

NOMENCLATURE OF REGIONAL HYDROGEOLOGIC
UNITS OF THE SOUTHEASTERN COASTAL
PLAIN AQUIFER SYSTEM

By James A. Miller and Robert A. Renken

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 87-4202



Atlanta, Georgia

1988

DEPARTMENT OF THE INTERIOR
DONALD PAUL HODEL, Secretary

U.S. GEOLOGICAL SURVEY
Dallas L. Peck, Director

For additional information
write to:

U.S. Geological Survey
Office of Regional Hydrologist
Richard B. Russell Federal Building
75 Spring Street, S.W., Suite 772
Atlanta, Georgia 30303
(Telephone: (404) 331-5174)

Copies of this report can be
purchased from:

U.S. Geological Survey
Books and Open-File Reports
Federal Center, Bldg. 810
Box 25425
Denver, Colorado 80225
(Telephone: (303) 236-7476)

CONTENTS

	Page
Abstract	1
Introduction	1
Background	1
Purpose and scope	2
Hydrogeologic framework	3
Regional setting	3
Hydrogeologic units	4
Regional aquifer nomenclature	6
Chickasawhay River aquifer	7
Pearl River aquifer	7
Chattahoochee River aquifer	9
Black Warrior River aquifer	13
Relation of regional and subregional aquifers	13
Relation of contiguous aquifer systems	17
Summary and conclusions	19
References	21

ILLUSTRATIONS

		Page
Figure 1.	Map showing location of study area and line of hydrogeologic sections	2
2.	Chart showing schematic classification of rock-stratigraphic and regional hydrogeologic units	5
3.	Map showing location and outcrop or shallow subcrop areas of major hydrogeologic units	8
4.	Generalized hydrogeologic section A-A' in east-central Georgia (location of section shown in figure 1)	10
5.	Map showing the geology and configuration of the top of the Pearl River aquifer	11
6.	Generalized hydrogeologic section B-B' in eastern Alabama and northern Mississippi (location of section shown in figure 1)	12
7.	Map showing the geology and configuration of the top of the Chattahoochee River aquifer	14
8.	Map showing the geology and configuration of the top of the Black Warrior River aquifer	15
9.	Chart showing relation among regional and subregional hydrogeologic units in the Southeastern Coastal Plain aquifer system	16

TABLES

Table 1.	Chart showing relation among hydrogeologic units differentiated by the Southeastern Coastal Plain, Gulf Coast, Floridan, and Northern Atlantic Coastal Plain Regional Aquifer-System Analysis studies	18
----------	---	----

NOMENCLATURE OF REGIONAL HYDROGEOLOGIC UNITS OF THE SOUTHEASTERN COASTAL PLAIN AQUIFER SYSTEM

By James A. Miller and Robert A. Renken

ABSTRACT

Clastic sediments of the Southeastern Coastal Plain aquifer system can be divided into four regional aquifers separated by three regional confining units. The four regional aquifers have been named for major rivers that cut across their outcrop areas and expose the aquifer materials. From youngest to oldest, the aquifers are called the Chickasawhay River, Pearl River, Chattahoochee River, and Black Warrior River aquifers and the regional confining units separating them are given the same name as the aquifer they overlie. Most of the regional hydrogeologic units are subdivided within each of the four States that comprise the study area. Correlation of regional units is good with hydrogeologic units delineated by a similar regional study to the west and southwest. Because of complexity created by a major geologic structure to the northeast of the study area and dramatic facies change from clastic to carbonate strata to the southeast, correlation of regional hydrogeologic units is poor in these directions.

INTRODUCTION

Background

The Southeastern Coastal Plain aquifer system is composed of a series of major aquifers that lie within clastic sediments ranging in age from Cretaceous to late Tertiary and that are hydraulically connected in varying degrees (Renken and others, in press). The aquifer system underlies an area of approximately 120,000 mi² in the Coastal Plain of South Carolina, Georgia, Alabama, and Mississippi and contiguous small areas in southeastern North Carolina and northern Florida (fig. 1). The system extends eastward from the Mississippi embayment in central Mississippi to the southwestern flank of the Cape Fear arch in southeastern North Carolina. The Southeastern Coastal Plain aquifer system grades laterally to the northeast into the Northern Atlantic Coastal Plain aquifer system (Meisler, 1980); it is partly overlain by, and partly grades laterally into, the Floridan aquifer system (Miller, 1986) to the south and the Mississippi embayment and Coastal Lowlands aquifer systems (Grubb, 1986) to the west. The latter two aquifer systems have been studied as part of the Gulf Coast Regional Aquifer-System Analysis (Grubb, 1986). The northern limit of the Southeastern Coastal Plain aquifer system is its contact with crystalline rocks or indurated Paleozoic sedimentary rocks at the Fall Line which marks the updip limit of Coastal Plain rocks.

The Southeastern Coastal Plain aquifer system was studied as part of the U.S. Geological Survey's Regional Aquifer-System Analysis (RASA) program, which was begun in 1978 to examine the major ground-water systems that provide a significant part of the Nation's water supply. As stated by Sun (1986), one of the objectives of each RASA study is to define the regional geology and hydrology of a particular aquifer system. This objective was met for the Southeastern Coastal Plain aquifer system by synthesizing large volumes of geologic and

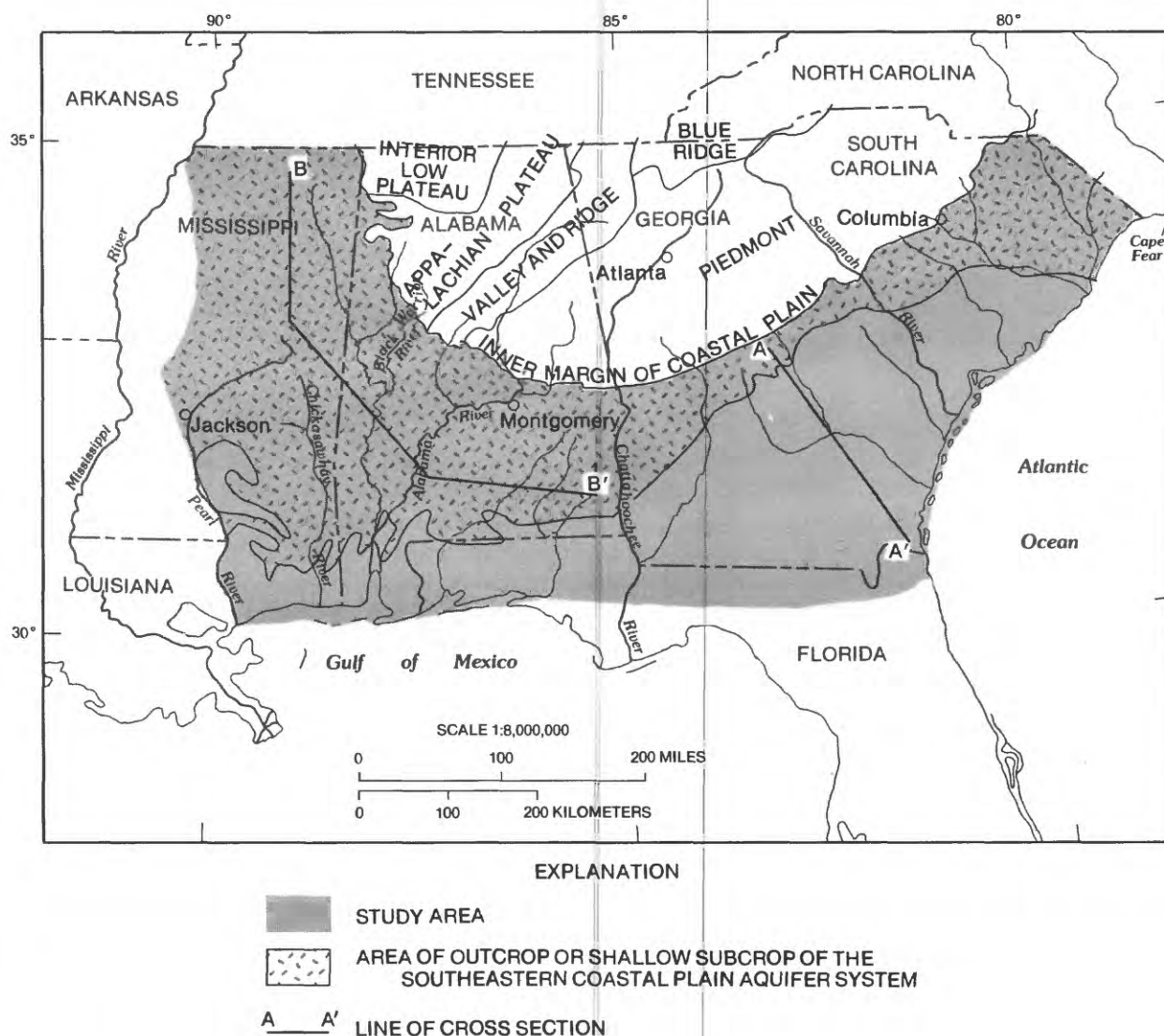


Figure 1.—Location of study area and line of hydrogeologic sections.

hydrologic data and establishing a manageable number of regionally-extensive hydrogeologic units. Results of this synthesis have been presented in reports by Renken (1984) and Renken and others (in press) which form the basis for the descriptions and conclusions presented in this report.

Purpose and Scope

The purpose of this report is to briefly describe the hydrogeologic framework of the Southeastern Coastal Plain aquifer system and to establish names for the regional aquifers and confining units that comprise the aquifer system. Numerous reports presenting the results of the Southeastern Coastal Plain RASA study have been published that use an alphanumeric code to identify regional aquifers and confining units. Recently published guidelines for naming aquifers

and confining units (Laney and Davidson, 1986) offer valuable suggestions which, if followed, allow nomenclature to be assigned to these regional hydrogeologic units that is more desirable than the alphanumeric nomenclature currently in use.

This report presents descriptions and maps of the four regional aquifers that comprise the Southeastern Coastal Plain aquifer system and shows the relation of these aquifers to each other and to aquifers studied as parts of adjacent regional aquifer systems. The Southeastern Coastal Plain study area was divided into four subregional areas in order to scrutinize local flow systems and water problems in more detail. Each of these subregional areas contains numerous local aquifers, and the relation of these local aquifers to the four regional aquifers is discussed. The report also shows the correlation between geologic and hydrogeologic units in the regional study area.

HYDROGEOLOGIC FRAMEWORK

Regional Setting

Sediments in the Coastal Plain of the southeastern United States form a thick wedge of clastic and carbonate strata that generally dips and thickens seaward from a featheredge at the Fall Line, a physiographic boundary which coincides with the inner margin of Coastal Plain rocks. The gentle coastward dip of the rocks is locally interrupted by large- to small-scale folding and faulting (Renken, 1984). Coastal Plain sediments range in age from Jurassic to Holocene. They are underlain by relatively impervious igneous, metamorphic, and sedimentary rocks mostly of early Paleozoic to early Mesozoic age that form the floor of the Coastal Plain. In some parts of the study area, these low-permeability rocks are a southwestern extension of the Appalachian Mountains or a southeastern extension of Piedmont rocks; in other parts, they represent Mesozoic graben-fill sediments and igneous intrusives that may have formed in an ancient rift system. The configuration and character of the base of the Coastal Plain, over much of the study area, have recently been mapped by Wait and Davis (1986).

The Coastal Plain sediments were laid down during a series of transgressions and regressions of the sea. Accordingly, the rocks represent depositional environments ranging from fluvial to shallow marine, with the exact locale of each environment depending upon the relative positions of land masses, shoreline, and streams at a particular point in geologic time. Fluctuating depositional conditions account for the observed complex variations in sediment lithology in the study area. Because the lithology of the sediments largely determines hydraulic conductivity, there is likewise much variation in this property. Consequently, the occurrence and flow of ground water in the Southeastern Coastal Plain are greatly controlled by the texture, composition, and bedding character of the sediments.

Some of the Tertiary units within the clastic rock sequence that is the focus of this study grade southward in southern Georgia, southeastern Alabama, and southwestern South Carolina into a thick sequence of highly permeable carbonate rocks that make up the Floridan aquifer system (Miller, 1986). Thus, in places, the Southeastern Coastal Plain aquifer system is in direct hydraulic connection with the Floridan aquifer system. The Floridan is overlain by an upper confining unit consisting mostly of low-permeability clastic rocks of Oligocene to Pliocene age. This confining unit is, in turn, overlain by a sandy surficial aquifer.

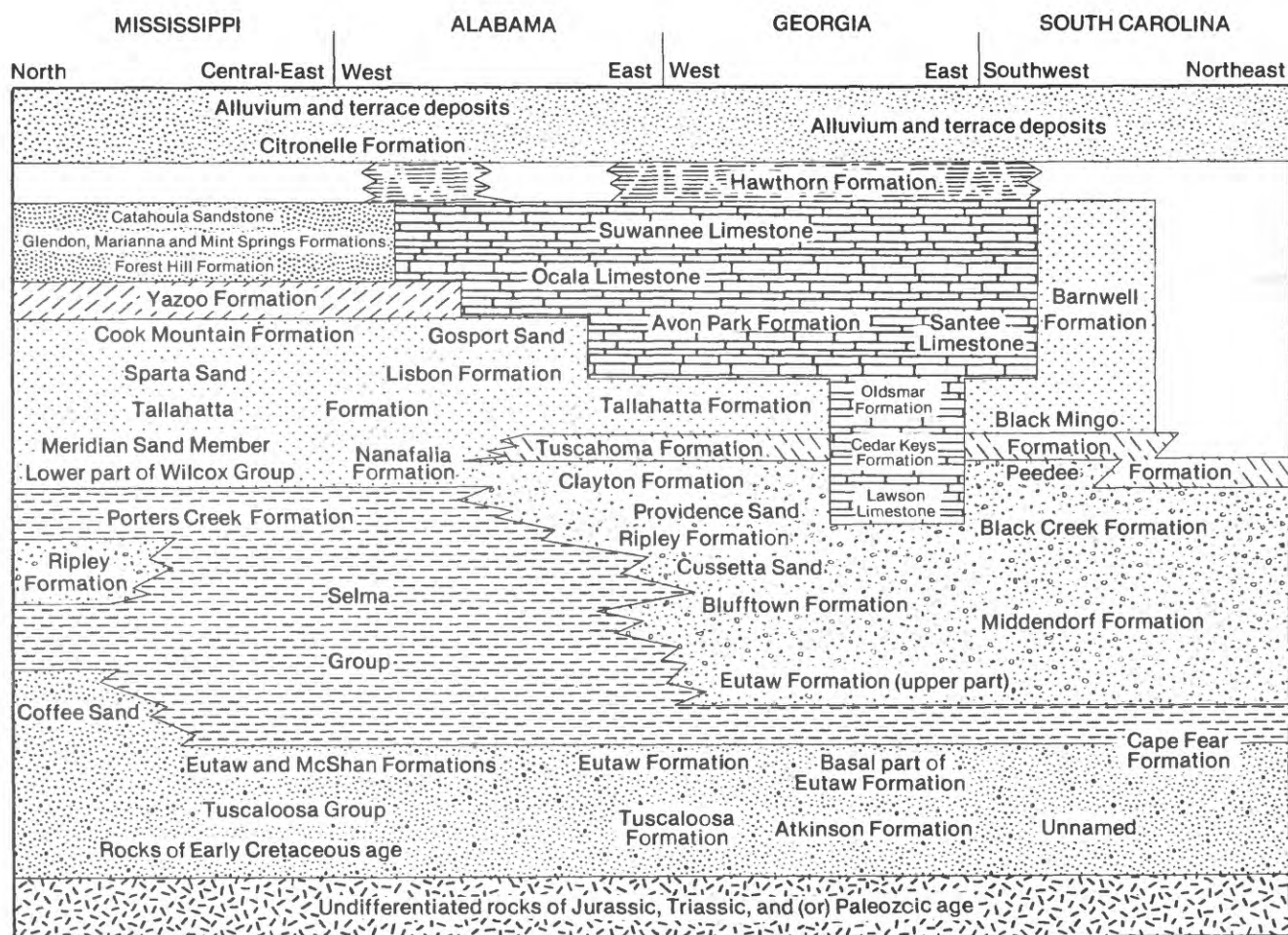
Hydrogeologic Units

The complexly interbedded strata that comprise the Southeastern Coastal Plain aquifer system contain numerous aquifers and confining beds. Sequences of local aquifers that can be shown to be hydraulically connected in varying degrees are treated in this study as a single regional aquifer. Where head data exist, the degree of interconnection is judged primarily by the similarity in hydraulic head among the local aquifers. Where such data are lacking, interconnection is established by extrapolation of the geohydrologic framework delineated in places where hydraulic parameters are known. In a similar fashion, sequences of local confining beds that can be shown to be connected, or that have the same hydraulic effect, are grouped into regional confining units. The relative difference in hydraulic head between discrete aquifers within a regional aquifer is generally less than the head difference between adjacent regional aquifers. Regional confining units generally separate regional aquifers; however, where an intervening confining unit pinches out, two regional aquifers may be in contact. Similarly, two regional confining units may locally be directly connected where the regional aquifer between them is missing.

The sediments that comprise the Southeastern Coastal Plain aquifer system have been grouped into seven regional hydrogeologic units: four regional aquifers separated by three regional confining units (Renken, 1984). For the most part, each hydrogeologic unit consists of a series of sand or clay beds that can be shown or reasonably assumed to behave together as a single hydrogeologic unit. On a local scale, it is possible to differentiate separate aquifers and confining beds within each regional hydrogeologic unit. The regional aquifers consist chiefly of coarse to fine sand, but locally include small amounts of gravel and limestone. Due to changes in lithology throughout the Coastal Plain, only the lowermost aquifer is continuous across the study area. The regional confining units are mostly clay, mudstone, or shale; however, a thick sequence of chalk in Alabama and Mississippi also forms an effective regional confining unit.

The hydrogeologic framework established for this study is intended to emphasize the contrast in permeability between regionally-extensive units. The physical boundaries of a regional aquifer or confining unit may locally parallel those of a stratigraphic unit such as a formation. Stratigraphic and hydraulic boundaries do not always coincide, however, especially when hydrogeologic units are extended over a regional area. The top or base of a regional hydrogeologic unit may lie within a stratigraphic unit rather than at its boundaries. Stratigraphically equivalent rocks may comprise part of a regional aquifer in one place and part of a confining unit elsewhere.

It is difficult to impossible to apply existing formation or local-aquifer nomenclature to the regional aquifers and confining units delineated in the Southeastern Coastal Plain aquifer system. The difficulty is due in part to the generally poor correspondence of hydrogeologic unit boundaries with stratigraphic unit boundaries and in part to the regional extent of the hydrogeologic units. Each hydrogeologic unit encompasses several formations or parts of formations, as shown on figure 2. Interim reports produced by the Southeastern Coastal Plain RASA study used a system of alphanumeric designations for the regional hydrogeologic units. Regional aquifers were designated by the letter A and regional confining units were designated by the letter C. The four regional aquifers were numbered sequentially to indicate their relative positions, with



EXPLANATION

HYDROGEOLOGIC UNITS

	Surficial aquifer		A3: Chattahoochee River aquifer
	Upper confining unit		C3: Black Warrior River confining unit
	Floridan aquifer system		A4: Black Warrior River aquifer
	A1: Chickasawhay River aquifer		Base of system
	C1: Pearl River confining unit		
	A2: Pearl River aquifer		
	C2: Chattahoochee River confining unit		

Figure 2.—Schematic classification of selected rock-stratigraphic and regional hydrogeologic units. Exact geologic correlations are not implied.

aquifer A4 being the lowest and aquifer A1 the highest. Confining units were likewise numbered, with regional confining unit C3 (lowest) lying above regional aquifer A4 and below regional aquifer A3; and so on.

Alphanumeric nomenclature represents a type of shorthand that is useful for internal, day-to-day communication during the early stages of a study. However, such designations mean little to workers outside the staff of the project using the alphanumeric naming scheme. With alphanumeric nomenclature, it is easy to infer exact equivalence between hydrogeologic units and the aquifer and confining-unit layers simulated in digital models: equivalence that may not, in fact, exist. Accordingly, a new set of names is proposed in this report for the regional aquifers that comprise the Southeastern Coastal Plain aquifer system. The method of selecting names follows the guidelines set forth by Laney and Davidson (1986). It is important to emphasize that the alphanumeric designations replaced by the names in this report are designations of hydrogeologic units, not model layers.

Each of the four regional aquifers of the Southeastern Coastal Plain aquifer system is herein named for a major river in the study area. The rivers chosen transect the outcrop of the regional aquifer which bears their name, and part of the aquifer is exposed in outcrop along the nominate river. The new set of names chosen is as follows:

<u>Alphanumeric code</u>	<u>New aquifer name</u>
A1	Chickasawhay River aquifer
A2	Pearl River aquifer
A3	Chattahoochee River aquifer
A4	Black Warrior River aquifer

The regional confining units separating these aquifers are herein named the same as the regional aquifer they overlies. This was done in order to avoid the proliferation of new names. The new set of confining unit names is as follows:

<u>Alphanumeric code</u>	<u>New confining unit name</u>
C1	Pearl River confining unit
C2	Chattahoochee River confining unit
C3	Black Warrior River confining unit

Figure 2 shows the relation of the new names to the old alphanumeric designations and to the different formations that comprise each hydrogeologic unit. In the following sections of this report, only the water-yielding hydrogeologic units (regional and local aquifers) are discussed individually. Although local and regional confining units strongly influence the ground-water flow system, the Southeastern Coastal Plain RASA study, like most ground-water investigations, emphasizes the hydrogeologic units from which water can be obtained.

REGIONAL AQUIFER NOMENCLATURE

The four regional aquifers differentiated within the Southeastern Coastal Plain aquifer system consist primarily of fine to coarse sand that was deposited under relatively high energy conditions in fluvial to shallow marine environments. Locally, beds of gravel and limestone are included in some of the

aquifers. Many clay beds are included in all of the regional aquifers because depositional environments shifted over the period of time during which the aquifers were laid down. On a regional scale, however, each regional aquifer delineated behaves as a single hydrogeologic unit.

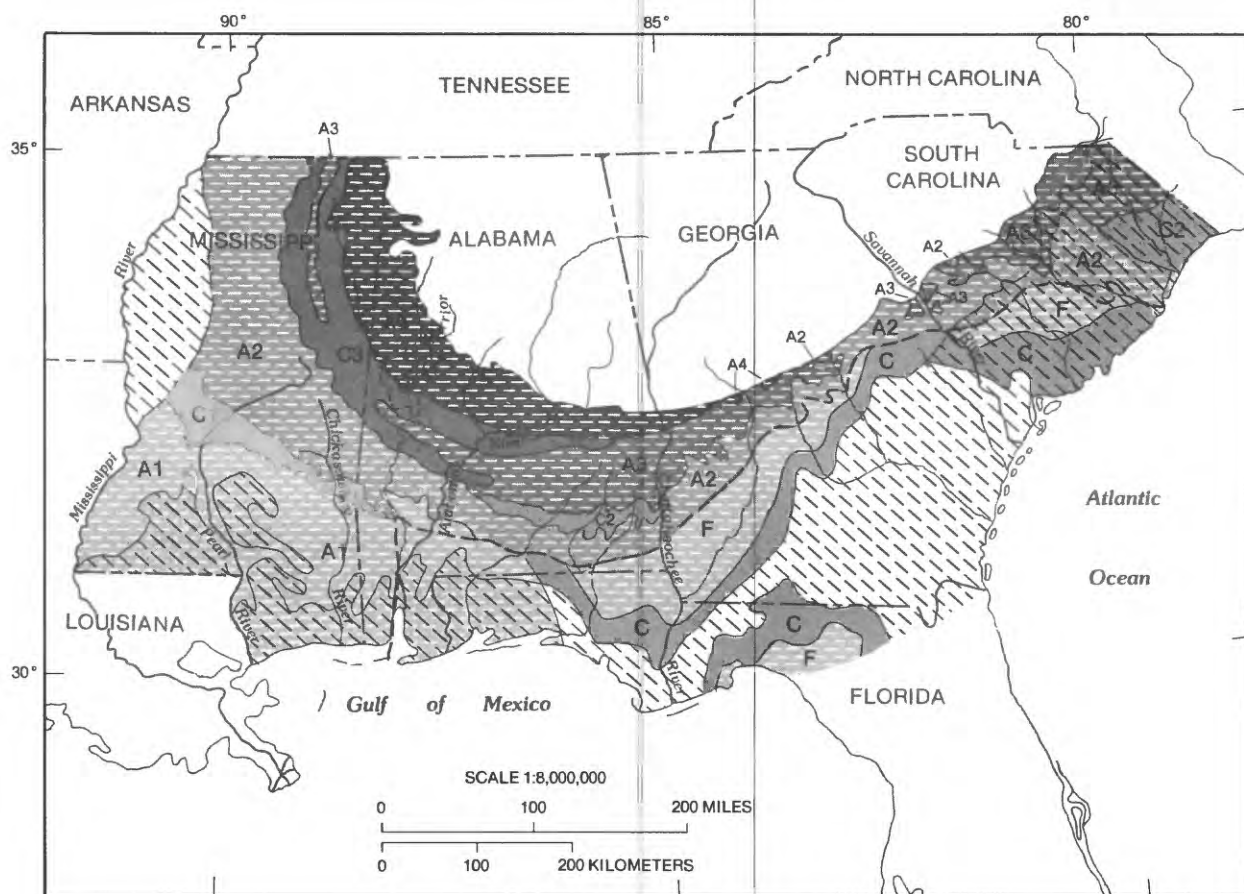
The basal regional confining unit of the Southeastern Coastal Plain aquifer system (Wait and Davis, 1986) consists of crystalline rocks or of consolidated to semiconsolidated sedimentary rocks, all of which have low permeability. The three regional confining units that separate the regional aquifers mostly consist of argillaceous rocks. However, chalk is an important component of one of the regional confining units. The fine-grained materials comprising the regional confining units were deposited in quiet water in either marine or fluvial environments. Each regional confining unit locally contains beds of sand or other high-permeability materials. Regionally, however, the strata included in the confining units behave together to retard vertical flow between the regional aquifers.

Chickasawhay River Aquifer

The Chickasawhay River aquifer, named for the Chickasawhay River in Mississippi and formerly referred to as the Al aquifer, is present in southwest Alabama and southern Mississippi. This aquifer is the uppermost regional aquifer in the Southeastern Coastal Plain aquifer system. The aquifer consists of clastic and carbonate rocks of Oligocene and Miocene age and extends southwestward into Louisiana, where it becomes the lower part of the Coastal Lowlands aquifer system (Grubb, 1986). In southwestern Alabama and panhandle Florida, the Chickasawhay River aquifer changes facies to a limestone and becomes the upper part of the Floridan aquifer system; accordingly, these equivalent sediments are not considered part of the Southeastern Coastal Plain aquifer system there. The outcrop area of the Chickasawhay River aquifer is shown on figure 3. In the regional computer simulation of the aquifer system, the Chickasawhay River aquifer is not considered an active model layer; rather, it is treated as a source-sink layer. The Chickasawhay River aquifer is underlain by the Pearl River confining unit (formerly called the C1 confining unit) which consists predominantly of the clayey Yazoo Formation of late Eocene age. The Pearl River confining unit is equivalent to the Vicksburg-Jackson confining unit that forms the base of the Coastal Lowlands aquifer system in Louisiana and western Mississippi.

Pearl River Aquifer

The Pearl River aquifer, named for the Pearl River in Mississippi, is a thick sequence of sand with minor amounts of sandstone, gravel, and a few limestone beds. This regional aquifer ranges in age from late Eocene to Paleocene. The sediments that comprise the Pearl River aquifer were mostly deposited under marine conditions except for parts of Mississippi, where they were laid down in deltaic to fluvial environments. The Pearl River aquifer is equivalent to the Mississippi embayment aquifer system (Grubb, 1986) to the west and southwest. In south Georgia and in parts of southern Alabama and southwestern South Carolina, the sands of the Pearl River aquifer pass by facies change into carbonate rocks that are part of the Floridan aquifer system. Miller (1986, p. 45) defined the Floridan aquifer system as a "vertically continuous sequence of carbonate rocks of generally high permeability that are mostly of middle and late Tertiary age and hydraulically connected in varying



EXPLANATION

SOUTHEASTERN COASTAL PLAIN AQUIFER SYSTEM

- A1** A1: Chickasawhay River aquifer
- C1** C1: Pearl River confining unit
- A2** A2: Pearl River aquifer
- C2** C2: Chattahoochee River confining unit
- A3** A3: Chattahoochee River aquifer
- C3** C3: Black Warrior River confining unit
- A4** A4: Black Warrior River aquifer

- SURFICIAL AQUIFER**
- C** UPPER CONFINING UNIT
- F** FLORIDAN AQUIFER SYSTEM
- UPDIP LIMIT OF FLORIDAN (MODIFIED FROM MILLER, 1984)
- A** REGIONAL AQUIFER UNIT
- C** REGIONAL CONFINING UNIT

Figure 3.—Location and outcrop or shallow subcrop areas of major hydrogeologic units.

degrees and whose permeability is, in general, an order to several orders of magnitude greater than that of those rocks that bound the system above and below." The definition of the Floridan is, thus, partly lithologic and partly hydraulic. Figure 4 shows the relation between the Floridan and Southeastern Coastal Plain aquifer systems in part of Georgia. The boundary between the Southeastern Coastal Plain and Floridan aquifer system in these areas is not a well-defined confining unit but rather is a lithologic transition, and the two systems are directly hydraulically connected. The top of the Pearl River aquifer, as shown in figure 5, coincides with the base of the Floridan aquifer system as mapped by Miller (1986) where the two are juxtaposed.

The Pearl River aquifer in eastern Alabama and most of Georgia and South Carolina is separated from the deeper Chattahoochee River aquifer by the Chattahoochee River confining unit, formerly called the C2 confining unit, composed of clay of Late Cretaceous to Paleocene age. The Chattahoochee River confining unit is largely equivalent to the Tuscaloosa Formation in Georgia and eastern Alabama and to the lower part of the Black Mingo Formation and, locally, part of the Peedee Formation in South Carolina. This regional confining unit is locally absent in updip parts of the Coastal Plain in eastern Georgia and western South Carolina, where the Pearl River and Chattahoochee River aquifers are in direct contact. In Mississippi and western Alabama, the Chattahoochee River confining unit changes facies into a sand. In western Alabama, the Chattahoochee River aquifer merges with the overlying Pearl River aquifer where the Chattahoochee River confining unit separating them pinches out (fig. 6). Accordingly, west and north of this pinchout, the Chattahoochee River aquifer is not mapped except for a small area in northeastern Mississippi, where beds of the Ripley Formation are considered part of it (fig. 6).

Chattahoochee River Aquifer

The Chattahoochee River aquifer is named for the Chattahoochee River that forms much of the Alabama-Georgia border. This regional aquifer, previously known as the A3 aquifer, is continuous in the subsurface from western Alabama into North Carolina, where it merges with aquifers that are part of the Northern Atlantic Coastal Plain aquifer system. In outcrop, the Chattahoochee River aquifer is discontinuous because it is overlapped by the Pearl River aquifer in northeastern Georgia and southwestern South Carolina (fig. 3). The Chattahoochee River aquifer grades westward by facies change into calcareous shale and chalk that are part of the Selma Group and the Black Warrior River confining unit (figure 2). The aquifer is chiefly of Late Cretaceous age and consists mostly of a series of thick to thin sand beds that are separated by dark, calcareous, commonly lignitic clays. Sandy, glauconitic limestone of the Clayton Formation and glauconitic sands of the Nanafalia Formation, both of Paleocene age, are part of the aquifer in western Georgia and eastern Alabama. Sands of the Ellenton Formation of Paleocene age are very locally included in this aquifer in South Carolina.

Locally in southeast Georgia, the Chattahoochee River aquifer grades into carbonate rocks that comprise the lower part of the Floridan aquifer system (fig. 4). In western Alabama and east-central Mississippi, the Chattahoochee River aquifer merges with the overlying Pearl River aquifer and is not mapped separately (figs. 3 and 6). The rocks of the Chattahoochee River aquifer were deposited mostly in deltaic to shallow marine environments; however, fluvial deposits make up part of the aquifer in South Carolina. The aquifer is

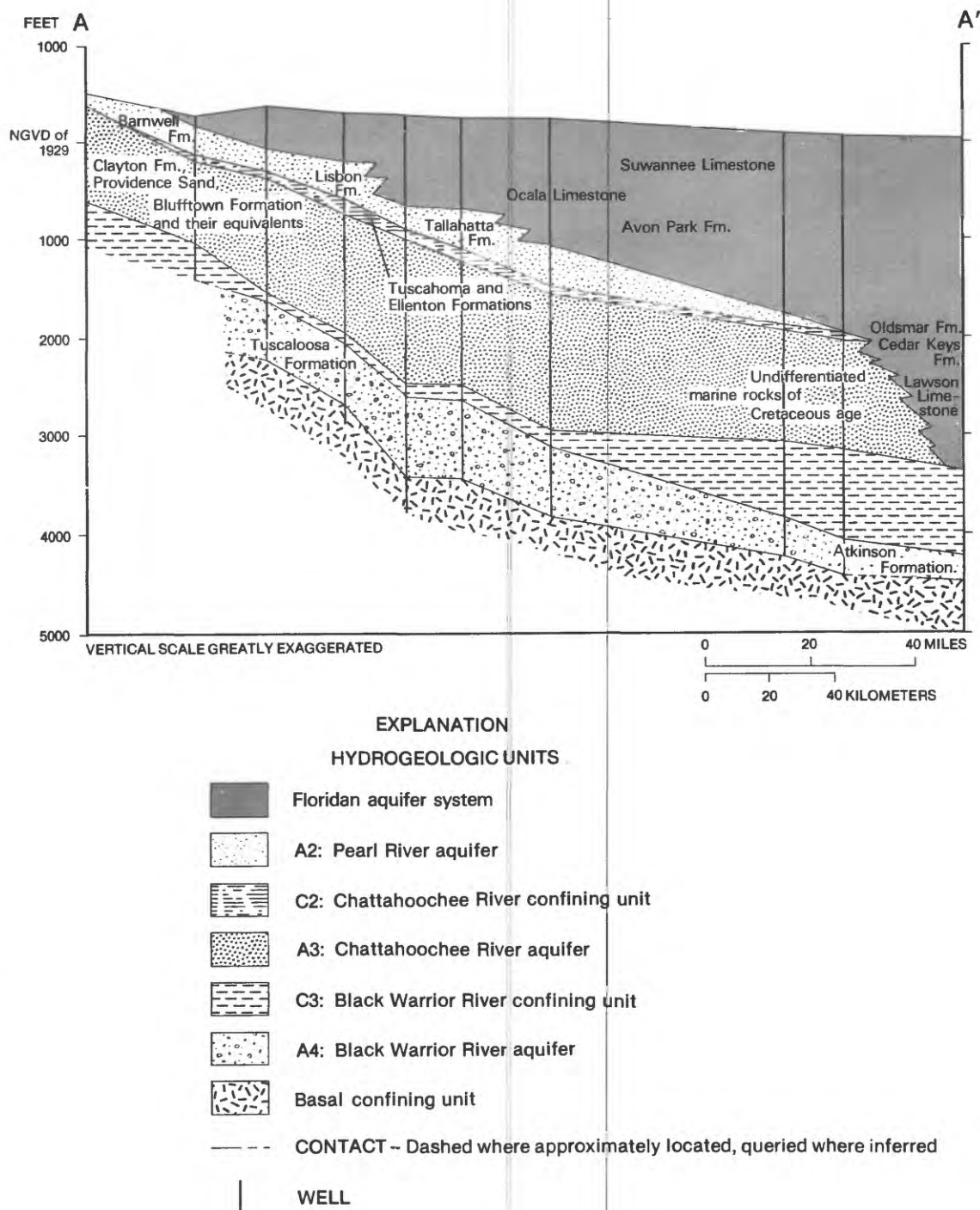
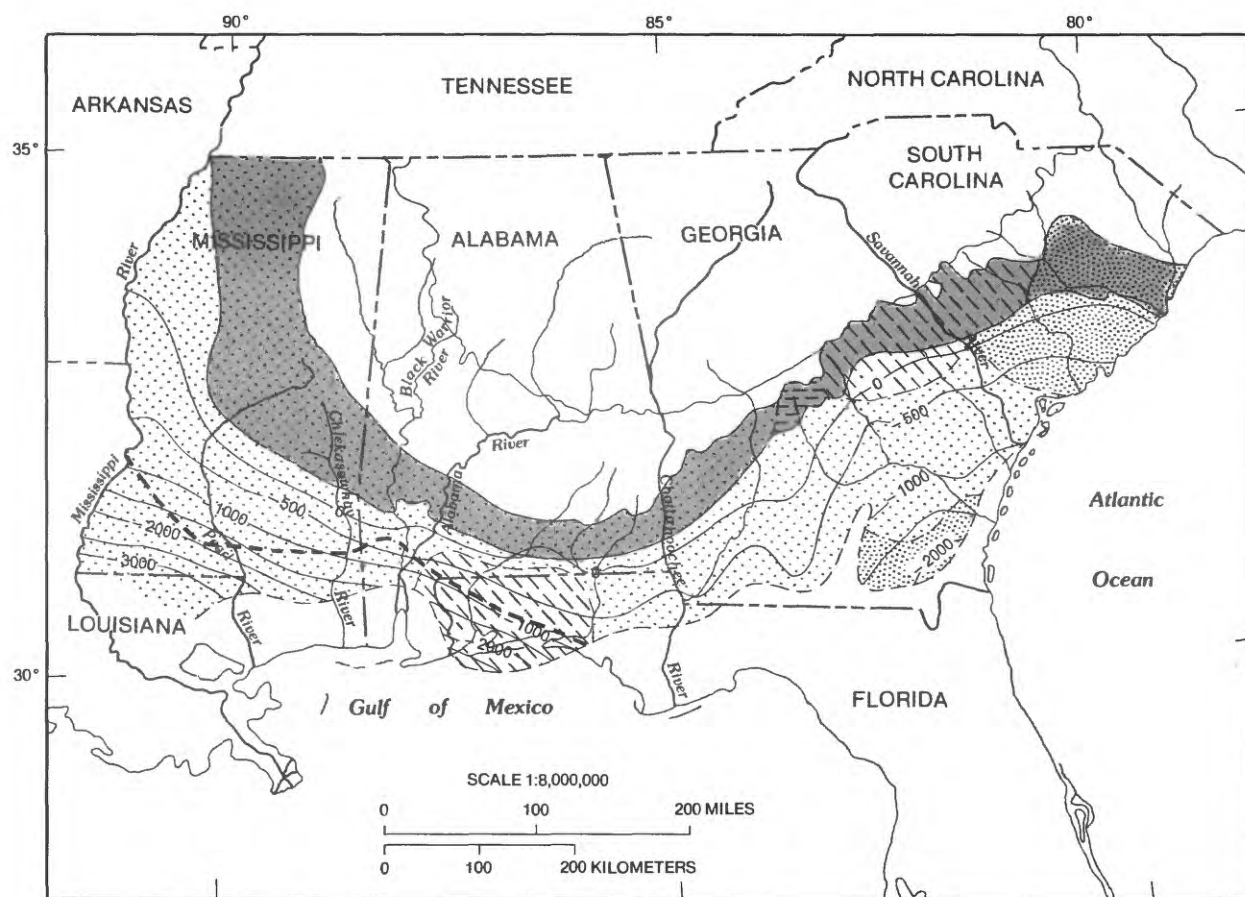


Figure 4.—Generalized hydrogeologic section A-A' in east-central Georgia (location of section shown in figure 1).



EXPLANATION

- APPROXIMATE DOWNDIP LIMIT OF AQUIFER UNIT
- 1000 - STRUCTURE CONTOUR. SHOWS ALTITUDE OF TOP OF AQUIFER UNIT. CONTOUR INTERVAL, 500 FEET. DATUM IS SEA LEVEL
- APPROXIMATE UPDIP LIMIT OF WATER CONTAINING 10,000 MILLIGRAMS PER LITER DISSOLVED SOLIDS

 AREA OF OUTCROP

TIME-STRATIGRAPHIC UNIT COMPRISING TOP OF REGIONAL AQUIFER UNIT





-  UNDIFFERENTIATED EOCENE ROCKS
-  ROCKS OF LATE EOCENE AGE
-  ROCKS OF MIDDLE EOCENE AGE
-  ROCKS OF EARLY EOCENE AND PALEOCENE AGE

Figure 5.—Geology and configuration of the top of the Pearl River aquifer.

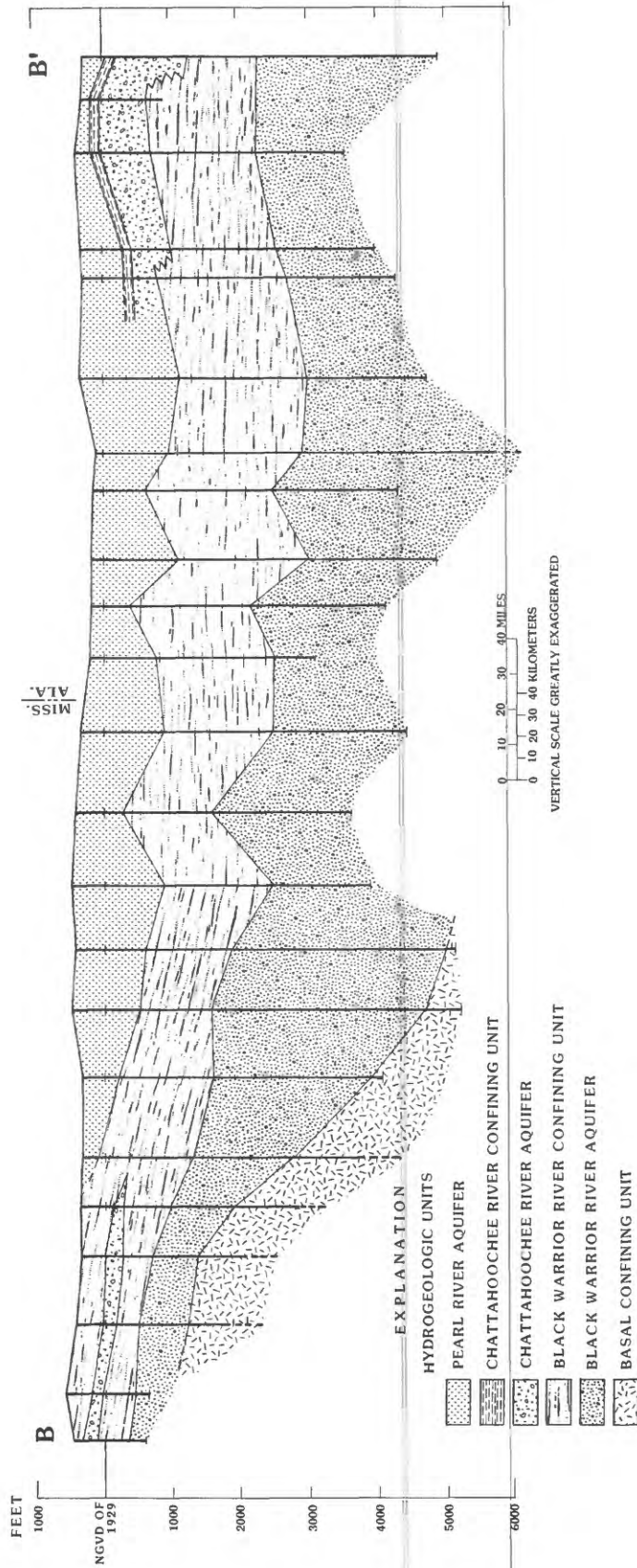


Figure 6.—Generalized hydrogeologic section B-B' in eastern Alabama and northern Mississippi (location of section shown in figure 1).

generally less permeable than the other regional aquifers, owing in part to the highly variable character and texture of its sediments. Because of its stratigraphic position, marine sand of the Ripley Formation in northern Mississippi is considered part of the Chattahoochee River aquifer, even though the Ripley is not connected to the main body of the aquifer (fig. 2). Northward and westward, the Ripley Formation becomes part of an extensive Upper Cretaceous aquifer that is being studied in detail by the Gulf Coast RASA investigation. Figure 7 shows the configuration of the top of the Chattahoochee River aquifer. Chalk of the Selma Group and clays of the Porters Creek Formation, the middle part of the Eutaw Formation, and the upper part of the Cape Fear Formation (fig. 2) comprise the Black Warrior River confining unit that underlies the aquifer everywhere.

Black Warrior River Aquifer

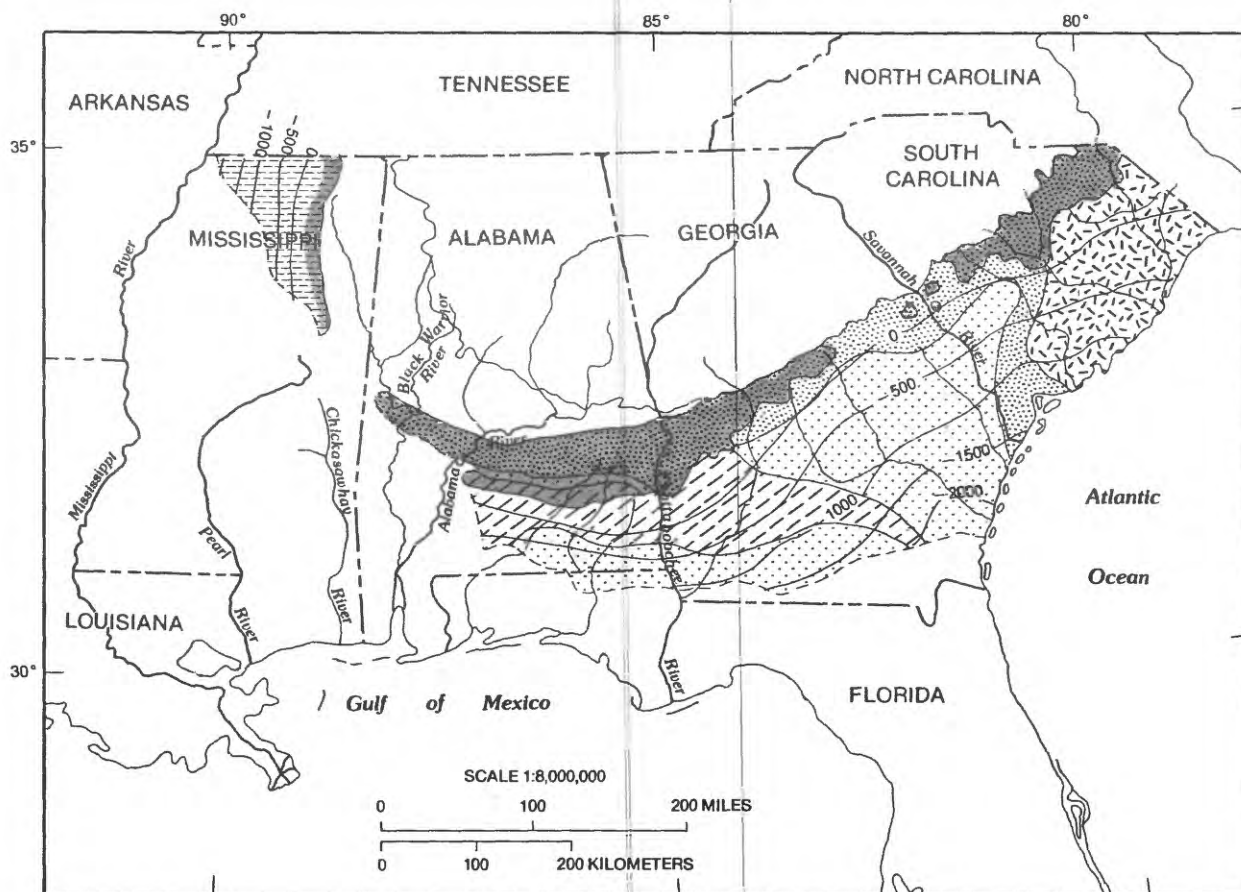
The Black Warrior River aquifer, named for the Black Warrior River in Alabama and formerly called the A4 aquifer, is the basal regional aquifer of the Southeastern Coastal Plain aquifer system. This aquifer is the most widespread regional aquifer delineated and extends in the subsurface from the Mississippi-Tennessee border eastward into North Carolina. However, the aquifer crops out only in Mississippi, Alabama, and a small part of western Georgia (fig. 3). The Black Warrior River aquifer consists mostly of Late Cretaceous-age sands and interbedded clays of fluvial and deltaic origin; marine sand and clay comprise part of the aquifer in southern Alabama and southwestern Georgia. Sands of Early Cretaceous age are locally included in the aquifer (fig. 2). Figure 8 shows the extent and configuration of the top of the Black Warrior River aquifer.

The basal confining unit of the Southeastern Coastal Plain aquifer system is made up of rocks mostly of early Paleozoic to early Mesozoic age that are generally of low permeability. This confining unit underlies the Black Warrior River aquifer everywhere. Although the rocks comprising the basal confining unit are locally porous and permeable, in most places they contain water with dissolved-solids concentrations greater than 10,000 milligrams per liter (mg/L). Accordingly, little or no movement of ground water is thought to occur in these rocks.

The approximate downdip extent of water having dissolved-solids concentrations less than 10,000 mg/L is shown by a line on figures 5 and 8. South of these lines, the ground-water flow system is considered to be very sluggish and the system was not simulated by digital computer modeling. However, the regional aquifers are mapped south of the lines where equivalent rocks are permeable.

RELATION OF REGIONAL AND SUBREGIONAL AQUIFERS

The Southeastern Coastal Plain RASA study area was subdivided into four subregions, each corresponding roughly to one of the four States (Mississippi, Alabama, Georgia, and South Carolina) that comprise the majority of the study area. Within each subregion, the aquifer system was studied in greater detail than was possible for a regional assessment of the system. As part of this closer scrutiny, the regionally-extensive hydrogeologic units were subdivided in the different subregions into a series of discrete aquifers and confining units. The subdivisions used in each State are shown on figure 9, along with the correlation of hydrogeologic units from State to State.



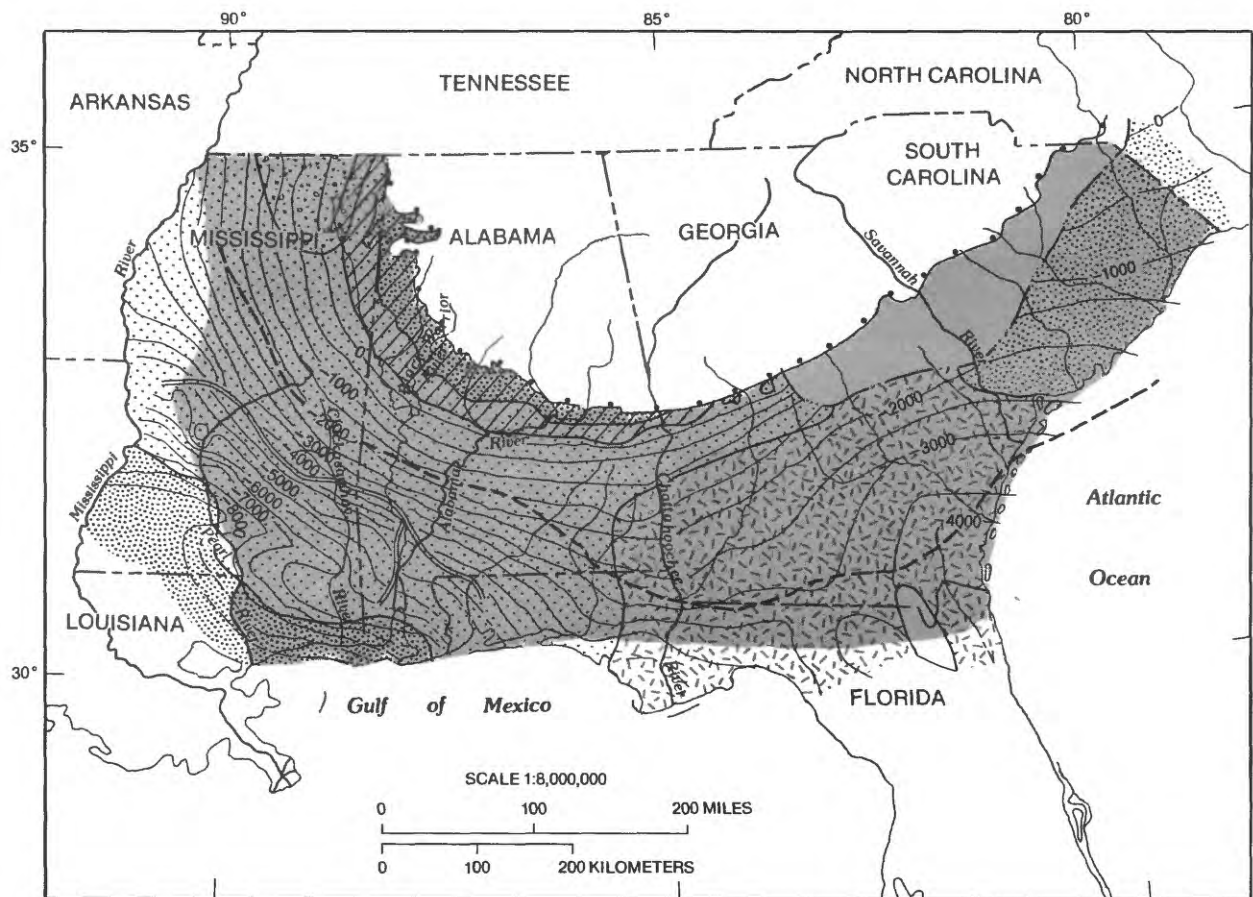
EXPLANATION

- APPROXIMATE DOWNDIP LIMIT OF REGIONAL AQUIFER UNIT
- 500 — STRUCTURE CONTOUR. SHOWS ALTITUDE OF TOP OF REGIONAL AQUIFER UNIT. CONTOUR INTERVAL, 500 FEET. DATUM IS SEA LEVEL
- AREA OF OUTCROP

TIME-STRATIGRAPHIC UNIT COMPRISING TOP OF REGIONAL AQUIFER UNIT

- ROCKS OF LATE PALEOCENE AGE (SABINIAN)
- ROCKS OF EARLY PALEOCENE AGE (MIDWAYAN)
- UNDIFFERENTIATED ROCKS OF LATE CRETACEOUS AGE
- ROCKS OF LATE CRETACEOUS AGE (NAVARROAN)
- ROCKS OF LATE CRETACEOUS AGE (TAYLORAN)

Figure 7.—Geology and configuration of the top of the Chattahoochee River aquifer.



EXPLANATION













	REGIONAL AQUIFER UNIT ABSENT		INNER MARGIN OF COASTAL PLAIN
	AREA OF OUTCROP		STRUCTURE CONTOUR - Shows altitude of top of A4 regional aquifer unit. Dashed where approximately located. Contour interval 500 feet. Datum is Sea Level
	COFFEE SAND		APPROXIMATE UPDIP LIMIT OF WATER CONTAINING 10,000 MILLIGRAMS PER LITER DISSOLVED SOLIDS
	EUTAW AND McSHAN FORMATIONS		LOCATION OF PICKENS-GILBERTOWN FAULT SYSTEM
	TUSCALOOSA GROUP/FORMATION		STUDY AREA
	ATKINSON FORMATION		
	CAPE FEAR FORMATION		

Figure 8.—Geology and configuration of the top of the Black Warrior River aquifer.

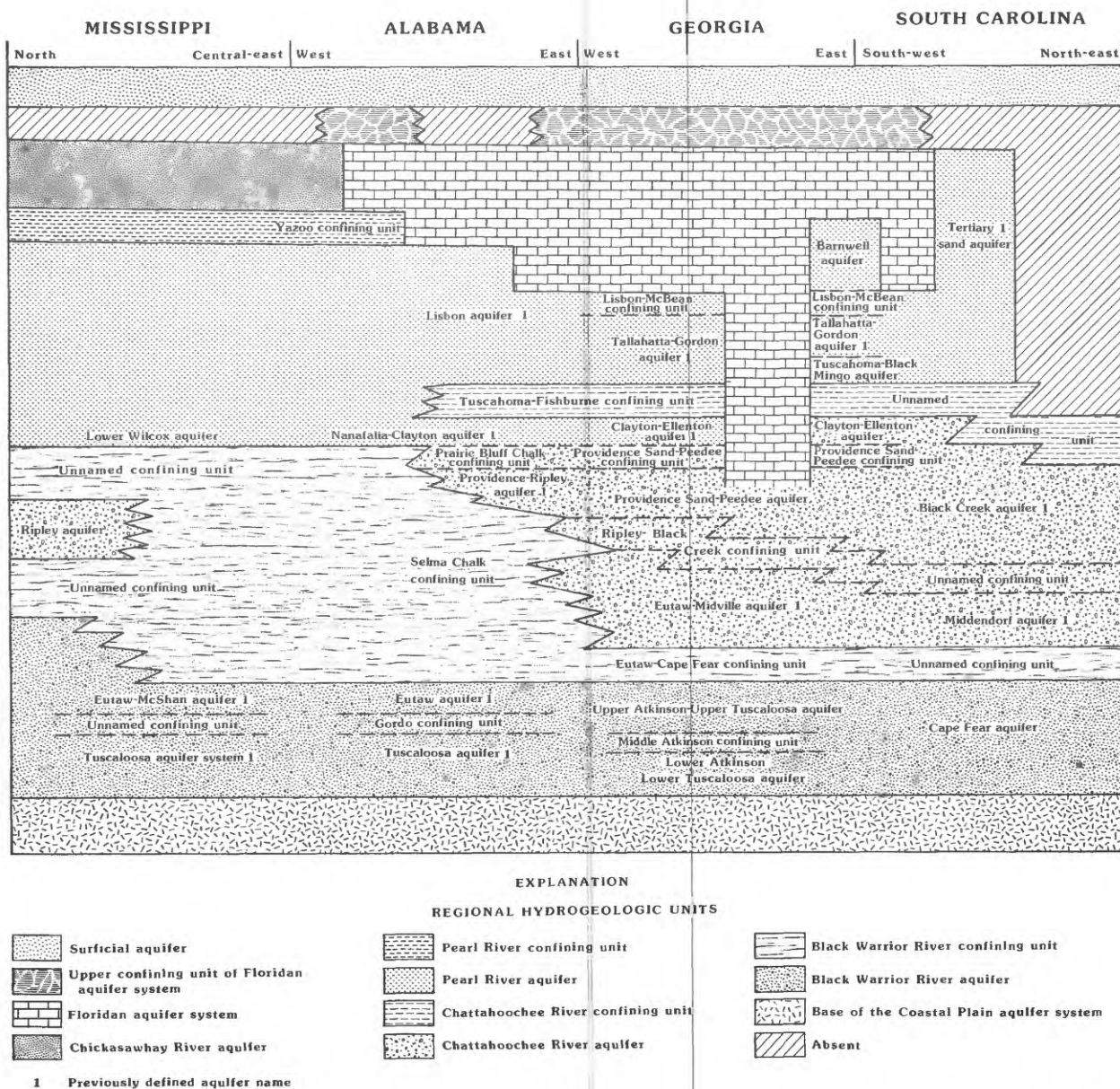


Figure 9.—Chart showing relation among regional and subregional hydrogeologic units in the Southeastern Coastal Plain aquifer system.

All of the regional hydrogeologic units are subdivided in one or more of the subregional areas. For example, a local aquifer exists in the Chattahoochee River confining unit in Georgia; the Black Warrior River aquifer is subdivided into two aquifers with one intervening confining unit in all States except South Carolina; three aquifers and two confining units comprise the Chattahoochee River aquifer in Georgia; and so on.

Even though the regional hydrogeologic units are subdivided at the subregional scale, their overall hydrologic characteristics are similar throughout the region and among the subregions. That is, the strata included in the Black Warrior River aquifer, for example, are more highly permeable everywhere than the rocks of the overlying and underlying confining units. As figure 9 shows, there is a confining unit that extends from Mississippi through Georgia in the Black Warrior River aquifer, but the majority of the rocks included in the regional aquifer and its subregional components constitute aquifers. For practically all of the regional aquifers, their tops and bases correspond to the tops and bases of some combination of subregional aquifers. Likewise, the tops and bases of regional confining units are identical to those of subregional confining units.

The names marked with a footnote on figure 9 represent nomenclature currently in use in the different States as applied to previously-defined aquifers. The unmarked aquifer names are new designations coined during the Southeastern Coastal Plain RASA study and applied in the individual subregions. Except for the Floridan aquifer system in Alabama, Georgia, and South Carolina (Miller, 1986), and the Gordon (Brooks and others, 1985), Clayton (Clarke and others, 1984), and Dublin (Clarke and others, 1985) aquifers of Georgia, aquifers in the subregions are named for the geologic formations, or combination of formations, that comprise them. Confining units in the subregions have not been assigned formal names except in Georgia and Alabama, where the confining units, like the aquifers, are mostly named for geologic formations.

RELATION OF CONTIGUOUS AQUIFER SYSTEMS

The seven major hydrogeologic units differentiated in the Southeastern Coastal Plain have stratigraphic and hydraulic counterparts in adjacent RASA study areas. The relation of the seven hydrogeologic units named in this report to aquifers and confining units named in the Gulf Coast, Northern Atlantic Coastal Plain, and Floridan RASA areas is shown on table 1. This chart is designed to show the relative positions of regional aquifers and confining units among the different regional aquifer systems, and does not imply that all of the hydrogeologic units in contiguous aquifer systems are physically or hydraulically connected. The predominately clastic character of the Southeastern Coastal Plain units is maintained in the Northern Atlantic Coastal Plain and Gulf Coast areas. In contrast, Floridan aquifer system equivalents of Southeastern Coastal Plain aquifers and confining units consist of carbonate rocks. The upper confining unit of the Floridan aquifer system, the overlying surficial aquifer, and in many places the Floridan's lower confining unit, consist of clastic rocks. At other places, however, this lower confining unit consists of anhydrite and gypsum.

There is excellent correlation of regional aquifers and confining units between the Southeastern Coastal Plain and Gulf Coast RASA areas. The boundaries of the Pearl River and Mobile River aquifers coincide with the boundaries

Table 1.—Relation among hydrogeologic units differentiated by the Southeastern Coastal Plain, Gulf Coast, Floridan, and Northern Atlantic Coastal Plain regional aquifer-system analysis studies

[Sources: a, Grubb, 1986, b, Miller, 1986, c, Henry Trapp, Jr., U.S. Geological Survey, written comm., d, confining units between aquifers not shown, e, stratigraphic position varies]

SOUTHEASTERN COASTAL PLAIN RASA		GULF COAST RASA ^a		FLORIDAN RASA ^b		NORTHERN ATLANTIC COASTAL PLAIN RASA ^c				
Chickasawhay River aquifer		Coastal Lowlands ^d aquifer system	Holocene—Upper Pleistocene aquifer	Surficial aquifer		Surficial aquifer				
			Lower Pleistocene—Upper Pliocene aquifer			Upper Chesapeake aquifer				
			Lower Pliocene—Upper Miocene aquifer	Upper confining unit ^e		Lower Chesapeake aquifer				
			Middle Miocene aquifer							
			Lower Miocene—Upper Oligocene aquifer							
Pearl River confining unit		Vicksburg—Jackson confining unit		Floridan aquifer system	Upper Floridan aquifer ^e		Castle Hayne—Piney Point aquifer			
Pearl River aquifer		Mississippi Embayment ^d aquifer system	Upper Claiborne aquifer						Middle confining unit ^e	
			Middle Claiborne aquifer							
			Lower Claiborne—Upper Wilcox aquifer		Lower Floridan aquifer ^e					
			Middle Wilcox aquifer							
		Lower Wilcox aquifer								
Chattahoochee River confining unit					Midway confining unit		Beaufort—Aquia aquifer			
Chattahoochee River aquifer		Upper Cretaceous aquifer		Brightseat—Upper Potomac aquifer (upper part) ^e						
		Not studied				Lower confining unit				
				Peedee—Severn aquifer						
Black Warrior River confining unit						Black Creek—Matawan aquifer				
Black Warrior River aquifer						Magothy aquifer				
						Brightseat—Upper Potomac aquifer (lower part) ^e				
						Middle Potomac aquifer				
						Lower Potomac aquifer				

of two major aquifer systems, each consisting of five aquifers, mapped by the Gulf Coast RASA study to the south and west of the Southeastern Coastal Plain. Unnamed confining units locally separate aquifers within the two major aquifer systems, but the major confining units in the Gulf Coast RASA area coincide with the Pearl River and Chattahoochee River confining units of this report (table 1). The Gulf Coast RASA investigation did not study rocks older than the equivalent of the upper part of the Chattahoochee River aquifer. Such rocks lie at great depths and contain saline water because they have been severely down-warped during the formation of the Gulf Coast geosyncline (Grubb, 1986). The names used for aquifers and confining units in the Gulf Coast RASA study area correspond to time- and rock-stratigraphic units, because there is good correlation between the hydrologic units and either time-stratigraphic or rock-stratigraphic units there.

Correlation between aquifers of the Northern Atlantic Coastal Plain aquifer system and regional aquifers of the Southeastern Coastal Plain aquifer system is not so precise (table 1). Unnamed local to subregional confining units separate the ten aquifers delineated in the Northern Atlantic Coastal Plain RASA study area. These aquifers are named for geologic formations, except for the surficial aquifer. A major geologic structure, the Cape Fear arch, separates the Southeastern Coastal Plain study area from North Carolina. This structure has been intermittently active since Early Cretaceous time (Brown and others, 1972) and is largely responsible for extensive facies change between North and South Carolina. It is this rapid facies change that accounts for the general lack of correspondence of aquifers between the two States.

There is not exact correlation between Southeastern Coastal Plain hydrogeologic units and those of the Floridan aquifer system (table 1). The two major aquifers of the Floridan are equivalent to parts of Southeastern Coastal Plain regional aquifers combined with regional confining units. This lack of correlation results from three factors. Firstly, and most importantly, most of the clastic rocks of the Southeastern Coastal Plain aquifer system pass by facies change into carbonate rocks of the Floridan. A given carbonate facies may or may not be as permeable as its clastic equivalent, because of the complex effects of diagenesis, dissolution, and so forth, on carbonate-rock permeability (Miller, 1986). Secondly, there is a dramatic contrast in the permeability of the Floridan aquifer system and that of the Southeastern Coastal Plain aquifer system, with the Floridan's permeability being an order to several orders of magnitude higher in most places. Accordingly, the clastic part of the rocks designated as the Floridan's lower confining unit can (and do, in places) constitute an aquifer in the Southeastern Coastal Plain aquifer system. Thirdly, because of the complexity of permeability development in carbonate rocks, neither aquifer nor confining unit boundaries tend to follow stratigraphic boundaries as closely as permeability follows stratigraphy in clastic rocks. Accordingly, the stratigraphic position of aquifers and confining units within, and bounding, the Floridan aquifer system varies considerably from place to place (Miller, 1986).

SUMMARY AND CONCLUSIONS

The clastic sediments that comprise the Southeastern Coastal Plain aquifer system can be divided into four regional aquifers separated by three regional confining units. Although each of these regional hydrogeologic units is made up of several aquifers and confining units of local to subregional scale, the

strata in an individual regional unit can be shown to be hydraulically connected in varying degrees and to function collectively as a single aquifer or confining unit. Stratigraphic and hydraulic boundaries of the regional hydrogeologic units coincide locally but diverge regionally because of facies change created by complex depositional conditions.

The four regional aquifer units are named for major rivers that transect aquifer outcrop areas, and along or near where the aquifers are exposed. From youngest to oldest, the regional aquifers are the Chickasawhay River, Pearl River, Chattahoochee River, and Black Warrior River aquifers. Regional confining units separating the regional aquifers are named the same as the aquifer they overlie. For example, the Pearl River confining unit lies between the Pearl River and Chickasawhay River regional aquifers.

The regional aquifers and confining units have been subdivided within four subregional study areas roughly corresponding to the States of South Carolina, Georgia, Alabama, and Mississippi, that together make up the Southeastern Coastal Plain RASA study area. Regional aquifer and confining unit separations correlate throughout all the States, whereas subregional breakdowns may persist over only one or two States, or part of a State.

The major hydrogeologic units named in this report correlate well with major permeability breakdowns in the Gulf Coast RASA study area to the west and southwest of the Southeastern Coastal Plain. Correlations of major hydrogeologic units between the Northern Atlantic Coastal Plain and Floridan aquifer systems that border the Southeastern Coastal Plain to the northeast and southeast, respectively, are not as good. This poor correlation is due to the influence of the Cape Fear arch, a major structural feature between South and North Carolina, and to facies change from the clastic rocks of the Southeastern Coastal Plain aquifer system into carbonate rocks of the Floridan aquifer system.

REFERENCES

- Aucott, W. R., Davis, M. E., and Speiran, G. K., 1987, Geohydrologic framework of the Coastal Plain aquifers of South Carolina: U.S. Geological Survey Water-Resources Investigations Report 85-4271, 7 sheets.
- Brooks, Rebekah, Clarke, J. S., and Faye, R. E., 1985, Hydrogeology of the Gordon aquifer system of east-central Georgia: Georgia Geologic Survey Information Circular 75, 41 p.
- Brown, P. M., Miller, J. A., and Swain, F. M., 1972, Structural and stratigraphic framework, and spatial distribution of permeability of the Atlantic Coastal Plain, North Carolina to New York: U.S. Geological Survey Professional Paper 796, 79 p.
- Clarke, J. S., Faye, R. E., and Brooks, Rebekah, 1984, Hydrogeology of the Clayton aquifer of southwest Georgia: Georgia Geologic Survey Hydrologic Atlas 13, 6 sheets.
- _____, 1985, Hydrogeology of the Dublin and Midville aquifer systems of east-central Georgia: Georgia Geologic Survey Information Circular 74, 62 p.
- Grubb, H. F., 1986, Gulf Coast Regional Aquifer-System Analysis--A Mississippi perspective: U.S. Geological Survey Water-Resources Investigations Report 86-4162, 22 p.
- Laney, R. L., and Davidson, C. B., 1986, Aquifer-nomenclature guidelines: U.S. Geological Survey Open-File Report 86-534, 46 p.
- Meisler, Harold, 1980, Plan of study for the Northern Atlantic Coastal Plain Regional Aquifer System Analysis: U.S. Geological Survey Water-Resources Investigations Report 80-16, 27 p.
- Miller, J. A., 1986, Hydrogeologic framework of the Floridan aquifer system in Florida and in parts of Georgia, Alabama, and South Carolina: U.S. Geological Survey Professional Paper 1403-B, 91 p.
- Renken, R. A., 1984, The hydrogeologic framework of the Southeastern Coastal Plain aquifer system of the United States: U.S. Geological Survey Water-Resources Investigations Report 84-4243, 26 p.
- Renken, R. A., Mahon, G. L., and Davis, M. E., in press, Hydrogeology of clastic Tertiary and Cretaceous regional aquifers in the Southeastern Coastal Plain aquifer system of the United States: U.S. Geological Survey Hydrologic Investigations Atlas HA-701.
- Sun, R. J., 1986, Regional Aquifer-System Analysis Program of the U.S. Geological Survey - Summary of Projects, 1978-1984: U.S. Geological Survey Circular 1002, 264 p.
- Wait, R. L., and Davis, M. E., 1986, Configuration and hydrology of the pre-Cretaceous rocks underlying the Southeastern Coastal Plain aquifer system: U.S. Geological Survey Water-Resources Investigations Report 86-4010, 1 sheet.