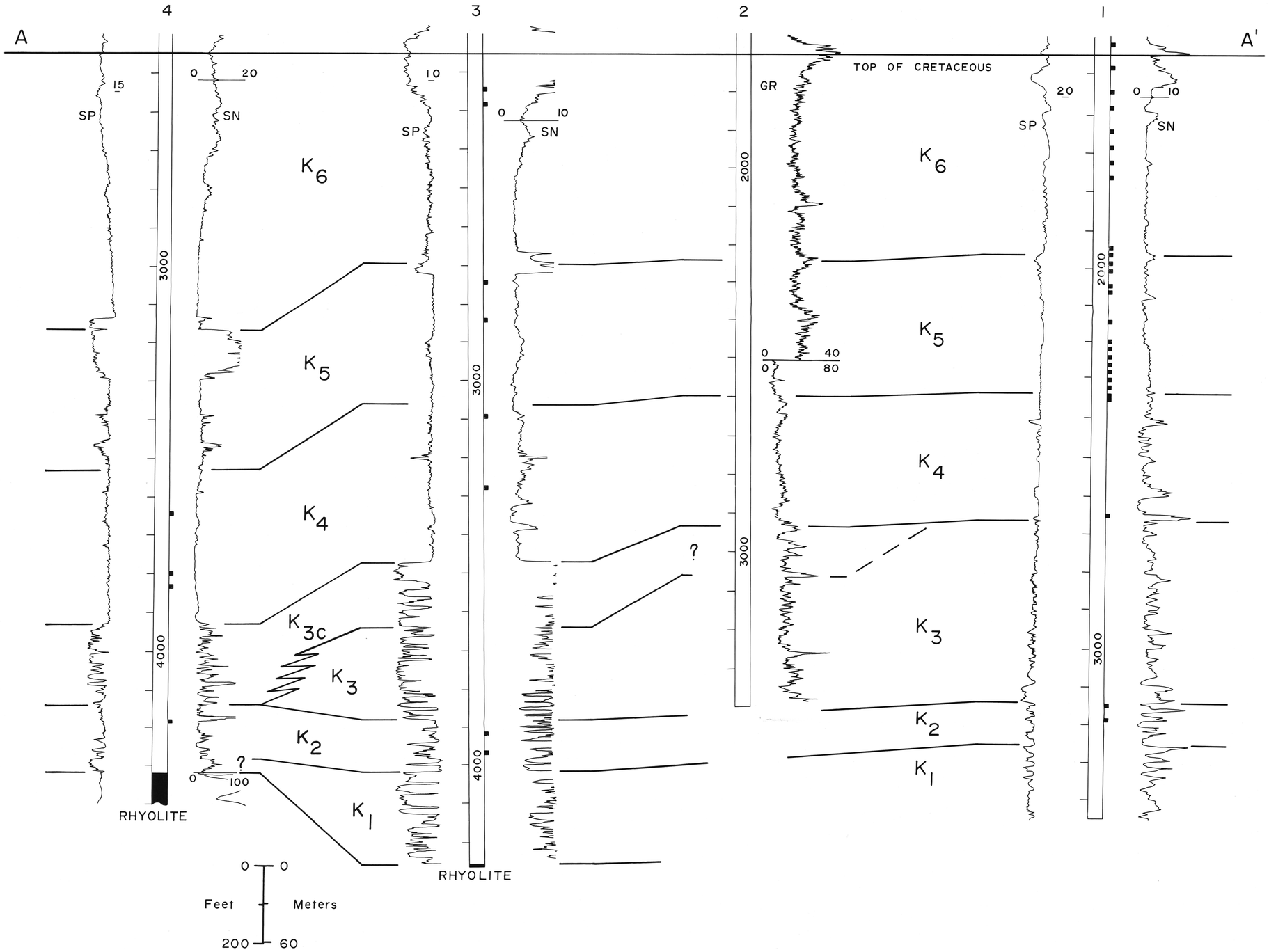
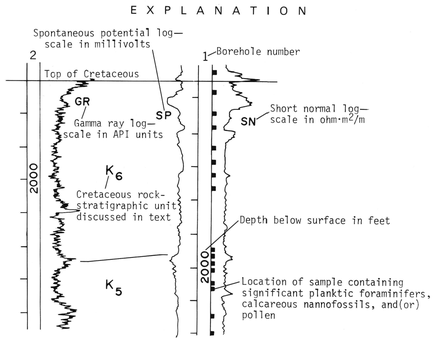
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1015-C
GOHN AND OTHERS—PRELIMINARY CROSS SECTIONS OF
CRETACEOUS SEDIMENTS ALONG GEORGIA COASTAL MARGIN
SHEET 1 OF 2





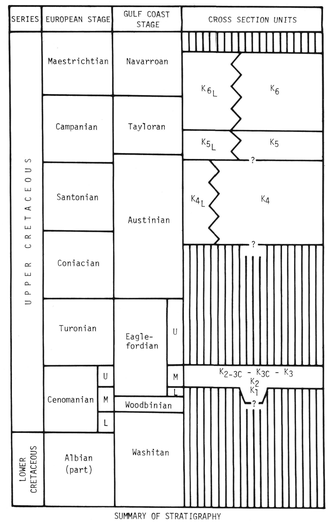


Table 1.--*Borehole locations and data sources. Geophysical logs for the boreholes were originally calibrated in U.S. customary units. (E, electric log; G, gamma log; X, other geophysical logs; Cu, cuttings; Co, core; F, fossil data; K.B., kelly bushing; D.F., drilling floor; G.L., ground level.)*

Borehole number and name	Location	Total depth ft	Total depth (m)	Elevation ft	Elevation (m)	Source of new data	Published data
1. Parris Island No. 2	Beaufort Co., SC 32° 18' 40" N 80° 41' 50" W	3454	(1053)	18	(5.5)	E	McLean (1960) Siple (1965, 1969) Maher and Applin (1971) USGS Data Files
2. USGS-Pooler No. 1	Chatham Co., GA 32° 07' 01" N 81° 13' 19" W	3407	(1038)	20	(6.1)	E, G	
3. Larue-Jelks and Rogers No. 1 (Ga. Geol. Survey 363)	Liberty Co., GA 31° 41' 15" N 81° 20' 45" W	4764	(1300)	26	(7.9)	E	Hurst (1960) Herrick (1961) Applin and Applin (1967) Marsalis (1970) Maher and Applin (1971)
4. Pan American-Union Camp No. 1 (Ga. Geol. Survey 1197)	Glynn Co., GA 4 miles SE of Everett, GA	4438	(1353)	K.B.24 D.F.23 G.L.13	(7.3) (7.0) (4.0)	E, G, X, Cu, F	Marsalis (1970)
5. Humble-Union Bag Camp Paper No.ST-1 (Ga. Geol. Survey 724)	Glynn Co., GA Ga. Military Dist. 27; Spring Bluff area	4632	(1412)	D.F.24 G.L.14	(7.3) (4.3)	E, Cu, F	Applin and Applin (1967) Marsalis (1970) Maher and Applin (1971)
6. California-J.A.Dule No. 1 (Ga. Geol. Survey 153)	Camden Co., GA 4.5 miles NW of Tarboro, GA 31° 03' 01" N 81° 52' 48" W	4969	(1515)	D.F.65	(19.8)	E	Southeastern Geological Society (1949) Applin and Applin (1964) Applin and Applin (1967) Marsalis (1970) Maher and Applin (1971)
7. Pan American-Union Camp No. B-1 (Ga. Geol. Survey 1198)	Camden Co., GA 9 miles E of Folkston, GA	4690	(1430)	K.B.27.5 G.L.14.5	(8.4) (4.4)	E, G, X, Cu, F	
8. St. Mary's River-Hilliard Turpentine No. 1	Nassau Co., FL Sec. 19, T.4N, R.24E	4824	(1470)	110	(33.5)		Cole (1944) Southeastern Geological Society (1949) Applin and Applin (1967)
9. Hunt-H.L. Hunt No.1	Baker Co., FL Sec. 21, T.1N, R.20E	3349	(1021)	134	(40.8)	E	Southeastern Geological Society (1949) Applin and Applin (1967)
10. Felsenthal and Weatherford-Bradley No. 1 (Ga. Geol. Survey 148)	Appling Co., GA 6 miles NE of Pine Grove	4106	(1252)	229	(69.8)	E	Applin and Applin (1967) Marsalis (1970) Maher and Applin (1971)
11a. W.K. Davis-C.D. Hopkins No. 1	Wayne Co., GA 3.5 miles E of Gardi, GA 31° 32' 30" N 81° 43' 45" W	3175	(968)	K.B.27 G.L.75	(23.5) (22.9)	G, X, Co, F	
11b. W.K. Davis-C.D.Hopkins No. 2	Wayne Co., GA 4.3 miles NE of Gardi, GA	4371	(1332)			E, G, X, Cu, F	

INTRODUCTION

The recent great interest in the petroleum potential of the South Atlantic Continental Shelf has prompted reconnaissance studies by the U.S. Geological Survey (USGS) of the subsurface Mesozoic and Cenozoic sediments of the South Carolina and Georgia coastal margins. These studies are based on lithologic data from cores, cuttings, and (or) geophysical logs and new biostratigraphic data from studies of calcareous nannofossil, planktic foraminiferal, and pollen assemblages obtained from a number of water wells, oil tests, and stratigraphic tests. The purpose of these studies is to provide a generalized stratigraphic framework that can serve as a starting point for more detailed stratigraphic work in both the emerged and submerged parts of the South Atlantic Coastal Plain. Recently published reports in the MF-1015 series include studies of the Cretaceous and Cenozoic sediments of the South Carolina coastal margin (Gohn and others, 1978a, 1978b). Borehole 1 of this report is the same as borehole 9 of Gohn and others (1978a).

This report describes the distribution of Cretaceous sediments along the Georgia coastal margin. Cross sections employing in-hole geophysical logs have been drawn to illustrate the distribution of the major stratigraphic units. The units delineated on the cross sections are informal rock-stratigraphic units of approximately formational rank. Formational names have not been used, however, to avoid discussions of stratigraphic nomenclature and the necessarily tenuous correlation of subsurface and outcropping units. Ages of the lithic units shown on the cross sections are given where determined in specific boreholes.

Any study of the Cretaceous sediments of Georgia must necessarily begin with the extensive work by E.R. Applin and P.L. Applin (for example, Applin and Applin, 1967). Some biostratigraphic data from their reports (Table 1) has been reinterpreted for the study of wells 1, 3, 6, 8, 9, and 10. Fossiliferous samples from these six wells were not examined during the present study. Locations of samples containing significant biostratigraphic data from the Applins' reports or from new studies of planktic foraminifers, calcareous nannofossils, and (or) pollen are shown by black boxes along the right side of each well log. The length of these sample-location boxes corresponds to the length of the well interval sampled. In the upper half of well 11, point samples were taken from the core; the locations are represented by horizontal ties along the right side of the log. Names, locations, and other data for each borehole are given in table 1.

Harold Gill and Michael Higgins of the USGS were instrumental in procuring samples for this study. The cooperation of the Georgia Geological Survey in supplying samples from deep oil tests is gratefully acknowledged. Dinoflagellates from some of the samples shown in borehole 11a were examined by F.E. May of the USGS.

STRATIGRAPHIC UNITS

The Cretaceous System in the subsurface of eastern Georgia probably consists entirely of Upper Cretaceous (Gulfian) sediments. The data from the studied wells indicate that sediments of late Cenomanian to middle Maestrichtian (middle Eaglefordian to Navarroan) Age occur in the subsurface across the Georgia coastal margin from South Carolina to northern Florida. Within this sequence, the Turonian Stage and probably most of the Coniacian Stage are not represented. No Early Cretaceous or older fossils were found in the studied wells. Although unit K_1 is unfossiliferous within the study area, all of the stratigraphic units described in this report have been assigned a Late Cretaceous age.

Unit K_1

Unit K_1 is present in boreholes 1, 3, 5, 6, 8, and 11, and possibly present in boreholes 4 and 10. Cuttings from unit K_1 consist primarily of medium- to very coarse-grained, feldspathic, quartz sand with less common red or brown, sandy and silty clay. In most of the boreholes, K_1 was seen to overlie pre-Cretaceous volcanic or sedimentary rocks. Unit K_1 varies considerably in thickness and may be absent locally as shown in several of the studied wells. Visual inspection of cross sections A-A' and B-B' suggests that the thickness and distribution of this unit may have been controlled by original topography on the pre-Cretaceous surface.

No fossils were found in unit K_1 during the present study, and no fossils have ever been reported from this unit in eastern Georgia or South Carolina. The Applins assigned these beds to either the lower member or revised lower member of their Atkinson Formation or to the undifferentiated Lower Cretaceous (Applin and Applin, 1947, 1964, 1967; Applin, 1955). Based upon the apparent close stratigraphic association of unit K_1 with the fossiliferous part of the lower member of the Atkinson (Applin and Applin, 1967), and the interpretation by Hazel (1968) of a late Cenomanian Age for that member, Gohn and others (1978a) tentatively suggested a late Cenomanian Age for K_1. Data gathered for the present report can neither confirm nor deny a close temporal association of unit K_1 with overlying fossiliferous beds (K_2), and a provisional Late(?) Cretaceous age is retained here pending the acquisition of other biostratigraphic data.

Unit K_2

Unit K_2 is a relatively thin sequence of fossiliferous limestone, sand, and clay encountered in boreholes 1, 3, 4, 5, and 11. All of the lithologies described by Gohn and others (1978a) in K_2 in South Carolina persist into Georgia including gray, glauconitic, fossiliferous, sandy limestone; gray, sandy or silty, calcareous, fossiliferous clay; and thinly interbedded fine-grained sand and clay. Mollusks, benthic and planktic foraminifers, ostracodes, lignite fragments, mica, and pyrite are common constituents of this unit. Pollen (4, 5, 11)[1] indicates a late Cenomanian (middle Eaglefordian) Age for Unit K_2. Foraminifers from this unit in boreholes 1 and 3, used by Applin (Southeastern Geological Society, 1949; Maher and Applin, 1971) to indicate a Woodbinian (middle Cenomanian) Age, also occur in units equivalent to K_2 in central Georgia that contain late Cenomanian (middle Eaglefordian) foraminifers and ostracodes (Applin, 1955; Hazel, 1969). The use of pollen zone IV for equating a late Cenomanian Age with an early Eaglefordian Age for unit K_2 (Gohn and others, 1978a) has been revised, and the upper part of the European Cenomanian Stage is now correlated on the basis of pollen and microfaunas with the middle part of the United States provincial Eaglefordian Stage (Christopher, 1979). Unit K_2 is the lateral equivalent of the lower part of unit K_{2-3C} described below.

Unit K_3

As described by Gohn and others (1978a), unit K_3 is a readily identifiable sequence of sparingly fossiliferous, red- or brown-mottled sand and clay that occurs between the fossiliferous gray sediments of units K_2 and K_4. Unit K_3 was encountered in boreholes 1, 2, 3, 10, and 11, but thins to the south and is overlapped and laterally replaced in that direction by the temporally equivalent unit K_{3C}.

No fossils were found in unit K_3 in Georgia, but a late Cenomanian (middle Eaglefordian) Age is assigned based upon the ages of the over- and underlying units, and upon the presence of sparse planktic foraminiferal assemblages in this unit in South Carolina (Gohn and others, 1978a; Hazel and others, 1977).

Unit K_{3C}

Unit K_{3C} is a sequence of fossiliferous, calcareous, fine-grained sand and sandy clay recognized in boreholes 3, 4, and 5. It is laterally equivalent to the coarser grained sand of unit K_3 to the north. A tongue of unit K_{3C} overlies unit K_3 in borehole 3 and extends an uncertain distance to the north. Although no fossiliferous samples were examined from K_{3C}, a late Cenomanian (middle Eaglefordian) Age is preferred based upon fossils in the over- and underlying units and in the laterally equivalent units.

Unit K_{2-3C}

Gray, calcareous, fine-grained deposits of units K_2 and K_{3C} become increasingly difficult to distinguish to the south, and these two units are grouped as unit K_{2-3C} in boreholes 6, 7, and 8. Pollen, planktic foraminifers, and calcareous nannofossils in borehole 7 indicate a late Cenomanian (middle Eaglefordian) Age for K_{2-3C}. Foraminifers from boreholes 6 and 8 were interpreted to indicate an Eaglefordian Age by Maher and Applin (1971) and Applin and Applin (1967). Unit K_2 and the lower part of unit K_{2-3C} constitute the lower member of the Atkinson Formation of Applin and Applin (1967), whereas units K_3, K_{3C}, and the upper part of unit K_{2-3C} compose the upper member of that formation. The geographic distribution of the two members of the Atkinson Formation is shown on plate 3 of Applin and Applin (1967).

Units K_4 and K_{4L}

Unit K_4 is a lithologically heterogeneous sequence of fossiliferous sediments which was penetrated by all the studied wells except borehole 9, and by numerous wells in South Carolina (Gohn and others, 1978a). As described by Gohn and others (1978a), typical lithologies in K_4 include: gray, calcareous, silty clay, in some instances thinly interbedded with fine-grained quartzose sand; gray, poorly sorted, calcareous, muddy, macrofossiliferous, fine- to medium-grained sand; well-sorted, medium- to coarse-grained quartz sand; and fine-grained, calcareous sand or sandy limestone. Mollusks, microfossils, lignite, glauconite, phosphate, and mica are common constituents. Unit K_{4L}, a lateral equivalent of unit K_4, consists of chalky limestone with some anhydritic dolomite (Southeastern Geological Society, 1949; Applin and Applin, 1967) and was found only in borehole 9.

Earlier workers (Maher and Applin, 1971, and others) suggested an Austinian Age for the sediments included here in units K_4 and K_{4L} based on foraminifers from boreholes 1, 3, 6, 8, and 9. Pollen (4, 5, 7, 11), planktic foraminifers (5, 7), and calcareous nannofossils (4, 5, 7, 11) indicate that unit K_4 ranges in age from Santonian, or possibly late Coniacian, to earliest Campanian (Austinian).

Unit K_5

Unit K_5 may be divided typically into three lithofacies: an upper sand, a middle calcareous clay, and a lower calcareous, muddy sand. These three facies are developed to varying degrees in each well on cross sections A-A' and C-C', and the distinction between the clay and the muddy sand is difficult in some instances. Calcareous nannofossils and pollen in borehole 11 indicate an early Campanian (early Tayloran) Age. Foraminifers in boreholes 1, 3, and 10 indicate an early(?) Tayloran Age (McLean, 1960; Maher and Applin, 1971).

Unit K_{5L}

Unit K_{5L} is the lateral and temporal equivalent of unit K_5 in southern Georgia and northern Florida. A gradual southward change from the terrigenous clastic sediments of unit K_5 to the more calcareous sediments of K_{5L} requires that the two lithologic units be defined. The boundary between the two units has been placed somewhat arbitrarily between boreholes 4 and 5. Planktic foraminifers and calcareous nannofossils in boreholes 5 and 7 and pollen in borehole 5 indicate an early Campanian (early Tayloran) Age that is compatible with the ages of the over- and underlying units.

Unit K_6

Unit K_6 is a cyclic sequence of clay and poorly sorted sand of marine origin encountered in boreholes 1, 2, 3, 4, 10, and 11. As described by Gohn and others (1978a) in South Carolina, typical lithologies include gray, calcareous, fossiliferous clay and gray, glauconitic, calcareous fine- to medium-grained muddy sand. Calcareous nannofossils, planktic foraminifers, and pollen in borehole 11 indicate a late Campanian(?) to middle Maestrichtian (late Tayloran(?) to Navarroan) Age for Unit K_6. Foraminifers in boreholes 1 and 3 have been interpreted to indicate a late Tayloran to Navarroan Age (Maher and Applin, 1971; McLean, 1960). Common Paleocene microfossils from this unit in borehole 4 have been interpreted herein as cavings.

Unit K_{6L}

Unit K_{6L} is the lateral and temporal equivalent of K_6, but is more calcareous than the latter unit; both limestone and dolomite constitute major parts of the K_{6L} section. Approximately the upper two-thirds of unit K_{6L} is equivalent to the Lawson Limestone of Applin and Applin (1967). Planktic foraminifers and calcareous nannofossils in boreholes 5 and 7 indicate a late Campanian to middle(?) Maestrichtian (late Tayloran to Navarroan) Age. Fossils, principally foraminifers, from boreholes 6, 8, and 9 indicate a late Tayloran to Navarroan Age for unit K_{6L} (Applin and Applin, 1967; Maher and Aplin, 1971). The "Taylor kick" on the electric log for borehole 9 is a widespread bentonite layer in northern Florida that is generally considered to mark the position of the top of the Tayloran (Campanian) Stage (Chen, 1965; Applin and Applin, 1967).

[1]Numbers in parentheses indicate boreholes in which fossils were found.

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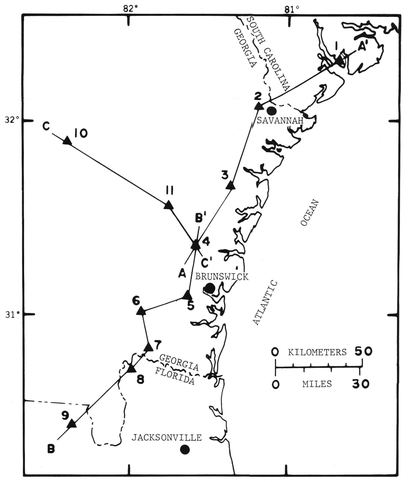

Index map showing location of boreholes and cross sections

PRELIMINARY STRATIGRAPHIC CROSS SECTIONS OF ATLANTIC COASTAL PLAIN SEDIMENTS OF THE SOUTHEASTERN UNITED STATES-CRETACEOUS SEDIMENTS ALONG THE GEORGIA COASTAL MARGIN

By

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1980

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