JACKSONVILLE

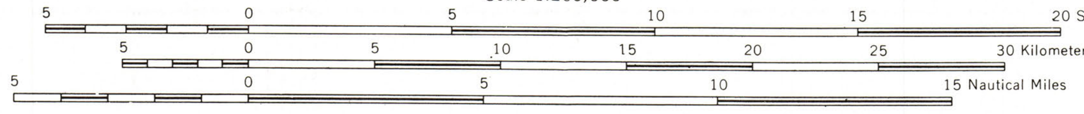
FLORIDA DEPARTMENT OF NATURAL RESOURCES
BUREAU OF GEOLOGY

Each area outlined on this map may consist of more than one kind of sub-surface sediment. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

EXPLANATION

- Med.—Fine Sand and Silt
- Clayey Sand
- Shelly Sand and Clay

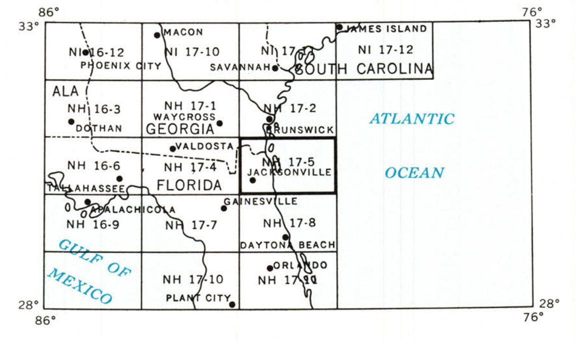
Scale 1:250,000



CONTOUR INTERVAL 50 FEET WITH SUPPLEMENTARY CONTOURS AT 25 FOOT INTERVALS

ENVIRONMENTAL GEOLOGY SERIES
JACKSONVILLE SHEET

LOCATION DIAGRAM



INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1974

TOWNSHIP OR RANGE LINE

LAND GRANT BOUNDARY

SECTIONIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

JACKSONVILLE, FLORIDA; GEORGIA

1957

LIMITED REVISION 1966

ENVIRONMENTAL GEOLOGY SERIES

JACKSONVILLE SHEET

By

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DIVISION OF RESOURCE MANAGEMENT
BUREAU OF GEOLOGY

TALLAHASSEE

1978

INTRODUCTION

Development of guidelines for wise management of Florida's natural resources depends upon a good working knowledge of the State's geology as it relates to man's environmental problems. Management decisions must be based upon adequate geologic data for such fields as waste disposal, water resources management, land management, highway construction, geologic hazards, soils mapping, mining and reclamation. Environmental geologic maps provide the basic data needed for the creation and execution of sound programs in the above-mentioned fields. It is hoped that this map will not only serve the purpose for which it is intended but will also serve as a base map for future presentation of geologically related data of a more specialized or local nature. The ultimate purpose of the State's environmental geology mapping program is to insure development of Florida's natural resources with the least possible environmental damage.

This map presents geologic data in such a way that it can be understood by persons not specially trained in the science of geology. Common rock types are shown as they occur from just below the soil zone to depths of expected use for most purposes. Mapping involved aerial photographic and topographic interpretation and field work (visiting quarries, borrow pits, canals, road cuts and other rock exposures) to provide the necessary data points. Use was also made of all published and unpublished data in the files of the Florida Bureau of Geology plus published reports of the U.S. Geological Survey and the U.S. Soil Conservation Service.

REGIONAL SETTING

The study area is located in northeastern peninsular Florida, north and east of the crest of the Ocala uplift or Ocala high. The major structural features of the area include the Southeast Georgia Embayment and the deeply buried Peninsular Arch. It is underlain by deposits of Eocene limestones covered by younger dolomitic limestones, sands, clays and shell beds. The forces responsible for the development of the surface features of the map area are marine and fluvial processes and dissolution of carbonate material.

Two major generalized physiographic divisions occur within the map area. As named by Puri and Vernon (1964), they are the Central Highlands and the Coastal Lowlands. The Central Highlands form approximately the western one-third to one-quarter of the map area while the remaining area belongs in the Coastal Lowlands division. The Central Highlands include such specific physiographic features as the Northern Highlands, Duval Upland and Trail Ridge. The Coastal Lowlands include features such as the Eastern Valley, St. Marys Meander Plain, Center Park Ridge, and the Atlantic Coastal Ridge and Lagoon. The St. Johns River Valley occupies a portion of the Eastern Valley in the map area.

Location and Extent--The map area is bounded on the east by the Atlantic Ocean and on the west by the longitudinal meridian of 82^{o} west. The northern boundary is the parallel of latitude 31^{o} north while the southern boundary is the parallel of 30^{o} north latitude. The counties shown on the map either in their entirety or partially are Clay, Duval, Nassau, and St. Johns. Major rivers of the area include the St. Johns and the St. Marys Rivers. The map area totals approximately 2,000 square miles.

Population and Development--The map area covers approximately 2,000 square miles with an average density of 306 people per square mile (based on 1970 estimates). However, much of the total population is concentrated near major cities of the region. The 1970 census reveals the following population by county: Clay - 32,059 with 47.8% urban; Duval - 528,865 with 98% urban; Nassau - 20,626 with 33.7% urban; and St. Johns - 30,727 with 40.2% urban. A comparison of the 1960 census and the 1970 census provides the growth rates for each county. The rates, from greatest increase to least increase, are as follows: Clay - 64.1%; Nassau - 20%; Duval - 16.1%; and St. Johns - 2.3%.

The largest cities found in the map area are Jacksonville which includes all of Duval County, with 528,865, and Fernandina Beach with a population of 6,955.

Industry and Transportation--The industry of the area ranges from tourism to extensive manufacturing and shipping interests. The St. Johns River provides a "substantial port for the use of sea-going vessels, thus making the city (Jacksonville) an important southeastern port" (State of Florida, 1955). This seaport provides the center for the area's economy.

Timber and commercial fishing are important industries of the area. Much of Nassau County is used as timber-producing lands. General agricultural interests are small with the majority of the crops consumed locally.

Tourism also plays an important role in the economy of some portions of the area. Beautiful beaches and excellent fishing and boating in the rivers and lakes attract many visitors.

Mining operations occur within the area, with heavy minerals being the most economically important commodity. The heavy minerals mined in the area include ilmenite, leucoxene, rutile, staurolite, zircon, kyanite, sillimanite, and tourmaline. There are two major ore bodies within the map area, Trail Ridge ore body and Boulougne ore body. Clayey sand and sand are mined in the area.

Numerous highways, both federal and state, traverse the area. These include the north-south routes I-95, U.S. 1, A1A, and U.S. 17; and east-west routes I-10, U.S. 90 and Fla. 100. Many other highways occur in the area.

Climate--The average annual temperature for the area is approximately 69^{o} F (20^{o} C), with August being the hottest month, having an average of 81^{o} F (27^{o} C) and January as the coldest month, having an average of 56^{o} F (13^{o} C). The average annual precipitation fluctuates from year to year but averages near 50 inches (127 cm) a year. The largest accumulation of snow ever recorded in Florida was recorded in this area. On January 10, 1800 at Point Peter near the mouth of the St. Marys River, five inches (12.7 cm) of snow was recorded by a survey team (Morris, 1977).

GEOLOGIC DISCUSSION

The surface and near-surface deposits of northeastern Florida range from unconsolidated medium to fine sands to coquina and poorly to moderately indurated sandy dolomites. Five lithologic units are recognized for the purpose of surface mapping and cross section construction in this area. They are: medium to fine sand and silt, clayey sand, shell sand and clay, limestone, and dolomite. The deposits exposed at the surface and shown in the cross sections range in age from Miocene (25 million years ago) to Recent.

Limestone and dolomite do not occur at the surface within the map area. In the subsurface the limestones occur within the Miocene Hawthorn Formation and in the younger sediments generally shown as shell sand and clay lithology. The limestones are generally sandy, occasionally phosphatic, particularly in the Hawthorn Formation, and often contain abundant mollusk fragments. They range from poorly consolidated to well indurated and highly recrystallized. The limestones tend to occur as lenses or thin units within other lithologies. This is easily seen on the accompanying cross sections. They are overlain in various areas by dolomite, clayey sand, shell sand and clay, or medium to fine sand lithologies.

The dolomites shown in the cross sections occur almost exclusively in the Miocene Hawthorn Formation. In general the dolomites are slightly sandy to very sandy with varying amounts of phosphorite and clay. The induration varies from very poorly indurated to well indurated. However, within the map area the dolomites are usually poor to medium induration. They are generally grayish-white in color and fine to very finely crystalline.

Clayey sands cover extensive areas of the western and central portions of the map area. They comprise much of the higher areas with elevations commonly reaching over 100 feet above sea level. Lithologically, the clayey sands contain silt, fine to coarse sands and gravels bound by a clay matrix. The clay may be kaolinite, montmorillonite, or other clay minerals, depending upon the depositional environment and post-depositional alterations. These clayey sands range in color from greens and grays to orange hues. These sediments have been variously called unnamed coarse clastics, Miocene coarse clastics, Citronelle Formation, and Fort Preston Formation.

Unconsolidated sands are widespread throughout the map area. They are included in two of the mappable lithologic units, medium to fine sand and silt, shell, sand and clay. The unconsolidated sands that are incorporated in the shell, sand and clay unit are basically surface sands representing soil horizons developed upon this unit and therefore, are not mapped as a primary lithology.

The medium to fine sand and silt lithology lacks shell material and clay. This unit is shown on the map as bodies of various size roughly paralleling the present-day coastline. The most prominent of these features is the Center Park Ridge. The formational equivalents of the sands have not been resolved. Puri and Vernon's (1964) geologic map shows them as marine and estuarine deposits of Pleistocene age. However, this is not accurate for all the sands of this type. As seen in the cross sections, this unit occurs in several formations including the Hawthorn Formation of Miocene age.

The shell, sand and clay lithologic unit represents beds ranging in age from Upper Miocene through Pleistocene age. These cover much of the central and eastern portions of the map area. The sediments of this unit represent ancient lagoonal and estuarine environments and contain a highly variable association of lithologies. The lithologies represented by this unit include coquina, shelly sands, shelly clays, silts, sands, clays, and shell beds. The lithologies vary with such frequency that mapping an individual component is not possible on a regional scale. This unit is generally found below 30 feet above mean sea level and forms much of the Atlantic Coastal Lowlands. Most of the beaches along the Atlantic Coast are designated as this lithology due to their incorporated shell content. Removal by solution of part or all the shell material has occurred in areas where the shell beds are continuously or periodically above the water table. In these areas the residual sand soil is mapped as part of the shell lithologic unit. This unit can be equated with several formations, depending upon the area. Portions of the shell unit may belong to formations such as the Anastasia Formation, Caloosahatchee Formation, Choctawatchee Formation, and others. The ages range from Upper Miocene through Pleistocene and Recent.

The shell lithology is overlain by the medium to fine sand and silt unit in areas such as the Center Park Ridge. Further to the west it is overlain by the clayey sands of the Northern Highlands. It is underlain predominantly by the dolomites of the Hawthorn Formation on which it rests unconformably.

Small peat deposits occur within the map area but are too small to be mappable.

PHYSIOGRAPHY

The State of Florida has been divided into three geomorphic zones by White (1970). These zones are the northern or proximal zone, the central or mid-peninsular zone, and the southern or distal zone. The Jacksonville quadrangle falls entirely within the northern or proximal zone of White. The northern zone is characterized by continuous high ground forming a broad upland which extends eastward to the Eastern Valley and westward continuously into the Western Highlands of Florida. For the most part, the northern zone is high enough to have its surface above the potentiometric surface of the Floridan Aquifer and is therefore characterized by many of the features of dry, highland, or dead zone karst, such as first generation, dry, steep walled sinks, abandoned spring heads, dry stream courses, intermittent lakes, and dry beds of former broad shallow lakes which are now prairies (White, 1970).

The Center Park Ridge, the Atlantic Coastal Lagoons and the Atlantic Barrier Chain form and parallel the present coastline of the map area. The barrier islands are composed of relict beach ridges and dunes with the land surfaces generally no higher than 20 feet above mean sea level. The barrier islands are composed of shelly fine to medium sands and are thus mapped as belonging to the shell lithologic unit.

Landward from the barrier islands are the coastal lagoons. However, in this area the lagoons are generally swampy and virtually sediment-filled. In fact, the intracoastal waterway must follow a canal for a portion of its route across the map area.

The Center Park Ridge lies on the landward side of the derelict lagoon and is composed primarily of medium to fine sands. The elevations are generally greater than 25 feet above mean sea level. The St. Johns River's coast-perpendicular segment forms the northern end of the ridge.

The Eastern Valley is a broad, flat valley lying west of the Atlantic Coastal Ridge and the Center Park Ridge. The St. Johns River follows it through its entire course except for that portion of the river that jogs westward to the St. Johns River Offset. The river returns to the Eastern Valley near Palatka and follows it to the coast.

The Duval Upland lies immediately west of the Eastern Valley and is adjacent to Trail Ridge and the Northern Highlands. It is represented by the clayey sand lithology along the western one-third to one-half of the map.

Trail Ridge lies west of the Duval Upland between the Northern Highlands and the upland. White (1970) calls Trail Ridge a relict littoral feature which crowns the eastern edge of the Northern Highlands. On this map Trail Ridge is found only on the extreme southwestern edge and is represented by a medium to fine sand lithology. Economically important heavy mineral deposits are found in the ridge sediments. Another possible relict beach feature lies on the northern end of the Duval Upland. This feature contains the Boulougne Ore Body. It consists of medium to fine sands with heavy minerals and can be seen on the map in northwestern Nassau County.

The St. Marys Meander Plain lies east of the northern end of the Duval Upland, covering most of Nassau County and the northern one-third of Duval County. According to White (1970) the dominant geomorphic factor contributing to the formation of this feature seems to have been fluvial, the "meandering of a plexus of muddy sediment laden streams." South of the plain the dominant factor has been marine forces. On the surface map, the St. Marys Meander Plain is represented by the sand, shell, and clay lithology. However, the shell content is minimal and appears to increase toward the present coastline. White (1970) believes "it may well be that it was this strong fluvial environment which ended the 200 mile-long north-flowing St. Johns River and finally turned it seaward caught in an agrading plexus of meandering sediment laden streams."

GROUND WATER

Ground water within the map area occurs under two conditions, artesian and non-artesian. Artesian conditions occur in areas when the water is confined below some impermeable layer known as a confining layer or aquiclude. In an artesian well, water will rise above the point at which it is first encountered. Non-artesian conditions exist where water in the zone of saturation is not confined and is therefore not under pressure. This may also be called the water table aquifer.

The shallow aquifer system within the map area is generally non-artesian. However, under certain conditions artesian systems occur. The shallow aquifer system is composed of the permeable sands and limestones of the Hawthorn Formation, and shell, sand, and limestone of the younger materials. These units are lithologically discontinuous, both laterally and vertically, providing difficult correlations over long distances. The most laterally extensive unit is either a limestone, shell bed, or sand layer between 50 and 150 feet below the surface throughout much of the area (Leve, 1966). This unit also occasionally acts as an artesian aquifer when confining conditions exist. Within this unit, a limestone section between 112 to 140 feet below the surface is the major water-bearing section of the shallow system.

The water withdrawn from the shallow aquifer is generally of good quality. However, water withdrawn from the near-surface sands may contain undesirable amounts of iron. Also, brackish water may contaminate these wells rather quickly if they are in close proximity to the coast. The best quality water in the shallow system comes from the sediments above the Hawthorn Formation and is generally suitable for domestic, irrigation and industrial purposes.

Recharge to the shallow aquifer occurs primarily from local rainfall. Another source of recharge is from upward leakage from the Eocene limestones of the Floridan Aquifer. Some recharge may also occur due to ground water flow from outside the area.

Discharge from the shallow aquifer system occurs through springs, seeps, evapotranspiration, well withdrawals, and downward percolation into deeper aquifers.

The Floridan Aquifer is the principal source of fresh water for the map area. Jacksonville is one of the largest cities in the world to obtain its entire water supply from deep artesian wells (Leve, 1966). The city wells range from 1,000 feet to 1,500 feet in depth and penetrate the Ocala Group, the Avon Park Limestone and the Lake City Limestone of Eocene age. These formations and a few lenses in the Hawthorn comprise the Floridan Aquifer.

The clay and silty layers within the Miocene Hawthorn Formation act as confining layers retarding the upward movement of water from the Floridan. This causes the aquifer to be under pressure, thus, an artesian system. The permeable zones within the Floridan are porous limestones and dolomites. These may be separated by dense hard dolomites and limestones that act as impermeable barriers, thus restricting the vertical flow of water.

Recharge is chiefly by downward movement of water from the surface and the shallow aquifer system in areas where the aquiclude is thin or absent. Recharge also occurs due to ground water entering the area in the subsurface.

The Floridan Aquifer provides enormous quantities of potable water to the cities in the map area. The quality of the water is good. It is generally harder and contains more dissolved solids than the shallow aquifer system. Locally, the water from the Floridan Aquifer may be nonpotable.

The artesian pressure of the Floridan Aquifer system has declined irregularly but continually in wells measured periodically since 1934 (Leve, 1966). The general decline in pressure is a result of the great increase in withdrawals of water and long-term decline in rainfall over the map area. The amount of decline varies within the different zones of the aquifer.

ECONOMIC GEOLOGY

The economically important deposits found in the map area include heavy minerals, sand and clayey sand. Heavy minerals are the most important mineral commodity found in the map area. They are currently being mined from a relict beach ridge plain deposit (Pirkle, et al, 1974) in Nassau County. The principal ore minerals from the Boulougne area are ilmenite, leucoxene, zircon and monazite. Other heavy minerals present include rutile, kyanite, sillimanite, staurolite, zircon, and tourmaline.

Clayey sand and sand are mined locally from small borrow pits. They are used for local fill material and some road base.

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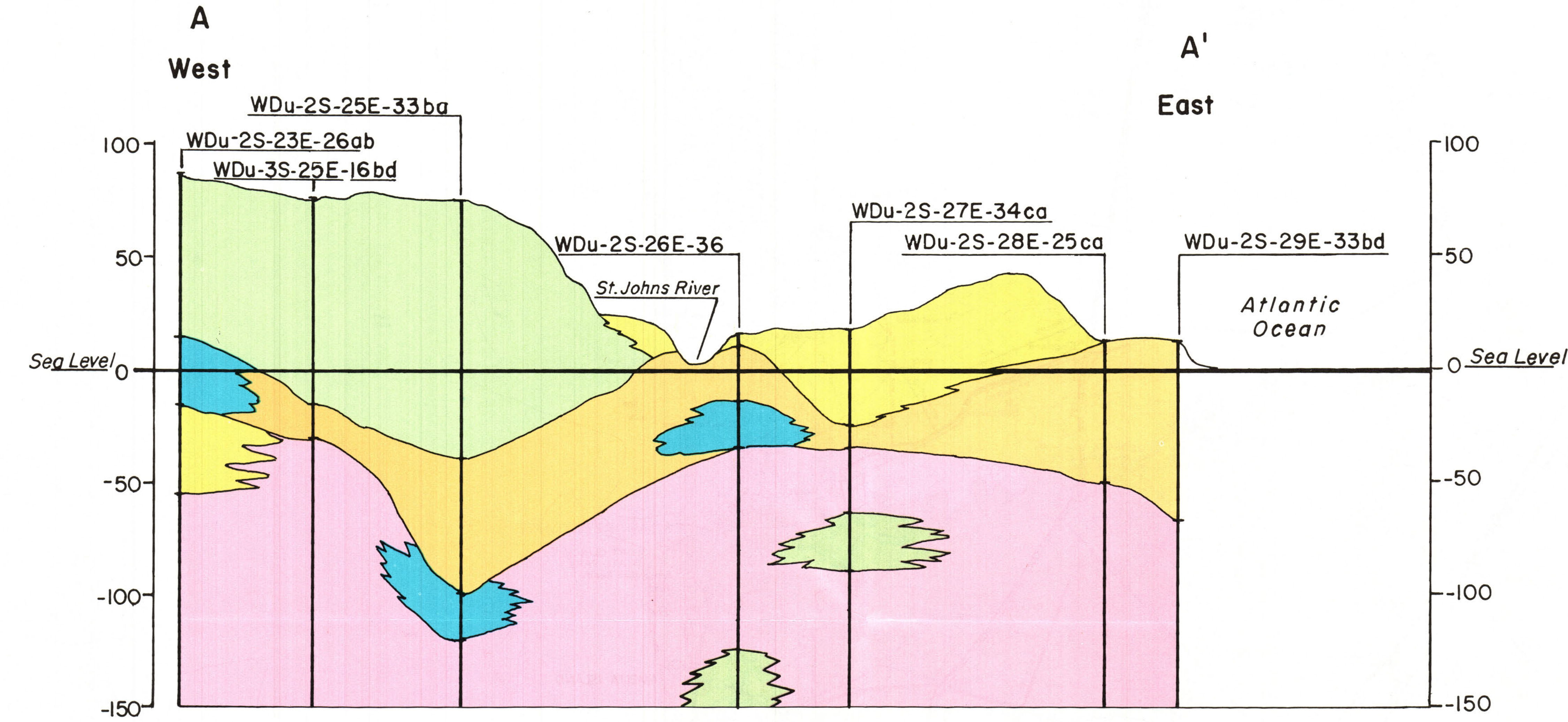
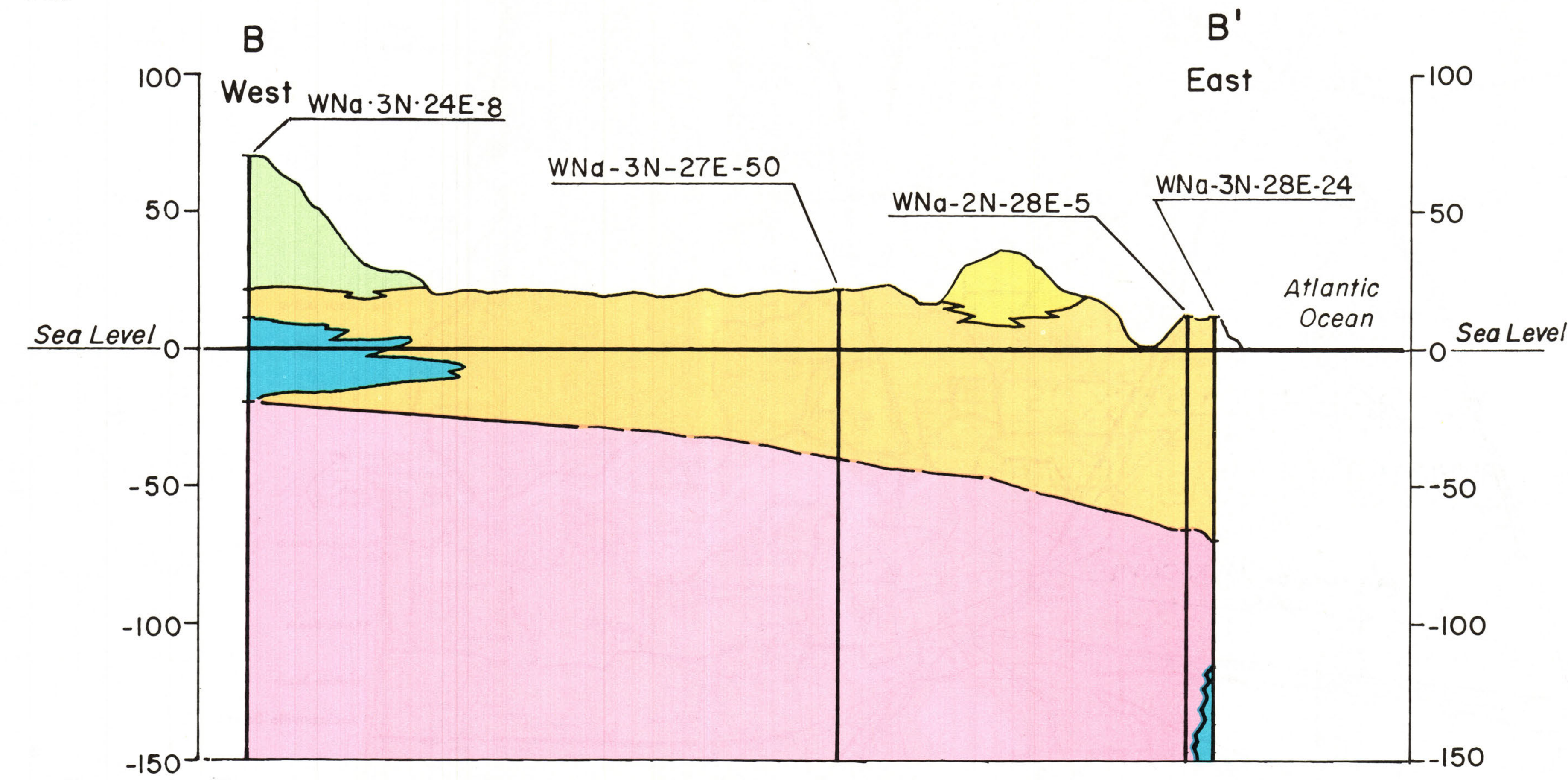
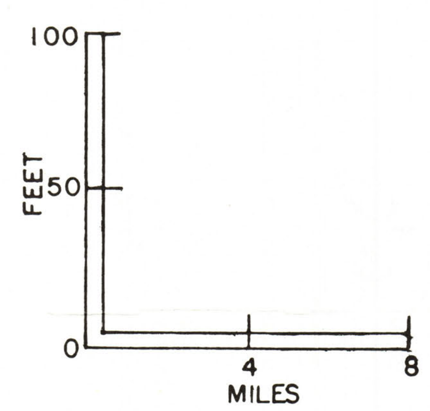
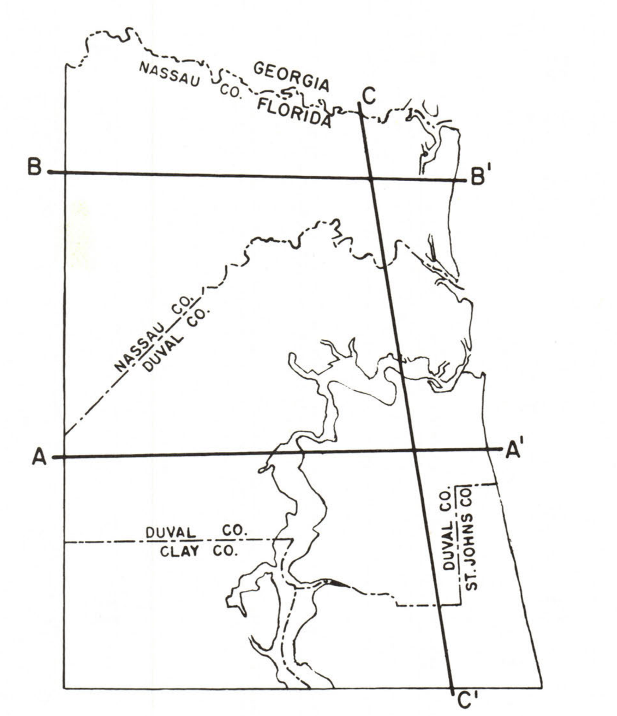




EXPLANATION

- Med. Fine Sand and Silt
- Clayey Sand
- Shelley Sand and Clay
- Limestone
- Dolomite





LOCATIONS of CROSS SECTIONS