick. The most uniform characteristic is the heterogeneity of the deposit. The deposits are commonly cross-bedded, lenticular, graveliferous sands containing an occassional thin bed of clay and with varying amounts of silt and clay as matrix that tend to weakly indurate the sediments. At no place has bedding been observed that extended more than a few hundred feet without noticeable changes in thickness and variations in size fractions. Channel scour and fill sequences are also common.

Though clay is present as massive, thin lenticular beds, it is more common as matrix throughout the formation. These clays are kaolinite and are more abundant in the basal portion of the formation. Either percolating ground water concentrated them toward the base of the formation or clays were a larger portion of earlier Citronelle deposits. At a few localities gravel-size white kaolinite balls are common. These are probably derived from thin beds of intraformational clay that have been broken up by erosion and redeposited during Citronelle time. Also, at some localities coarse sand size to granule size clay blebs, chips and flecks are common. The blebs and chips appear to be derived from broken up clay-lined burrows. These burrows, commonly found in the Citronelle sediments, are sand-filled tube-like features, one-two inches in diameter, up to three-five feet long, circular in cross section, with a thin (¼-inch) kaolinite lining or wall. These are sometimes branched or bifurcated and have been reported in Citronelle sediments in Escambia and Santa Rosa counties and in the Florida peninsula. These tubes are thought to be the burrows of the shrimp Callianassa which lives in a nearshore environment. Generally, in the area of study the burrows and broken clay blebs are more common near the base of the formation and may indicate that the lower Citronelle deposits were formed in a littoral environment as the Citronelle deltaic sediments encroached on the marine environment.

Quartzite gravels are scattered throughout the formation and they are abundant locally, usually along bedding planes. Granule-size quartz is more common than the larger fractions, and this predominance probably is due to the very weathered nature of the quartzite gravels that causes them to crumble rather easily even in the hand.

Minor constituents of this formation are sand size muscovite mica flakes, feldspar granules, and about one percent of sand size heavy minerals (i.e. ilmenite, rutile, zircon).

The color of the Citronelle deposits is usually a dull yellow-orange with common reddish mottling on weathered exposures. Where fresh cuts are observable bands of reds, yellows, lavenders, and purples commonly are randomly oriented and cut across bedding. At many quarries the upper few feet of the section is composed of a pale yellow-orange, loose, fine to very coarse, quartz sand. This sand is a weathered portion of the formation as the contact is usually gradational with typical Citronelle deposits below. Where surface wash has eroded and redeposited these loose sands the contact is sometimes disconformable.

Stratigraphic Relations and Age

The Citronelle deposits rest unconformably upon the underlying Neogene fine sands and clays throughout their extent in Walton County. Though the Citronelle sediments blanket the county, the contact with the underlying clastics can be observed in stream basins and in the cores taken by the Florida Bureau of Geology at selected localities throughout the county. The contact of the Citronelle with the overlying Pleistocene terrace sands is exposed in quarries in the southern portion of the county.

No fossil shells have been found in any of the Citronelle deposits with which to assign an age of deposition. The burrows of the shrimp Callianassa is indication of a near-shore environment; however, this type of burrow is known throughout the Tertiary section, and therefore, it affords no clue to the age of these sediments. The stratigraphic position of the Citronelle narrows it from post-Miocene to pre-Late Pleistocene in age.

More importantly in Walton County, the nature of the deposits assigned to the Late Miocene suggest no increased gradients in the direction of the source beds (north) as do the Citronelle deposits and, since the glacial Pleistocene did provide increased gradients with greater stream volumes and velocities it seems there is better logic in assigning a Pleistocene age to the Citronelle sediments.

Thickness and Structure

The top of the Citronelle sediments is coincident with the land surface, and is higly eroded. However, the highest elevation in Florida, 345 feet above sea level, occurs in the northwest corner of Walton County (SW/4 sec. 30, T6N, R30W). The base of the Citronelle near this location as determined from cores is at 223 feet elevation, indicating 123 feet of Citronelle. Data from core holes WW1-4N-20W-2 and WW1-2N-21W-16 indicate 147 and 144 feet of Citronelle, respectively. At these locations the elevations of the base of the Citronelle appears to be regionally low when compared to nearby data. This points out the relief of the surface of the Miocene deposits upon which the Citronelle sediments were deposited. The tops of the Miocene deposits (Alum Bluff Group undiff.) were recorded in 30 core holes from throughout the county as well as in numerous outcrops. Though this is an uneven surface, the general dip of about five feet per mile in a southwesterly direction is definable.

TERRACE AND FLUVIAL SANDS

History

Overlying most of the mapped and named geologic formations in Florida, is a sequence of relatively unconsolidated, clean quartz sands. These sands were deposited during the many Pleistocene sea-level fluctuations, as the shallow seas eroded, winnowed, and redeposited the existing sediments.

In Walton County most of this sand represents reworked Miocene and

Pliocene deposits, such as the Alum Bluff Group and the Citronelle Formation. This appears on the geologic cross-sections (figure 3) downdip near the present coast. Other locations where this type of lithology is found are along river valleys where more recent deposition is responsible.

Definition and Distribution

Ancient sea-level fluctuations to varying degrees have left behind "terraces" and shoreline "scarps" on our present landscape. These marine features have been mapped by several geologists (MacNeil, 1949; Healy, 1975; Winker and Howard, 1977) throughout Florida. In Walton County this coastal wedge of sands thins northward, and seems to pinch out near the 150 foot elevation line, along one of these ancient scarps (see fig. 2).

In addition, late Pleistocene to recent deposition along major river and stream valleys also represents a significant accumulation of these sands. In Walton County the Choctawhatchee River valley (fig. 1) in the southeastern part of the county is the major river system.

General Lithology

The reworked terrace and fluvial sands are predominately an unconsolidated body of white to light gray, medium grained quartz sands. Accessory minerals generally in amounts less than one percent, include various heavy minerals, mica, and phosphorite. Clay lenses are sometimes encountered, associated with occasional shell beds. Fossils present (generally near the present coast) include mollusks, and rare occurrences of foraminifera and echinoid remains.

Thickness and Structure

These quartz sands reach a maximum thickness of about 100 feet near the present coast and near the Choctawhatchee Bay area (figure 3). They thin northward and grade into the clastics of the Citronelle Formation.

Varying thicknesses of recent quartz sands can also be found along many of the stream valleys. These are not, however, visible on the geologic map (fig. 2) because their extent is too limited and sporadic to show up at the scale used.

ECONOMIC MINERALS

(This section is summarized from Yon and Hendry, 1969)

Clay

The clay deposits in Walton County are of a lenticular nature and are not traceable very far over horizontal distances. One location was sampled and tested for its economic potential by Yon and Hendry (1969, p. 73). It was determined that the clay was satisfactory for making lightweight aggregate. Other locations were tested by Calver (1949, p. 43, 58) and Yon and Hendry (1969, p. 36-62) and several types of brick and structure tile grades were found to be present.

Heavy Minerals

The term heavy mineral is applied to those mineral species that have a specific gravity greater than quartz. Minerals within this category that occur in Florida sediments are ilmenite, rutile, zircon, and other numerous minerals of less quantity and value. Ilmenite ($FeTiO_3$) is valuable for its titanium content. Zircon ($ZnSiO_4$) is valuable for its zirconium content; and rutile (TiO_2) is valuable for its titanium content.

Heavy minerals are present in all of the sediments in Walton County. However, the surficial deposits along the coastal area offer the most potential as a source of heavy minerals. It is not uncommon to find large local concentrations along the present beaches and in the recent sand dunes in the southern part of Walton County. Though only one specific study was made to determine the aggregate percentage of heavies in the sands, the tests performed by the U. S. Bureau of Mines on samples submitted for evaluation as a potential source for glass sand indicate that the titanium content ranges from 0.1 to 0.5 percent. Samples LW1-3S-20W-3 bb were collected from a dune and contained the 0.5 percent titanium. According to the Bureau of Mines analyses most of the titanium was concentrated on the minus-140 screen and could be removed by froth flotation or magnetic separation.

A channel sample was collected from the seaward side of the highest beach dune at Blue Mountain Beach in southern Walton County. This sample (LW1-3S-20W-12 cb) was examined for its heavy mineral content, which amounted to 2.4 percent by weight of the total samples. Those mineral species identified were ilmenite, rutile, kyanite, zircon, garnet, staurolite, and leucoxene.

Humate

The term humate was first used by Swanson and Palacas (1965, p. B1). They reported that "Layers of dune and beach sand along the north coast of the Gulf of Mexico are cemented or impregnated with a conspicuous dark-brown to black water-soluble organic substance herein called humate. The humate-cemented sand, generally six inches to three-feet thick but as much as 15 feet in some places, forms one or several irregular layers in the subsurface of broad land areas at a depth of a few inches to 35 feet. Humate accumulates in subsurface soil layers, in and beneath marsh deposits, in shore and beach sands of bayous and bays, commonly near the mouths of tea-colored, tannic acid laden streams and near ground-water seepages, and as a type of organic sediment in bodies of brackish or saline water.

Swanson and Palacas (p. B5-B10) list seven varieties of humate-impregnated or humate-cemented sand, several of which are very similiar to or the same as the hard-pan of local water-well drillers and carbonaceous sand exposed in banks of canals.

Yon and Hendry (1969) noted three to six-inch layers of humate or hard-pan exposed at many localities around Choctawhachee Bay, and in the banks of the Intracoastal Waterway. In southeastern Walton County thicknesses up to 12-15 feet of this material are exposed. Humate was also observed in samples taken from auger and core holes in southern Walton County.

Swanson and Palacas believe that humate is formed through the leaching of the decaying plant material on the surface, then surface and subsurface waters transport this humic substance either to be precipitated in some subsurface sand or transported elsewhere by natural waters and subsequently deposited. The geochemistry of humate is extremely complex (Swanson and Palacas, 1965, p. B1), and this aspect is not reviewed here. However, the economic significance of humate is intriguing and a brief statement follows.

The humate-cemented sand in the Choctawhatchee Bay area ranges from less than one to more than eight percent organic matter with the average composition of the extracted humate being 55.0 percent carbon, 4.4 percent hydrogen, 38.5 percent oxygen, 1.4 percent nitrogen, and 0.7 percent sulfur (Swanson and Palacas, 1965, p. B18).

"Humate has the capacity to sorb large amounts of metals..." (Swanson and Palacas, 1965, p. B27). Swanson, et al. (1966, p. C176) state, "...it is suggested that the metal-sorption property of the Florida humate may be of economic use."

The large tonnages available, with the unique characteristic of selectively extracting trace amounts of certain metals, makes humate potentially suitable for use in the chemical and fertilizer industries.

Swanson, et al. (p. C176-177) further state:

> "Simple drying, light crushing, and sieving of the humate-rich sand produces a powder that is 60 to 75 percent humate. Another seemingly attractive aspect of the humate is its almost instantaneous solubility, for example, in ammonia. Ammonia is widely applied in liquid form to soils as a nitrogen fertilizer. Humate is also soluble in a potassium phosphate (K_3PO_4) solution, and might also provide the other 2 of the 3 major constituents of fertilizers-potassium and phosphorous.
>
> "Other possible, but untested, uses of the physically separated or chemically extracted humate are as a water purifying com-

with some of the higher hills capped with 80 feet of Citronelle.

The Recent sands occurring along the stream valleys probably are of economic value but are not considered in this report because of the limited distribution of the deposits when compared to the Plio-Pleistocene sands. Reves (1960), in a report on the mineral resources of Choctawhatchee-Pea River Basin in Florida and Alabama, reports that commercial sand is being mined from the Choctawhatchee River in Alabama.

The sands from the Pleistoscene terraces and the recent dunes along the coast of Walton County were found to range in size from very fine to medium. These sands, because of their size range, were tested for suitability in the manufacture of glass.

Four of the samples tested were suitable for use in concrete, as they will meet A.S.T.M. and Florida State Road Department specifications. Two samples, LW1-5N-19W-22bb and LW1-5N-21W-29aac approach the necessary requirements for concrete and would be satisfactory if sand of a coarser fraction (4-8-16 size screens) was added so that the required fineness modulus could be reached. Sixteen of the samples meet the necessary requirements for use as abrasives and in mortar. Because of iron coatings none of these sands are suitable for use as glass sands.

Tests conducted by the U. S. Bureau of Mines indicate that sands in the southern part of Walton County can be beneficiated to meet specifications for glass sands. According to Shirley (personal communication, 1968) the sands will have to be beneficiated to remove the iron and titanium content. Shirley further states that the tests show the sands carrying most of the iron and titanium appears to be concentrated on the minus-140 mesh which might suggest pound, as an additive in well-drilling fluids, as a wood stain or paint pigment, and as a metal scavenger in a variety of commercial processes."

Limestone

Limestone of Oligocene age crops out near the Alabama-Florida state line in the northern part of Walton County along Bridge Creek at Natural Bridge.

A channel sample of limestone was collected by Yon and Hendry (1969) at Natural Bridge, SE¼, SE¼, section 26, T6N, R20W, and submitted to the Florida State Road Department, Division of Materials, Research and Training, for testing. William Wisner, State Road Department, Division of Materials, Gainesville, (personal communication, October 15, 1968), reported that the sample from this locality does not meet the State Road Department specifications for Ocala type limestone because of low carbonate content (90.0%) and high organic content (1.3%), though it did exhibit good load-bearing characteristics.

Sand

Sand is a name applied to an unconsolidated aggregate of minerals or rock particles that range in size from 2.0 to 0.062 millimeters (0.078 to 0.002 inches). According to the above definition, sand is a size characteristic and does not connote mineralogic composition.

In this report the term sand is used as a size range, ~~but it also~~ has a mineralogic connotation meaning that the sand is predominantly composed of the mineral quartz. The term "high-silica" sand is used to distinguish those sands composed of 98 percent or more silica from sands that are less pure because of either inclusions or iron content.

The grains of sands seen in Walton County are remnants of rocks that originally occurred in states to the north of Florida. Over a period of millions of years through various processes of chemical and physical weathering these rocks were disintegrated and the resulting smaller sand particles were washed into the streams by rains. The streams transported the sand to where some was deposited along streams' flood plains. That portion of the sand not deposited along the channels finally reached the sea, where it, too, finally came to rest in the area.

This is not to say that this was the final movement of the sand. Even today sands in the area are constantly being shifted around by streams and winds.

The Plio-Pleistocene (Citronelle) sands are the most important as a commercial-sand source because of their wide-spread nature and because they contain the variation in grain size necessary to meet standard specification for construction sands.

These Plio-Pleistocene deposits are very fine to very coarse grained, iron stained, multicolored, clayey quartz sands that are crossbedded and interbedded with kaolinites. It is not uncommon for the deposits to contain gravel (grain sizes above 4.5 mm or 0.2 inches). However, the gravel is not suitable for economic purposes because it is very fractured and crumbly. Data obtained from core holes drilled in Walton County indicate that in the southwest part of the county these sediments are in excess of 100 feet thick, whereas, in the other parts of the county they average 50 feet in thickness the material could be removed by washing, screening and froth flotation or magnetic separation.

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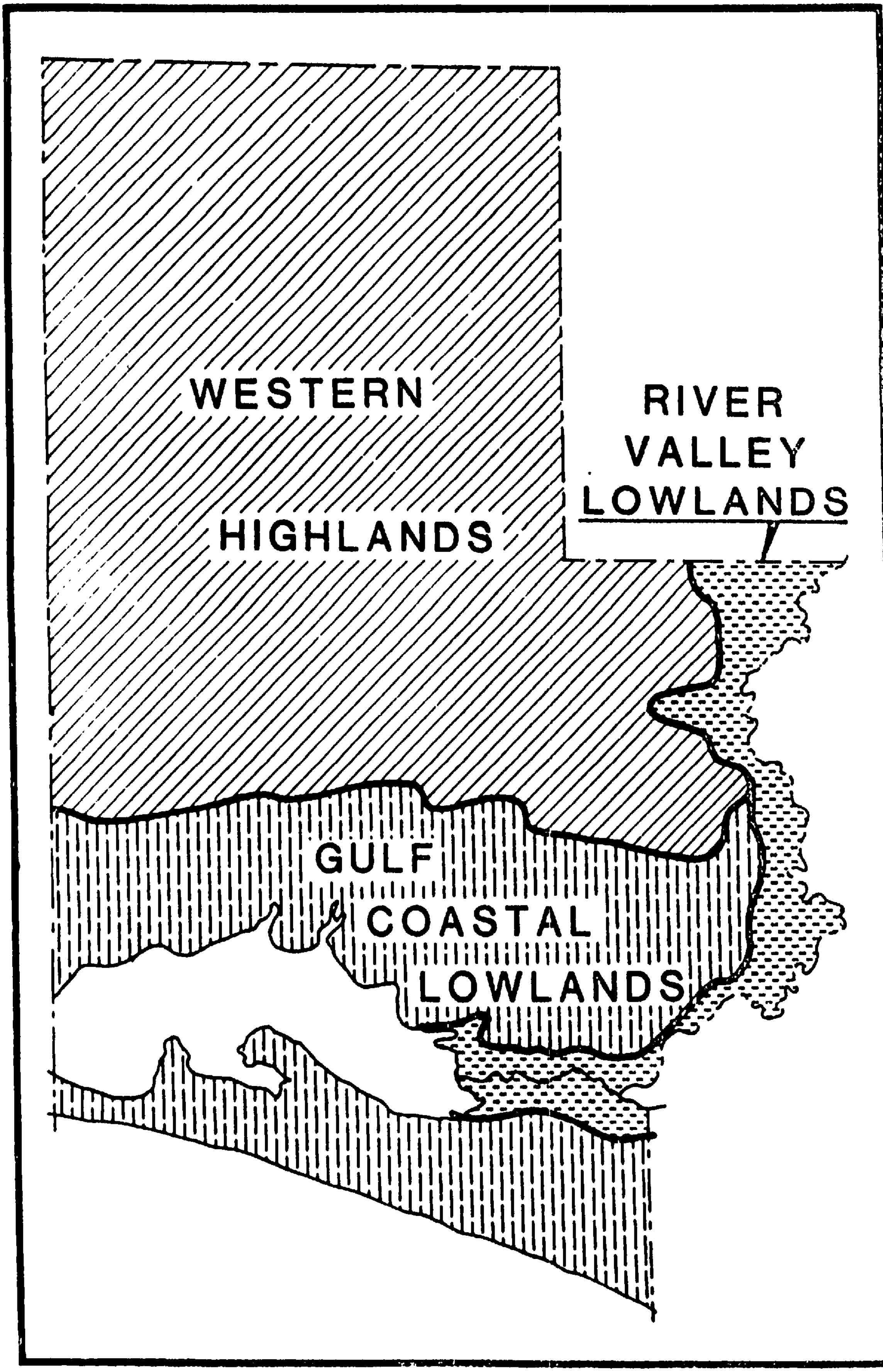
Figure 1. Physiographic divisions in Walton County.

Figure 2. Geologic Map of Walton County. Modified from an unpublished map prepared by Hendry, C. W. Jr., and Yon, J. W. Jr., Florida Geological Survey.

Figure 3. Geologic Cross Sections Through Walton County.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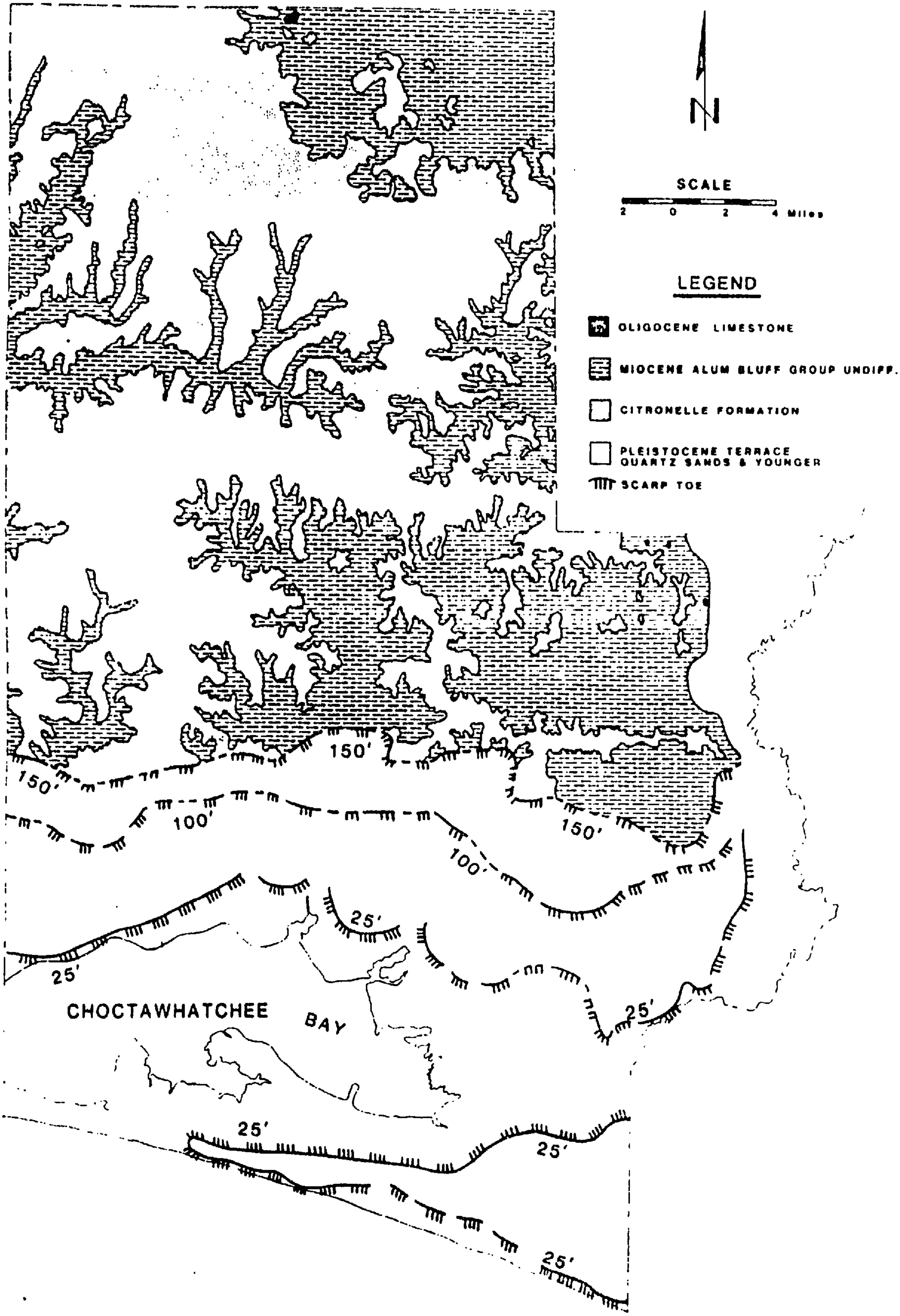

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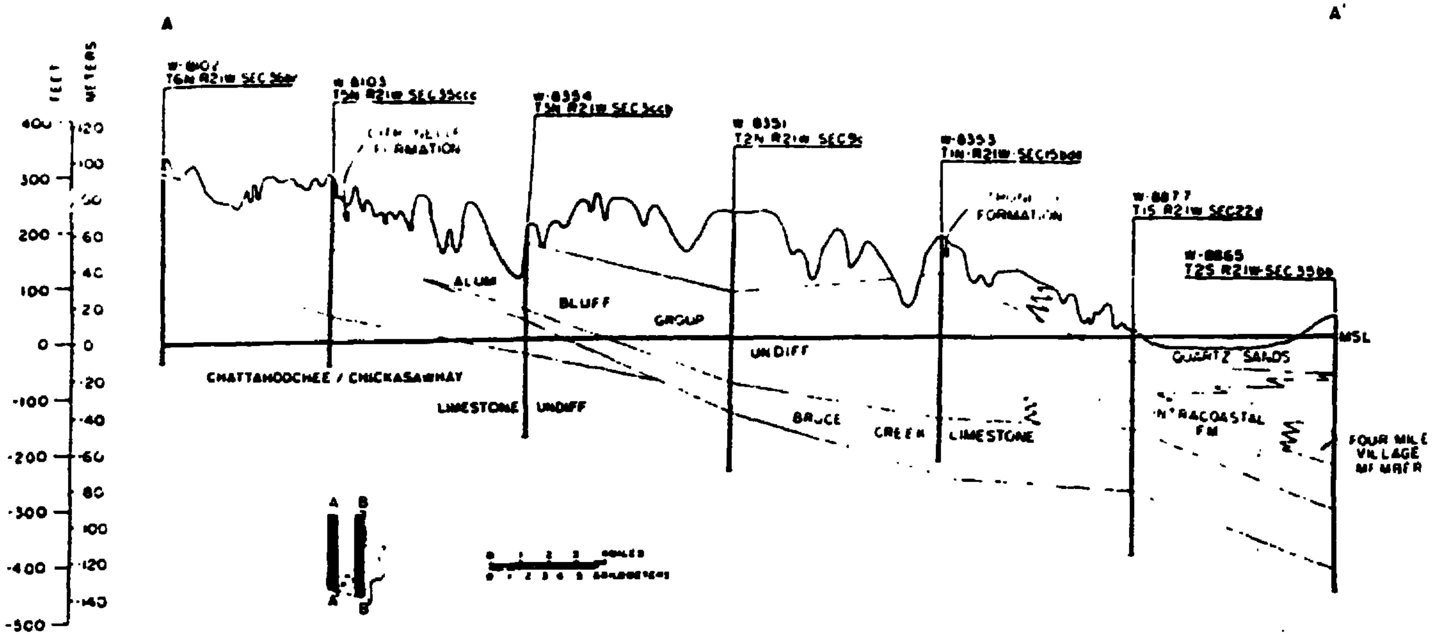
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T1S R21W SEC 22d
W-8865
T2S R21W SEC 35bb
FORMATION
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BLUFF
GROUP
UNDIFF
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CHATTAHOOCHEE / CHICKASAWHAY
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CREEK
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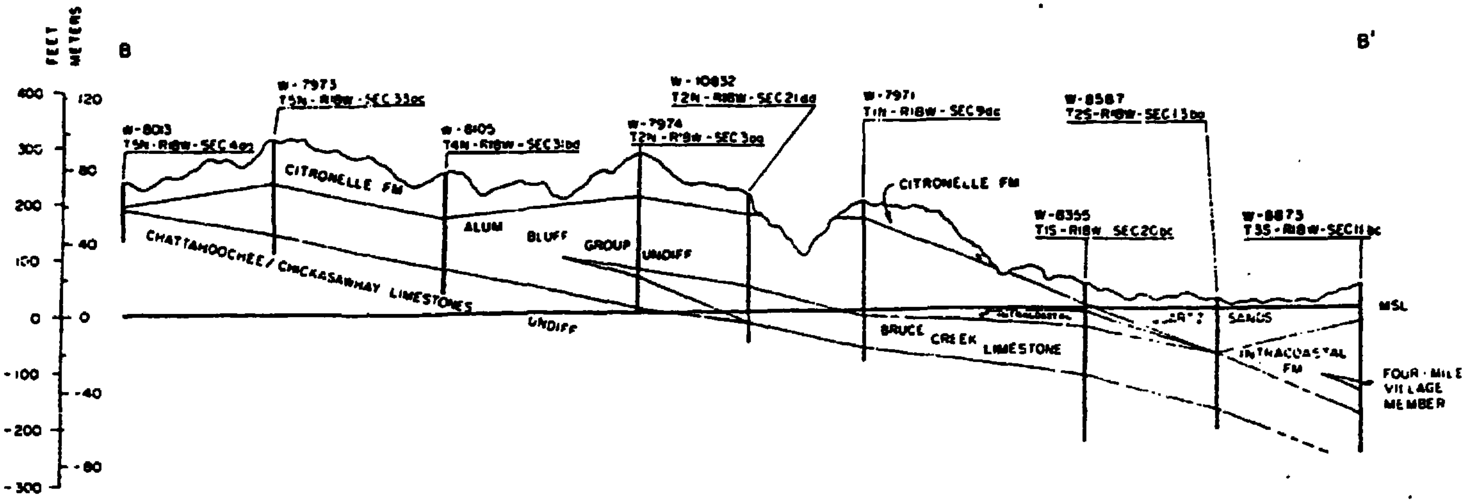
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CITRONELLE FM
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UNDIFF
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