DAYTONA BEACH

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
- Peat

DEPARTMENT OF NATURAL REOURCES
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This public document was promulgated at a total cost of $1,908.00 or a per copy cost of $.76 for the purpose of disseminating geologic data.

Scale 1:250,000

5 0 5 10 15 20 Statute Miles

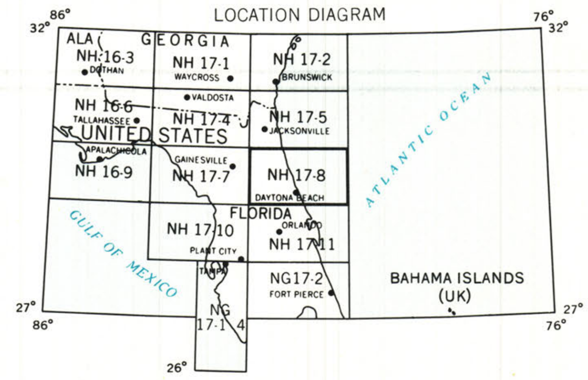
5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 50 FEET
WITH SUPPLEMENTARY CONTOURS AT 25 FOOT INTERVALS

ENVIRONMENTAL GEOLOGY SERIES
DAYTONA BEACH SHEET

LOCATION DIAGRAM



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

TOWNSHIP OR RANGE LINE
LAND GRANT BOUNDARY

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1974

GRID ZONE DESIGNATION: 17R

100,000 M. SQUARE IDENTIFICATION

MD	ND
MC	NC

IGNORE the SMALLER figures of any grid number; these are for finding the full coordinates. Use ONLY the LARGER figure of the grid number; example: 3210000

TO GIVE A STANDARD REFERENCE ON THIS SHEET TO NEAREST 1000 METERS

SAMPLE POINT: HUNTINGTON

1. Read letters identifying 100,000 meter square in which the point lies: MC
2. Locate first VERTICAL grid line to LEFT of point and read LARGE figure labeling the line either in the top or bottom margin, or on the line itself: 4
   Estimate tenths from grid line to point: 6
3. Locate first HORIZONTAL grid line BELOW point and read LARGE figure labeling the line either in the left or right margin, or on the line itself: 5
   Estimate tenths from grid line to point: 7

SAMPLE REFERENCE: MC4657

If reporting beyond 18° in any direction, prefix Grid Zone Designation, as: 17RMC4657

DAYTONA BEACH, FLORIDA
1954
REVISED 1972

STOCK NO V501XNH178***03

ENVIRONMENTAL GEOLOGY SERIES

DAYTONA BEACH SHEET

By

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DIVISION OF RESOURCE MANAGEMENT
BUREAU OF GEOLOGY

Tallahassee
1979

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 east central peninsular Florida, east of the crest of the Ocala uplift or Ocala high. The only prominent subsurface structural feature located here is the northern extension of the Sanford High in western Volusia County (Vernon, 1951). The area is underlain by extensive deposits of Eocene limestone covered by younger dolomites, limestones, sands, clays and shell beds. Dissolution of limestone and dolomite and marine processes are the predominant forces responsible for the development of the surface features found in the map area.

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-half of the map area while the remaining one-half is the Coastal Lowlands. The highland area includes such physiographic features as the Marion and Duval Uplands, the Mount Dora, Crescent City and Trail Ridges and the Central Valley. The Coastal Lowlands are comprised of features such as the Eastern Valley, the St. Johns River Offset, the Atlantic Coastal Ridge, the Palatka Hill and the various lagoons and chains of barrier islands.

LOCATION AND EXTENT

The map area is bounded on the east by the Atlantic Ocean and on the west by meridian of longitude 82° west. The northern boundary is the parallel of latitude 30° north while the southern boundary is the parallel of latitude 29° north. The counties shown on the map, either in their entirety or partially, are Clay, Flagler, Lake, Marion, Putnam, St. Johns and Volusia. Major rivers of the area include the St. Johns, the Oklawaha, and Matanzas. Major lakes include Lake George and Crescent Lake. The land area included in the map totals approximately 3,900 square miles.

POPULATION AND DEVELOPMENT

The map area is approximately 3,900 square miles and has an average population density of 60 people per square mile (based on 1970 population figures). However, much of the total population is concentrated in or around the major cities of the region. The 1970 census reveals the following population by county: Clay - 32,059 with 47.8% urban, Flagler - 4,454 with no urban; Lake - 69,305 with 43.4% urban; Marion - 69,030 with 40.4% urban; Putnam - 36,290 with 25.7% urban; St. Johns - 30,727 with 40.2% urban; Volusia - 169,487 with 70.4% urban. A comparison of the 1960 census and the 1970 census reveals the growth rates for each county. The rates, from greatest increase to least increase, are as follows: Clay - 64.1%; Volusia - 35.2%; Marion - 33.7%; Lake - 20.8%; Putnam - 12.7%; St. Johns - 2.3%; and Flagler - 2.5%.

The largest cities of the map area are: Daytona Beach - 45,327; Deland - 11,641; Palatka - 9,310; New Smyrna - 10,580; and St. Augustine - 12,352.

INDUSTRY AND TRANSPORTATION

The industry of the area is quite varied, ranging from tourism to extensive agricultural interests. Tourism is a very important factor influencing the area's economy. Tourist attractions include St. Augustine, Marineland, and Daytona Beach. The beaches, lakes and rivers of the region attract numerous visitors each year. Agriculture is another very important economic factor. Agricultural interests include extensive timber lands, vegetable farming, citrus and other fruits such as pecans and peaches. Truck farm crops grown in this region include tomatoes, peppers, beans, potatoes, peas, cabbage and watermelons.

Mining operations also occur in this region. Coquina, shell material, sand, clayey sand, and heavy minerals are actively mined.

Numerous major highways traverse the area. These include the north-south coastal routes I-95, US-1, and the famous A1A; the north-south central routes US-17 and FL-19; and the cross-state routes of I-4, US-92, FL-40, FL-20, and FL-100. Numerous other state and county roads traverse the area.

Commercial airlines provide regular service to the larger cities such as Daytona Beach and there are numerous small airports serving the smaller cities and rural areas. Most of the cities, towns and rural communities are also served by bus lines and railroads.

CLIMATE

The average annual temperature for the area is approximately 72° F (22° C) with August being the hottest month, having an average of 81° F (27° C) and January as the coldest month having an average of 58° F (14°C). The average annual precipitation fluctuates from year to year but averages between 48 inches (121.9 cm) and 53 inches (134.6 cm).

GEOLOGIC DISCUSSION

The surface and near-surface deposits of east central Florida range from unconsolidated sands to well-indurated carbonate rocks. Seven lithologic units are recognized for the purposes of surface mapping and cross section construction. They are: medium to fine sand and silt; clayey sand; sandy clay and clay; shell, sand and clay; peat; limestone and dolomite. The deposits represented on the map and cross sections range in age from Eocene (58 million years ago) to the Recent. The oldest deposit that crops out within the map boundaries is the Hawthorn Formation of Miocene age (25 million to 11 million years ago).

Limestone does not crop out within the boundaries of this map. Limestone units represented on the cross sections occur as shallow as 25 feet below mean sea level. The cross section extends only to 150 feet below mean sea level. These limestones belong predominantly to the Upper Eocene Ocala Group; however, the Upper Middle Eocene Avon Park Limestone is present in a few areas. The limestones are very fine to coarse grained, clean to chalky, porous, cream colored containing abundant mollusks and foraminifers. Hardness varies as does the amount of recrystallization. The buried surface of the limestone is generally solution pitted and eroded with chert occurring sporadically due to silicification of the limestones. The occurrence of the chert is much too sporadic to be represented on a regional scale map.

The undulating, eroded limestone surface generally dips gently eastward from the western map boundary beneath an increasing thickness of younger materials. This relationship is graphically illustrated by the cross sections A-A' and B-B'. The dolomites and clayey sands that immediately overlie the Tertiary limestones have been referred to as Miocene age. These lithologies comprise the Hawthorn Formation. The highly variable, diverse lithologic character of the Hawthorn includes interbedded and interfingering sands, clayey sands, sandy clays, phosphatic sediments, dolomites and limestones. The carbonate portion generally occurs in the lower Hawthorn and contains variable amounts of sand, clay, and phosphorite. The Hawthorn sediments underlie the entire map area except for most of northern Volusia County where the Hawthorn had been totally removed by erosion prior to deposition of the younger units.

The dolomites shown on the cross sections A-A' and B-B' occur entirely within the Hawthorn Formation. They are buff colored, crystalline, soft to hard, containing varying amounts of sand, clay and/or phosphorite. Dolomite also occurs in the Eocene limestones but at a depth greater than is shown on the cross sections.

Clayey sands cover much of the western one-third to one-half of the map area. They make up much of the Central Highlands including the Mount Dora Ridge, Marion Uplands, Deland Ridge, Palatka Hill, and the Northern Highlands. Lithologically, the clayey sands contain silt, fine to coarse sand, and a small amount of gravel bound by a clay matrix. The clay may be one of several clay minerals depending upon the depositional environment and post-depositional alterations. Coloration of the clayey sands varies from greenish and gray to orange hues. The clayey sands form steep sided road cuts and borrow pits scattered throughout the area. The portions of the clayey sands not belonging to the Hawthorn Formation have been variously called unnamed coarse clastics, Miocene coarse clastics, Citronelle Formation, and "Fort Preston" Formation. At the present time there is still uncertainty as to the formational identity of the unit or units.

Unconsilidated sands are widespread throughout the map area and represent two basic depositional environments. The first and most widespread occurrence of sand is the result of marine deposition. This includes large areas of Volusia County and part of the Atlantic Coastal Lowlands. Associated with these deposits are sands deposited as dunes. The second environment is one of fluvial deposition. Deposits of this type commonly occur in the Central Valley northward from Lake Apopka and in areas bordering other clayey sand highlands such as the Northern Highlands. Basically, the sands are eroded from the higher areas and redeposited in valleys and lowlands. The two types of deposits overlap and interfinger.

The unconsolidated sands of this area are mapped as medium to fine sands with associated silts. They lack appreciable clay and any shell material. The surface expression of this lithologic type is generally nearly flat to undulating except in areas of dune formation where relief may be more pronounced. The formational affinities of the sands has not been accurately defined. Puri and Vernon's (1964) geologic map shows them as marine and estuarine terrace deposits. As seen in the cross sections, the subsurface expression of this lithology occurs as facies in several formations including the upper portion of the Miocene-Hawthorn Formation.

Sand, shell and clay lithology (shell beds) of Miocene through Pleistocene in age occurs over much of the map area. It represents ancient lagoonal and estuarine environments and contains a highly variable association of lithologies. The lithologies represented in this unit include shelly sands and clays, sands and clays, and coquina. The lithologies vary with such frequency that mapping an individual component is not feasible on a regional scale. This unit is generally found lower than 30 feet above mean sea level and forms much of the Atlantic Coastal Lowlands. The Atlantic coastal beaches have been designated as this unit due to their incorporated shell content. Removal by solution of shell material has occurred in areas where the shell beds are continuously or periodically above the water table. In such areas the residual sand in considered as part of the sand-shell-clay unit. The incorporated shell content of this unit is less than the shell beds found along the same trend south of the map area. Also, the clay content appears to be higher here than to the south. The material from this lithologic unit is mined in Volusia, Flagler and St. Johns counties for road material.

The sand-shell-clay lithic unit may be equated with several formations, depending upon the location. Along the coast it belongs in part to the Anastasia Formation and partially to the deposits of Holocene age (Recent). Further inland it may belong to the Caloosahatchee Formation or older formations based upon its faunal components.

The shell lithology is overlain by medium to fine sand and silt in the Atlantic Coastal Ridge, in portions of the Atlantic Coastal Lowlands (Eastern Valley) and in areas adjoining the clayey sand higher areas. The older (Miocene age) segments of this unit may be overlain by clayey sand as in the case of the Deland Ridge. In areas where the shell content or carbonate content is sufficiently high, cabbage palms flourish.

Several small, discontinuous peat deposits occur in the map area. However, with the exception of the Florahome Valley peat deposit, they are not mappable units due to their size. The Florahome deposit is stated to be less than 5 feet thick on the average (Davis, 1946).

This lithologic unit consists of black to dark brown, fibrous peat with varying amounts of sand, silt and clay.

PHYSIOGRAPHY

The Florida peninsula 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 map area of the Daytona Beach quadrangle falls into two of these divisions, the northern or proximal zone and the central or mid-peninsular zone. The proximal zone occupies the northern one-third of the map with the dividing line placed approximately through Palatka. The mid-peninsular zone thus occupies the remaining two-thirds of the map area. The northern zone may be characterized as having continuous high ground forming a broad upland which extends eastward to the Eastern Valley, and westward continuously into the Western Highlands of Florida (White, 1970). The Central Zone is characterized by discontinuous highlands in the form of sub-parallel ridges separated by broad valleys all roughly paralleling the present coastline (White, 1970).

The Atlantic Coastal Ridge, Atlantic Coastal lagoons, and the Atlantic Barrier Chain form the present coastline of the map area. The lagoons die out northward in Volusia County through Flagler County and are absent in a part of St. Johns County. The barrier islands are composed of relict beach ridges and dunes and essentially shield the lagoons from the effects of the sea. The land surface is undulating, with the highest crests generally no higher than 30 feet above mean sea level. The barrier islands are composed primarily of shelly, fine to medium sands and are thus mapped as belonging to the shell lithologic unit.

The Atlantic Coastal Ridge lies on the west side of the coastal lagoons and reaches elevations of 50 feet above sea level. White (1970) believes it is almost wholly a product of Pamlico (?) time when sea level was approximately 30 feet higher than at the present. The Atlantic Coastal Ridge is higher and wider than the common relict progradational beach ridges of the Eastern Valley. White (1970) attributes this to the lack of shell material in the Coastal Ridge since it was deposited at the height of a transgression. The other relict beach ridges were deposited with abundant shell debris that has subsequently been dissolved, thus reducing the height of these ridges. The Atlantic Coastal Ridge is discontinuous and is shown on the map as a body of medium to fine sand paralleling the coast east of the Eastern Valley.

The Eastern Valley is a broad flat valley lying immediately west of the coastal ridge. Many geologists have assumed that the valley represents a broad Pamlico lagoon. White (1970), however, believes that it represents a beach ridge plain lowered due to removal of the carbonate portion of the deposits by dissolution. The St. Johns River begins in the southern Eastern Valley and follows it northward until the river suddenly jogs nearly 90 degrees west to the St. johns River Offset.

The St. Johns River Offset begins south of the map boundary on the Orlando quadrangle and continues north of Palatka where it rejoins the Eastern Valley. It receives its name from the fact that the St. Johns River changes from the valley of its origin to an older, more westerly one, then back to its original course. The reasons for this change are not clearly understood. However, Pirkle (1969) suggested that both solution and structural attributes of the underlying rocks were the cause.

East of the St. Johns River Offset and bounding it are the Deland and Crescent City Ridges. Both are possible ancient beach features, however, lithologically, the western side of the Deland Ridge is similar to the Mount Dora Ridge. This may be a remnant of a once ubiquitous highland of clayey sand.

West of the St. Johns River Offset are the Marion Uplands and the Mount Dora Ridge. The Marion Upland is represented in part by the medium to fine sand and silt lithology and in part by the clayey sand lithology and is to the west of the Marion Uplands. This may represent an erosional remnant of the "Hawthorn Delta" discussed by Vernon (White, 1958). The ridge surface varies in elevation generally between 50 and 100 feet. This surface represents a mature karst surface as evidenced by the wide range of elevations and numerous lakes. White (1970) postulated that many of these lakes formed as a result of solution activity controlled by relict beach ridges, thus giving the lakes and their intervening high ground a parallel to sub-parallel alignment.

West of the Mount Dora Ridge is the Central Valley. White (1970) refers to the Central Valley as an elongate lowland parallel to both the ridges which bound it, as well as the north-south orientation of the peninsula. He further states that it represents an unprotected soluble area reduced to its present lower elevation. The Central Valley is occupied through most of its length by the Oklawaha River and its tributaries. The lithologies found in the Valley are medium to fine sand and silt and clayey sand erosional remnants.

The Northern Highlands, which extend across the northern portion of Florida into Georgia and Alabama, are represented on this map by the clayey sand in the northwestern portion of the area. Trail Ridge, which is believed to be a relict littoral feature, can be seen on the map in the extreme northwest represented by a medium to fine sand and silt lithology. Florahome Valley, also part of the Northern Highlands, is a basin-like valley some 10 miles long by 4 miles wide. According to White (1970) it is quite likely a large solution valley. A large peat deposit is found in the valley which is along the Clay-Putnam county boundary.

As has been discussed, the map area is quite diverse lithologically and geomorphically. The land surface has been shaped predominantly by marine processes and later modified by solution removal of portions of the underlying carbonate material. Some of the most beautiful terrain found in the state may be seen in this area.

GROUND WATER

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

The non-artesian or clastic aquifer is composed primarily of sands, clayey sands, and shell beds. These sediments belong to several different formations ranging in age from Miocene to the Recent. The thickness and lithologies of this aquifer are quite variable, both laterally and vertically. The non-artesian aquifer is important in areas where the water quality of the underlying artesian aquifer is poor. This is particularly important in the coastal regions and the area surrounding the St. Johns River. Until techniques of well screen installation and well development in this aquifer become commonly used, the non-artesian aquifer's main function will be to act as a storage reservoir for recharge to the Floridan or artesian aquifer (Wyrick, 1960). At present the main uses for this water are to water lawns, livestock, and irrigation. The water quality varies depending on the lithology and other factors. However, factors such as hydrogen sulfied and iron content are easily overlooked in areas where the artesian aquifer is too mineralized to be potable.

Secondary artesian aquifers are locally present. These are sandwiched between the non-artesian and Floridan aquifers. They are composed chiefly of limestones and sand layers in the Hawthorn Formation and in a few areas, shell beds.

The artesian or Floridan Aquifer is the major water-producing unit in the state. It underlies all the state. Formationally, it consists of the Eocene limestones of the Lake City Limestone, the Avon Park Limestone, the Ocala Group, Suwannee Limestone and portions of the Hawthorn Formation that are in hydraulic contact with the underlying limestone. This unit is one of the most productive aquifers in the world. In some parts of the state, it may reach 1,000 feet in thickness. The lithologic and hydrologic character of the Floridan Aquifer is not uniform, either horizontally or vertically (Lichtler, 1972). In general, it consists of alternating layers of limestone and dolomite or dolomitic limestones of varying hardness and permeability.

There are numerous solution cavities and solution channels within the Floridan Aquifer. Some of the channels and cavities are quite large. They are interconnected to a large degree and large quantities of water flow through them, as has been proven by current meter tests in many wells.

The major portion of the ground water recharge comes from rainfall within the region. However, some water enters by underground flow from outside the region.

Discharge of ground water occurs as spring seepage into rivers, streams, and lakes, outflow to other areas, outflow to the Atlantic Ocean and from pumping of wells.

The quality of ground water in the Floridan Aquifer varies greatly. Geology is the major factor influencing the water quality but poor quality water may be introduced through drainage wells. Salt water is naturally found in some areas such as along the St. Johns River and along the coast. Here, it has not been flushed out of the aquifer by fresh water since the last encroachment of the sea. Heavy pumping in some areas has caused salt water to reenter previously fresh water portions of the aquifer thus contaminating water supplies.

Yields from wells in the Floridan Aquifer have been measured up to several thousand gallons per minute; however, lower figures are more common. The Floridan does produce more potable water than either the non-artesian or the secondary artesian aquifers. In many areas the Floridan will produce potable water from the upper 1,000 feet of limestone. Most domestic and commercial supplies are drawn from this aquifer.

ECONOMIC GEOLOGY

The economically important deposits of the map area include heavy minerals, shell material, lithified coquina, sand, clayey sand and peat.

Heavy minerals are the most economically important mineral mined in the map area. The Green Cove Springs ore body located in Clay and Putnam counties is actively mined. The heavy minerals found here include ilmenite, leucoxene, rutile, kyonite, sillimonite, staurolite, zircon and tourmaline (Pirkle, et al, 1974).

Shell and coquina are mined locally and are used for road base and fill material. Clay with shell is also being used to produce a light weight aggregate. Most of the shell and coquina are mined only on a local scale and are not an important economic deposit.

Sand is found throughout the district as both thin veneers and thicker deposits. Larger sand deposits occur on the ridge areas. Other small deposits are mined locally to be used for fill material and asphalt production.

Clayey sand is also mined in the map area and is basically used in construction and road base as fill material. The suitability of the material for fill varies with its clay content.

Peat is locally produced from deposits ranging up to ten feet in thickness.

Oil and gas have not been discovered in commercial qunatities within the map area.

Clays suitable for brick production have also been found within this area.

OUTCROPS ON INTEREST

1. Volusia County, Township 16 South, Range 33 East, Section 37. An excellent outcrop of shell material in county-owned borrow pit. On Hwy. 5A, Canal Rd. Daytona Beach Quadrangle.
2. Volusia County, Township 12 South, Range 31 East, Section 37. An excellent outcrop of coquina in old borrow pit east of Old Kings Road approximately 0.1 mile.
3. Flagler County, Township 12 South, Range 31 East, Section 39. An excellent outcrop of coquina in active borrow pit. Either side of Hwy. 100, east of I-95, approximately 0.5 mile.

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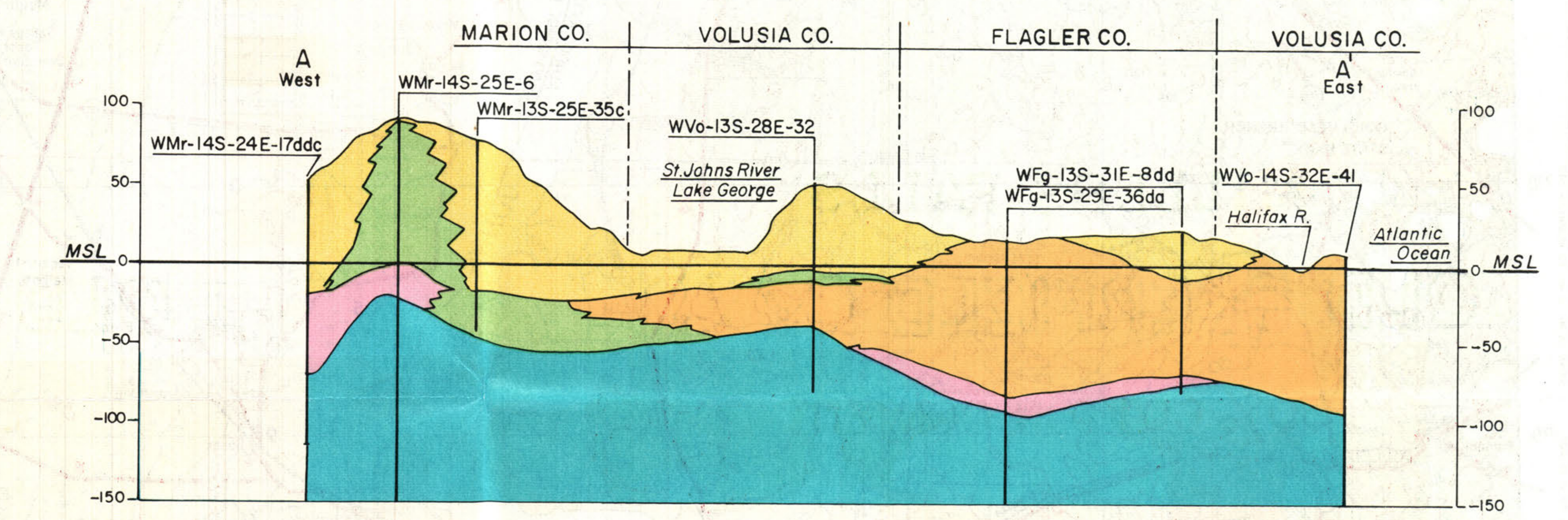

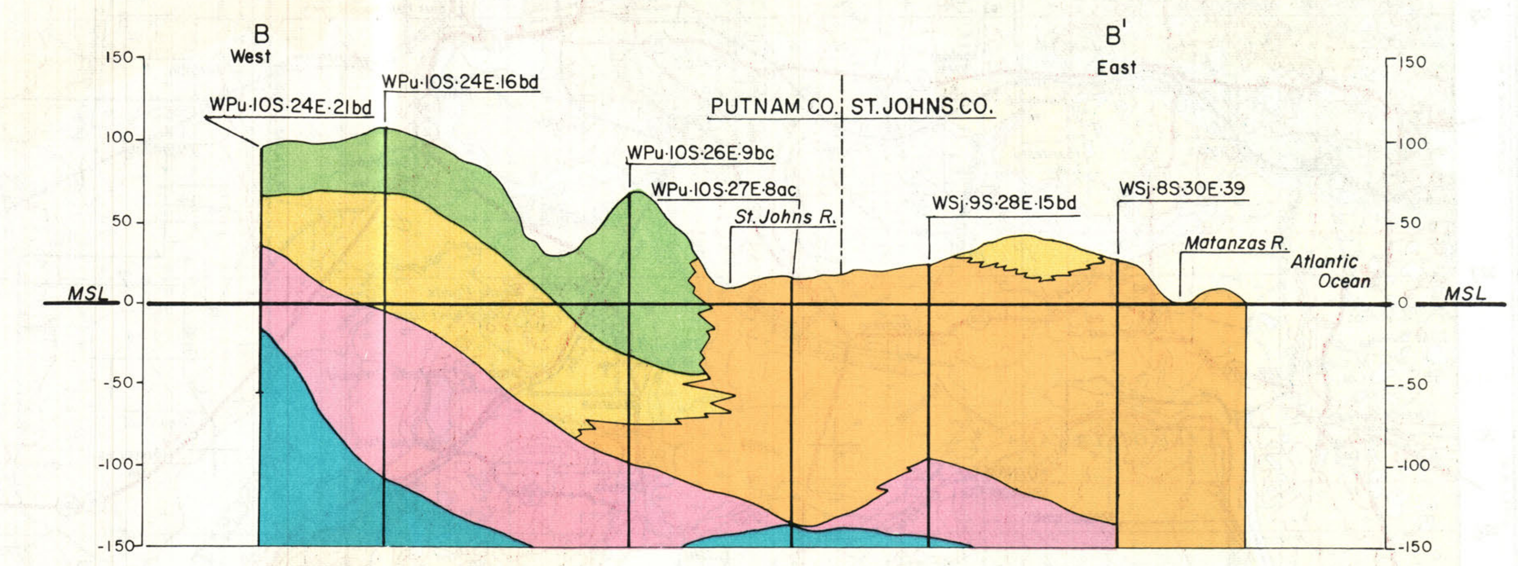

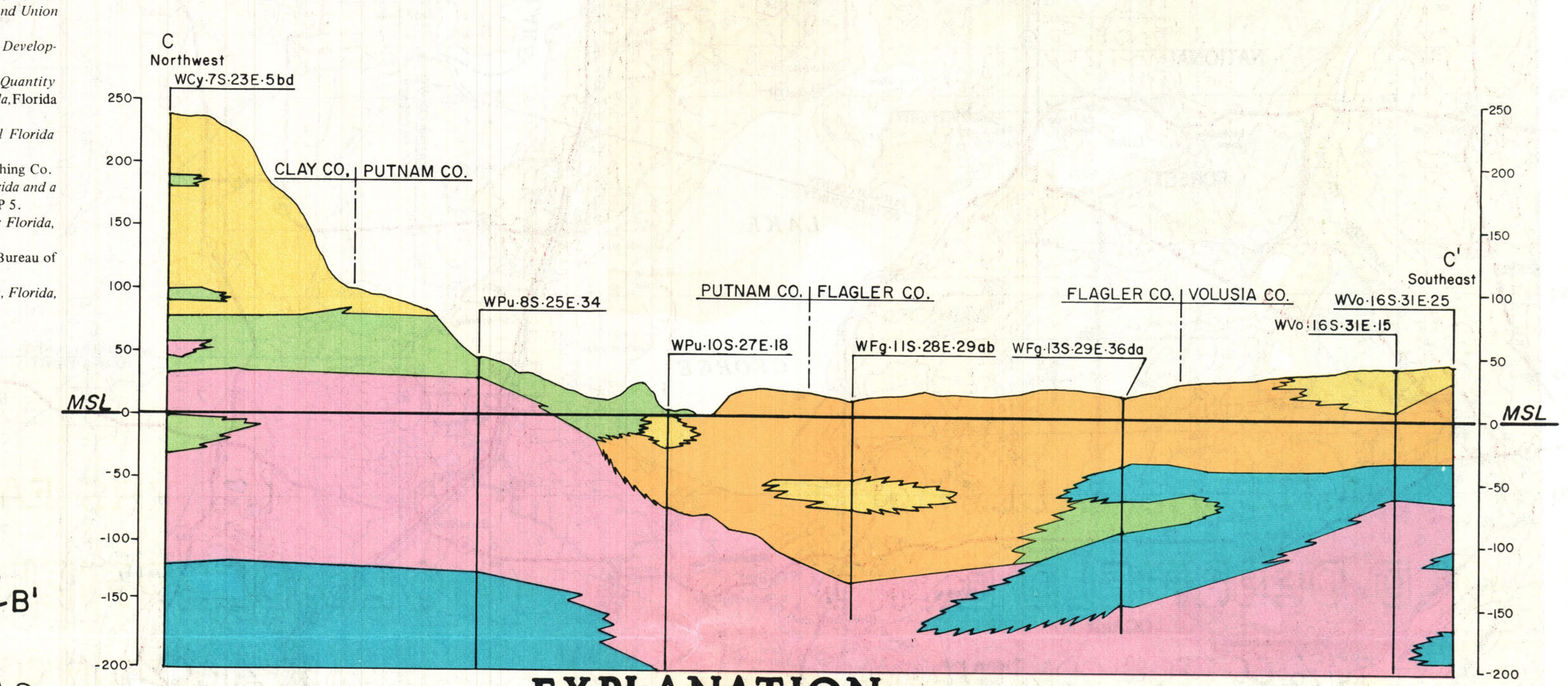

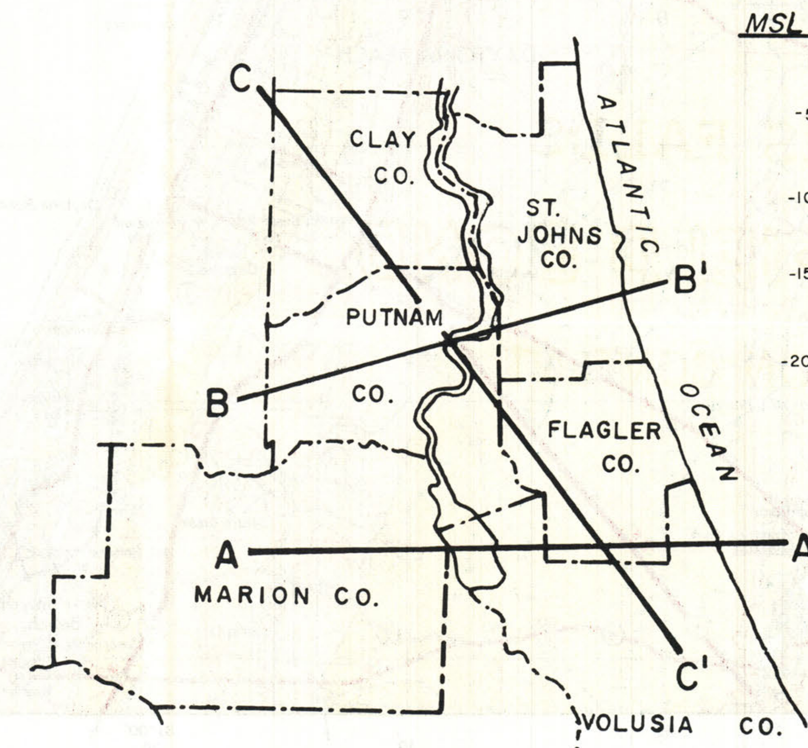

Location of Cross Sections

EXPLANATION