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A Brief Overview of Miocene Lithostratigraphy-Northern
Florida and Eastern Georgia

by

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A BRIEF OVERVIEW OF MIOCENE LITHOSTRATIGRAPHY-NORTHERN FLORIDA AND EASTERN GEORGIA

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INTRODUCTION

The Miocene Epoch was a time of dramatic changes in the depositional scheme of the southeastern United States. Carbonates, which dominated during the Paleogene, were no longer the dominant sediment type deposited in the marine environments. An influx of vast quantities of siliciclastic sediments beginning in the earliest Miocene first mixed with the carbonates then overran the carbonate-producing depositional environments. This influx of siliciclastic sediments appears to have been the result of renewed uplift in the Appalachian Mountains and the resultant increase in the erosional rate (Stuckey, 1965; Scott, 1988). The timing of this important epeirogenic episode is not well documented. However, it is reasonable to assume that the change occurred during the Late Oligocene to earliest Miocene, since most of the underlying Lower Oligocene and older Paleogene sediments are carbonates and the Upper Oligocene and oldest Miocene sediments are a mixture of carbonates and siliciclastics. The Gulf Trough and Southeast Georgia Embayment (Figure 1) provided an effective barrier to the limited siliciclastic supply reaching the marine environment prior to the uplift (Scott, 1988). With a major increase in the supply of siliciclastic sediments reaching the marine environment, the Gulf Trough and the Southeast Georgia Embayment began to be filled. As the influx of the siliciclastic sediments was carried into the basins, some of the sediment began to be moved south of these features onto the Florida Platform. With an increasing supply of siliciclastics reaching the Florida Platform, these sediments effectively forced carbonate deposition to occur further south.

While the change from carbonate deposition to siliciclastic deposition appears to occur quickly in a vertical sequence, the areal distribution of the change is significantly different. By the earliest Miocene, first in eastern Georgia and then south, in northern Florida, carbonate sediments are mixed and interbedded with siliciclastics with the proportion of siliciclastics increasing upsection. In southern Florida, carbonates continued to dominate deposition through the Early Miocene. However, in southern Florida, siliciclastics are more commonly intimately mixed and interbedded with carbonates along the eastern portion of the penin-

sula than along the west coast. This suggests the influx of siliciclastics was driven by the active longshore drift system associated with the Atlantic Coast. By Middle Miocene time, deposition over the entire Florida Platform was dominated by siliciclastics with only localized occurrences of carbonates. This pattern of deposition continued through the Late Miocene and into the Pliocene. During the later Pliocene and in the Pleistocene, carbonate deposition reoccurs in portions of southern Florida as the siliciclastic sediment supply began to dwindle.

The Miocene Series deposition included the formation of a number of unusual minerals. The most notable of these minerals is carbonate fluorapatite or francolite, the dominant phosphate mineral present in the Miocene sediments of the southeastern Coastal Plain. Within the sediments of the southeastern Coastal Plain, the Miocene time is unique in the abundance of francolite formed. The formation of francolite requires a specific, as yet not well understood, set of depositional conditions (Riggs, 1984). Post-depositional reworking and concentration of francolite has resulted in the formation of economically important phosphorite deposits in northern and central Florida (Scott, 1988). Concentrations of phosphate occur in the subsurface of eastern Georgia and northern Florida within the Coosawhatchie Formation, Hawthorn Group (Figure 2). In Georgia, this zone of phosphorite has been named the Tybee Phosphorite Member, Coosawhatchie Formation (Huddleston, 1988). A similar zone of phosphorite, possibly equivalent to the Tybee Phosphorite Member, occurs at the base of the Coosawhatchie Formation along the southern rim of the Jacksonville Basin (Figure 1) in northern Florida (Scott, 1988).

Dolomite occurs widely in the Miocene sediments of north Florida. It is present but less abundant in the eastern Georgia Miocene sediments. In northern Florida, virtually all of the limestones in this section have been diagenetically altered to dolostone.

One other important mineral occurring in the Miocene sediments of this area is palygorskite (also known as attapulgite). This Mg-rich clay mineral requires uncommon depositional conditions to form and as such its distribution is areally restricted (Weaver

and Beck, 1977). Although there are no known economically important deposits of palygorskite in northeastern Florida and eastern Georgia, this clay mineral occurs disseminated throughout the Miocene sediments (Hetrick and Friddell, 1984).

The Hawthorn Group sediments constitute the entire Miocene section to be considered in this text. These sediments were deposited under a variety of shallow, marine conditions. Huddlestun (1988) discusses the environment of deposition as having water depths ranging from very shallow, near sea level to "at least middle neritic" depths as indicated by the faunas associated with these sediments. Puri and Vernon (1964) stated that the Hawthorn sediments had "been a dumping ground for alluvial, terrestrial, marine, deltaic and marine beds of diverse lithologic units...." Current thought is that these Miocene sediments are of marine origin with subsequent modifications due to erosion, reworking and diagenetic processes (Huddlestun, 1988; Scott, 1988).

The Miocene sediments of Florida and Georgia have attracted the attention of geologists for many years. The cumulative understanding of these sediments is described in detail in Huddlestun (1988) and Scott (1988). The reader is referred to these references for complete descriptions of the units comprising the Hawthorn Group.

LITHOSTRATIGRAPHY

The currently recognized lithostratigraphic framework of the eastern Georgia and northern Florida area is primarily the work of Huddlestun (1988) (Figure 2). Scott (1988) utilized Huddlestun's Georgia framework extending it into northern Florida with only minor changes (Figure 2). The entire northern Florida-southern Georgia area is part of the same Atlantic coastal depositional regime of the Southeastern Georgia Embayment and the surrounding positive and negative areas (Figure 1). In the western portion of northern Florida and central-southern Georgia, there is a transitional change to a Gulf of Mexico coastal depositional regime. Also in central Georgia, the depositional environments are dramatically influenced by the Gulf Trough (Huddlestun, personal communications, 1988, 1989, 1990). The most notable changes from east to west are the dramatic reduction in phosphate occurrence and the general increase in clay content of the Lower and Middle (?) Miocene sediments across northern Florida into the panhandle.

The lithostratigraphic nomenclature currently accepted and utilized by the Florida Geological Survey and the Georgia Geologic Survey is that of Huddlestun (1988) and Scott (1988). The Hawthorn is a group

consisting of, in ascending order, the Parachucla Formation (in Georgia) and its equivalent Penney Farms Formation (in Florida), the Marks Head Formation, the Coosawhatchie Formation and its equivalent Statenville Formation.

Lower Miocene Series

Parachucla and Penney Farms Formations

Huddlestun (1988) reintroduced and revised the name Parachucla as a formation in Georgia. It consists of a lower member, the Tiger Leap, and an upper member, the Porters Landing. The Parachucla Formation occurs widely in Georgia. Huddlestun (1988) indicates that the Parachucla extends into South Carolina on the north and into Florida on the south. The occurrence of Parachucla sediments in Florida appears very limited (Scott, 1988). The lower Parachucla Formation has not been recognized as occurring in northern Florida (Huddlestun, personal communication, 1988). However, upper Parachucla, Porters Landing Member sediments have been recognized in outcrop along the upper Suwannee River in northern Florida (Portell, 1989) and in one core in Nassau County, Florida near the Georgia-Florida border (Huddlestun, personal communication, 1986). The upper Parachucla grades laterally into the Penney Farms Formation in southern Georgia and northern Florida (Scott, 1988). These formations characteristically vary in color from greenish gray to bluish gray in the siliciclastic-rich sediments and tan to greenish gray in the carbonate-rich zones.

The Tiger Leap Member of the Parachucla Formation is a lithologically heterogenous unit consisting of carbonates interbedded with siliciclastics (Huddlestun, 1988). The carbonates are characteristically limestone but locally vary to dolostone. The siliciclastic sediments are composed of clayey quartz sands. Phosphate is a minor component disseminated throughout the unit. The Tiger Leap Member is variably fossiliferous.

The Porters Landing Member is predominantly a siliciclastic unit composed of sands and clays. It is slightly phosphatic, nonfossiliferous to variably fossiliferous, occasionally gravelly and locally contains carbonate in the matrix or as discrete beds (Huddlestun, 1988). This member becomes more carbonate-rich to the south in Georgia and grades into the Penney Farms Formation in northern Florida (Scott, 1988).

The Penney Farms Formation, named by Scott (1988), is a very heterogenous unit consisting of interbedded carbonates, mostly dolostone, and siliciclastics. The carbonates are sandy, occasionally clayey, phosphatic and variably fossiliferous. Fossils are generally preserved only as molds and casts. The sands

and clays are phosphatic, often dolomitic and rarely fossiliferous. Phosphate is commonly found in greater concentrations in the Penney Farms Formation than in the Parachucla.

The greatest thickness of the Parachucla Formation is reported as 120 feet (37 m) in the northern portion of the Southeast Georgia Embayment (Huddleston, 1988). The greatest thickness of the Penney Farms Formation is more than 155 feet (47 m) in the Jacksonville Basin (Scott, 1988).

The Parachucla Formation disconformably overlies the Oligocene Suwannee Limestone and, where the Suwannee is absent, the Eocene Ocala Limestone. It is overlain disconformably (?) by the Marks Head Formation throughout most of Georgia. However, near its northern limit in Georgia, it is disconformably overlain by the Pliocene Cypresshead Formation (Huddleston, 1988).

The Penney Farms Formation disconformably overlies the Ocala Limestone throughout most of northern Florida. In a very limited area near its western limit, the Penney Farms Formation lies disconformably on the Suwannee Limestone. Except where the younger units have been removed, this unit is overlain disconformably by the Marks Head Formation. Where erosion has removed the younger units of the Hawthorn Group, it is overlain by undifferentiated sediments of presumed Plio-Pleistocene age.

The age of the Parachucla and Penney Farms Formations is Early Miocene (Aquitania) (Huddleston, 1988). The lower member of the Parachucla, the Tiger Leap, is older than the Penney Farms Formation which appears to equate in age with the Porters Landing Member. The age of the Penney Farms Formation is based on very limited paleontologic evidence and lithologic correlation with the upper Parachucla Formation (Scott, 1988; Huddleston, 1988).

Marks Head Formation

Huddleston (1988) reintroduced the name Marks Head Formation for the sediments of the middle portion of the Hawthorn Group. It consists of variable mixtures of siliciclastics and carbonate with variable phosphate content. In Georgia, the unit contains mostly siliciclastics with scattered carbonate beds (Huddleston, 1988). In Florida, the Marks Head Formation is the most lithologically variable unit of the Hawthorn Group consisting of interbedded phosphatic siliciclastics and carbonates (Scott, 1988). The siliciclastics are quartz sands with variable clay, dolomite and phosphate contents and clays with variable sand, dolomite and phosphate contents. Siliciclastic and carbonate intraclasts are very common in these sediments in northern Florida (Scott, 1988, 1989). The charac-

teristic colors in these sediments range from greenish gray to olive green in the siliciclastics and tan to greenish gray for the carbonates.

The maximum thickness of the Marks Head Formation is 139 feet (42 m) in northeastern Georgia. In Florida, the maximum recorded thickness is 130 feet (40 m). The Marks Head Formation overlies the Parachucla and Penney Farms Formations disconformably. It is disconformably overlain by the Coosawhatchie Formation in most of the area. Where the Statenville Formation replaces the Coosawhatchie Formation, the Marks Head is disconformably overlain by the Statenville. In areas where the youngest Hawthorn Group sediments are missing, the Cypresshead Formation or undifferentiated sediments lie on the Marks Head.

The age of the Marks Head Formation is considered to be late Early Miocene (Burdigalian) based on the occurrence of planktonic foraminifera in the Georgia sediments (Huddleston, 1988). These sediments in Florida are inferred to be late Early Miocene based on the lithologic correlations with the Georgia sediments (Scott, 1988).

Middle Miocene Series Coosawhatchie Formation

Huddleston (1988) formally named the Coosawhatchie Formation for the upper sediments of the Hawthorn Group in eastern Georgia. He recognized five members of the Coosawhatchie Formation, the Tybee Phosphorite Member, the Berryville Clay Member, the Ebenezer Member, the Meigs Member and the Charlton Member. With the exception of the Meigs Member, these members occur in easternmost Georgia. In northern Florida, sediments thought to be equivalent to the Tybee, Berryville and Ebenezer Members have been noted but not named. The Charlton Member is recognized over a large area of north Florida (Scott, 1988).

The Coosawhatchie Formation is predominantly a siliciclastic unit containing varying amounts of carbonate as discrete beds and sediment matrix. It appears that the Coosawhatchie sediments become more carbonate-rich in northern Florida (Scott, 1988). Clays and sands dominate the lithology, occurring in widely varying admixtures that include phosphate and carbonate. Phosphate is most common in the Tybee Phosphorite Member and its equivalents but also is scattered throughout the formation. The carbonates present in the Coosawhatchie Formation are characteristically limestone in most of eastern Georgia and become primarily dolostone in northern Florida (Huddleston, 1988; Scott, 1988). These sediments vary in color from light gray to olive gray.

The Coosawhatchie Formation attains a maximum thickness of 284 feet (87 m) in the Southeast Georgia Embayment of southeasternmost Georgia. It is laterally equivalent and gradational with the Statenville Formation. The Coosawhatchie Formation lies disconformably suprajacent to the Marks Head Formation. It occurs disconformably subjacent to the Cypresshead Formation and undifferentiated sediments of Plio-Pleistocene age.

Statenville Formation

The Statenville Formation was named by Huddleston (1988) for the interbedded phosphatic sands, dolostones and clays of the Hawthorn Group as exposed along the Alapaha River near Statenville, Georgia. This unit is currently known to occur in a limited area of southern Georgia and northern Florida. The phosphorite deposits mined in northern Florida belong in the Statenville Formation.

Quartz sands predominate in much of the unit. The sands are often very phosphatic and variably clayey, commonly with thin clay and dolostone beds. The proportions of clay and dolostone beds are highly variable. The clays and dolostones contain variable amounts of sand and phosphate. The Statenville Formation is the most distinctively bedded unit of the Hawthorn Group, commonly being crossbedded. The sediments range in color from light gray to yellowish gray and olive gray.

The Statenville Formation's thickness variability is not well known. Scott (1988) recognized a maximum of 87 feet (26.5 m) of Statenville sediments in a core hole in central northern Florida. It is laterally equivalent and gradational with the Coosawhatchie Formation. The Statenville Formation lies disconformably on the Marks Head Formation or an unnamed sand and dolostone of the Hawthorn Group in northern Florida and Georgia. In Florida, it is overlain by undifferentiated sands and clays of Plio-Pleistocene age. In Georgia, it may be overlain by the undifferentiated sediments or, in a limited area, the Miccosukee Formation.

Conclusion

Sediments of the Hawthorn Group, Miocene of the southeastern Atlantic Coastal Plain form a very interesting and complex lithostratigraphic sequence. These sediments have attracted much attention due to their interesting mineralogy and hydrogeologic properties. In our attempts to decipher the geological history of the coastal plain we have discovered many of its complexities. These sediments are not well understood in many ways and there are many avenues of research available. The next major step in our inves-

tigations is to determine the geological framework of the offshore, continental shelf areas.

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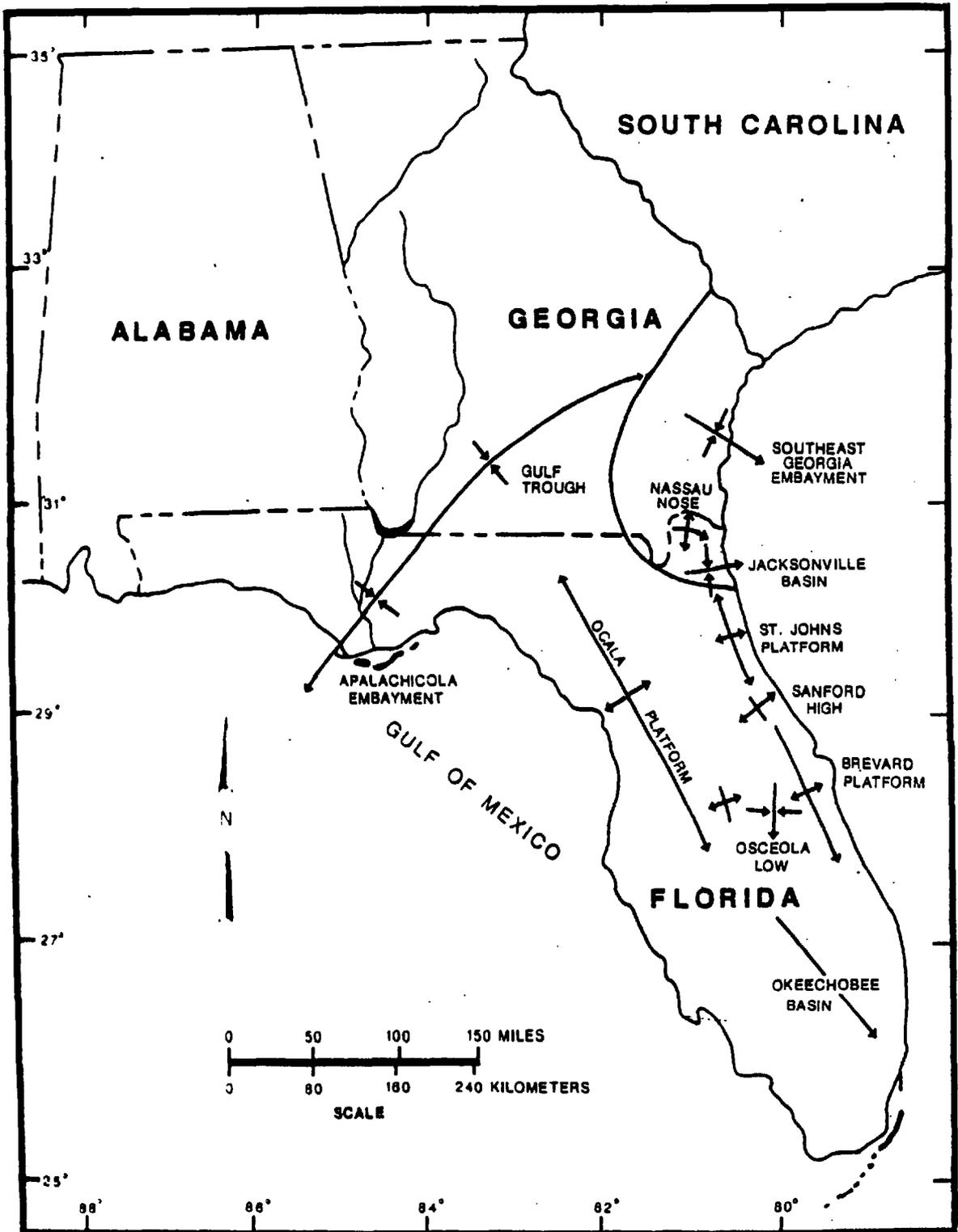


Figure 1- Coastal Plain structures in Georgia and Florida (modified from Scott, 1988).

Figure 2 - Lithostratigraphic nomenclature (modified from Scott, 1988).

		EASTERN NORTH CAROLINA	EASTERN SOUTH CAROLINA	SOUTHEAST AND EASTERN GEORGIA	EASTERN PANHANDLE AND SOUTHWESTERN GEORGIA	NORTHERN FLORIDA	SOUTHERN FLORIDA
PLIOCENE		YORKTOWN FM.	YORKTOWN/RAYSOR FMS.	CYPRESSHEAD/RAYSOR FMS.	MCCOBUKKEE/CITRONELLE FMS.	CYPRESSHEAD/NASHUA FMS.	TAMAMI FM.
MIOCENE	UPPER	EASTOVER F.M.		CHARLTON MBR.		REWORKED SEDIMENTS	WABASSO BEDS
	MIDDLE	PUNGO RIVER FM.	COOSAWHATCHE FM.	STATENVILLE FM. COOSAWHATCHE FM.	UNNAMED SANDS AND CLAYS	STATENVILLE FM. COOSAWHATCHE FM.	PEACE RIVER FM.
	LOWER		MARKS HEAD FM.	MARKS HEAD FM.	TORREYA FM.	MARKS HEAD FM.	ARCADIA FM.
UPPER OLILOCENE			PARACHUCLA FM.	PARACHUCLA FM.	CHATTAHOOCHEE ST. MARKS FMS.	PENNEY FARMS FM.	TAMPA MBR. NOCATEE MBR.
			COOPER SUWANNEE FMS.	SUWANNEE LS.	SUWANNEE LS.		"SUWANNEE LS."

Vertical labels on the right side of the table: HAWTHORN GROUP (between Middle and Lower Miocene), BONE VALLEY MBR. (between Upper and Middle Miocene), HAWTHORN GROUP (between Middle and Lower Miocene).



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