Open-File Map Series 106, Plate 3
*See Open-File Report 102 for accompanying text

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Florida Department of Environmental Protection
Florida Geological Survey

OPEN-FILE MAP SERIES 106, Plate 3

GEOMORPHOLOGY, SPRINGS, AND KARST FEATURES OF THE USGS SAINT AUGUSTINE 30 X 60 MINUTE QUADRANGLE, NORTHEAST FLORIDA

2014

BY

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Barrier Island Sequence District

The Barrier Island Sequence District extends into Florida from Georgia. The District is characterized by beach ridges, dunes and paleo-lagoons. The District extends from the Georgia-Florida state line southward to the vicinity of Lake Okeechobee. It lies to the east of the Central Lakes District and north of the Everglades District (Figure 3). Within the mapped area, the District is divided into three Terranes (Figure 4): the Atlantic Coastal Complex, the Duval Upland and the Lower St. Johns River Valley. Elevations within the District range from sea level to more than 145 feet (44.2 meters) above MSL. The surficial and shallow subsurface sediments of the District were deposited during the Plio-Pleistocene and lie unconformably on sediments ranging from the Middle Eocene Avon Park Formation to the Oligocene-Miocene Hawthorn Group. Beach ridge plains occur in several areas of the Barrier Island Sequence District at elevations ranging from near sea level to more than 75 feet (23 meters) above MSL. In the study area, these mostly occur on the Atlantic Coastal Complex (Figure 1). Drainage patterns in these areas may be strongly controlled by the relict beach ridges forming a distinct trellis drainage pattern. The beach ridge swales are often swampy and control the development of lakes on portions of the Osceola Plain. The Barrier Island Sequence District also contains relict (or paleo) lagoons. The occurrence of the lagoonal features is most prominent in the southern portion of the district in the headwaters of the St. Johns River. White (1970)* thought that this area was not a paleo-lagoon but a beach ridge plain that had been reduced in stature by dissolution of incorporated shell material. He stated that there were relict beach ridges in the area and that the ridges controlled the drainage. Modern topographic maps, however, do not show the beach ridges nor do they reveal a drainage pattern indicative of beach ridges. This paleo-lagoon lies between the Atlantic Coastal Ridge on the east and a prominent erosional scarp on the west. The scarp toe occurs at approximately 30 feet (9.1 meters) above MSL and extends nearly continuously from the southernmost portion of the Barrier Island Sequence District northward to the Florida-Georgia state line. The paleo-lagoon extends uninterrupted from the southern end of the district to southern Volusia County. Northward from southern Volusia County the relict lagoon is either interrupted or partially covered by beach ridges. However, the lagoon can be recognized as far north as the vicinity of Jacksonville in Duval County.

Atlantic Coastal Complex

The Atlantic Coastal Complex extends from the St. Johns River in Duval County to northern Brevard County (Figure 4). In the study area, this terrane consists of Pleistocene through recent barrier beach ridges and dunes that are consistent with the terrane as a whole. Elevations range from sea level to 90 feet (27.4 meters) above MSL. There are multiple coast parallel creeks and swamps in the swales separated by ridges and broad scale development of trellis drainage. Some of the major water features include Pellicer, Moses and Moultrie creeks and the Matanzas, Tolomato and Guana rivers. Construction of the Intracoastal Waterway, particularly in the southeastern part of the study area, separates the modern barrier island from the mainland to the west. The terrane has varying thickness of undifferentiated Quaternary sediments, undifferentiated Tertiary and Quaternary shelly sediments and outcrops of the Pleistocene Anastasia Formation near the Atlantic coast (OFMS 106, plate 2).

Duval Upland

The Duval Upland is a broad feature extending from Putnam County in the south to Nassau County and the Georgia boundary with Florida along the St. Marys River in the north (Figure 4). It is an area of higher elevation to the west of the Lower St. Johns River Valley and the St. Marys Plain (Figure 3). It is underlain by sediments of the Cypresshead Formation along the western edge and undifferentiated Quaternary sands (Qu) along the eastern edge. Notably, across the Duval Upland, mixed dendritic and trellis drainage reveal that, at least in part, this terrane was originally deposited having some aspect of ridge and swale topography akin to the Atlantic Coastal Complex. This affinity is why the Duval Upland terrane is included within the Barrier Island Sequence District. Statewide and within the mapped area, elevations range from sea level to approximately 145 feet (44.2 meters) above MSL.

Lower St. Johns River Valley

The Lower St. Johns River Valley has been hypothesized by Scott (2013, personal communication) as part of a paleo-lagoon. The relict lagoon feature extends nearly continuously from the headwaters of the St. Johns River in Palm Beach County to central Duval County. In Volusia County, the paleo-lagoon is either partially interrupted or partially covered by beach ridges. The southern end of this interruption corresponds to the westward turn of the St. Johns River as it occupies the St. Johns River Offset (Figure 4). The southern end of the Lower St. Johns River Valley includes Crescent Lake and extends northward to central Duval County where the St. Johns River turns east toward the Atlantic Ocean and some beach ridge uplands separate the St. Johns River Valley from the drainages associated with the Nassau and St. Marys rivers. Elevations of the terrane range from sea level to more than 95 feet (29.0 meters) above MSL. Within the study area, elevations range from sea level to 90 feet (27.4 meters) above MSL. Variable thicknesses of undifferentiated Quaternary sediments lie on undifferentiated Tertiary/Quaternary shelly sediments or the Hawthorn Group in the terrane.

Central Lakes District

The Central Lakes District occupies most of the Central Highlands of Cooke (1939)* in peninsular Florida. The district extends from eastern Alachua County, southeastern Bradford County and southern Clay County to southernmost Highlands County (Figure 3). A thick (up to 200 feet [61 meters]) sequence of siliciclastic and carbonate sediments of the Hawthorn Group and siliciclastic sediments of the Cypresshead Formation and undifferentiated sediments overlie the Ocala Limestone in the district. Dissolution of the limestone and subsequent subsidence or collapse has created the characteristic rolling hills, sinkhole lakes and dry sinks that dominate the landscape. Much of the district is internally drained due to the karst features and the permeable sand cover. District-wide elevations range from near sea level to over 300 feet (91.4 meters) above MSL. Within the mapped area, elevations vary from near sea level in the St. Johns River to 285 feet (86.9 meters) above MSL on Trail Ridge. In the study area, the Central Lakes District includes the Crescent City Ridge, the Fort McCoy Plain, the Hawthorne Lakes Region, the Mt. Dora Ridge, the Ocklawaha River Valley, Palatka Hill, the St. Johns River Offset, and Trail Ridge (Figure 4). Many of these features were once part of a more extensive Cypresshead Formation upland that subsequently was erosionally altered leaving remnant highs.

Crescent City Ridge

The Crescent City Ridge lies in northwestern Volusia County and southeastern Putnam County (Figure 4). It is located between the St. Johns River Offset and the Lower St. Johns River Valley. Crescent Lake lies at the eastern toe of the ridge. The lake likely represents a portion of the paleo-estuary of the ancestral St. Johns River, abandoned when the river began to occupy the St. Johns River Offset. Elevations vary from approximately MSL to 125 feet (38.1 meters) above MSL. Relief on the ridge can be substantial due to karst influences. The terrain is a rolling, karstic landscape with closed-basin lakes. A thin sequence of Quaternary sand overlies the Cypresshead Formation and undifferentiated Tertiary/Quaternary shelly sediments.

Fort McCoy Plain

The Fort McCoy Plain is a relatively flat, poorly to moderately drained area just east of the Ocala Karst Hills and southeast of the Hawthorne Lakes Region in the southwest corner of the study area (Figure 4). Scattered sinkholes are present within the terrane and elevations range from approximately 15 feet (4.6 meters) to approximately 90 feet (27.4 meters) above MSL within the study area. The Fort McCoy Plain is underlain by sediments of the Hawthorn Group, which are mantled with variable thicknesses of undifferentiated Quaternary sediments (Scott et al., 2001; Green et al., 2009a; Green et al., 2009b)*.

Hawthorne Lakes Region

The Hawthorne Lakes Region is bounded to the north and east by Trail Ridge, to the east by the Duval Upland, to the south by the Fort McCoy Plain and the Ocklawaha River Valley and to the northeast by the Southern Okeefenokee Basin (Figure 4). The lakes in the Hawthorne Lakes Region formed through karst processes and were modified by subsequent surficial erosion. Surficial erosion has caused some of the formerly closed basins to develop outflow streams. Elevations in the terrane range from approximately 10 feet (3.1 meters) above MSL for the water level in the lakes to approximately 225 feet (68.6 meters) above MSL on the hills. Relief generally decreases to the south, as does the elevation range. In the study area, the Hawthorne Lakes Region elevations range from approximately 10 feet (3.1 meters) above MSL to 225 feet (68.6 meters) above MSL. The Hawthorne Lakes Region is underlain by sediments of the Cypresshead Formation and undifferentiated Quaternary sediments.

Mt. Dora Ridge

The Mt. Dora Ridge occurs from western Orange County to Marion and Putnam counties, where it terminates near the southwestern corner of the study area (Figures 1 and 4). It is bound to the west by the Ocklawaha River Valley, Tavares Lakes Region, Lake Wales Ridge Complex, to the south and east by the Osceola Plain, and to the east by the Orlando Ridge, Wekiva Plain, Lake Plain and St. Johns River Offset Valley. The terrain is a rolling karstic landscape with numerous lakes. Elevations on the Mt. Dora Ridge range from 5 feet (1.5 meters) to 195 feet (59.4 meters) above MSL statewide and from 5 feet (1.5 meters) to 170 feet (51.8 meters) above MSL within the study area. Relief often exceeds 100 feet (30 meters). Karst processes acting through a thick sequence of siliciclastic sediments (deep-cover karst) created the landscape. Dissolution of the Ocala Limestone and carbonates within the Hawthorn Group is responsible for the development of the Mt. Dora Ridge's distinctive landscape. Tertiary/Quaternary dune sediments overlie the Cypresshead Formation on part of the Mt. Dora Ridge. Elsewhere, the Cypresshead Formation lies on the Hawthorn Group.

Ocklawaha River Valley

The Ocklawaha River Valley extends from near the Lake-Marion County line northward to the Marion-Putnam County line (Figure 4). In the study area, the valley abuts the St. Johns River Offset, Mt. Dora Ridge, Fort McCoy Plain, the Hawthorne Lakes Region and the Duval Upland where the river becomes confined to a narrow corridor (Figures 1 and 4). The headwaters of the Ocklawaha River occur in Lake Griffin in the Tavares Lakes Region, a broader and more karstic portion of the Central Lakes District. The terrane is underlain by the Ocala Limestone, Hawthorn Group, Cypresshead Formation and undifferentiated Quaternary sediments. Elevations of the valley range from sea level to 105 feet (32.0 meters) above MSL statewide and sea level to 70 feet (21.3 meters) above MSL within the study area.

Palatka Hill

Palatka Hill, in Putnam County, appears as a remnant bluff stranded in the broader feature of the St. Johns River valley. Where the St. Johns River Offset turns toward the east-northeast, the river has followed its current course south of Palatka Hill, but there is also an extensive eroded plain to the west and north of Palatka Hill. This remnant feature is at the junction of the St. Johns River Offset and the Lower St. Johns River Valley where the St. Johns River turns to the north-northwest, continuing the coastal sub-parallel trend in line with the Upper St. Johns River Valley further south. The Palatka Hill terrane appears to share affinity to both the Crescent City Ridge to the southeast and the Duval Upland to the north and northwest (Figures 1 and 4). It exhibits overland drainage incision like the Duval Upland, as may be observed at Ravine Gardens State Park, but is not devoid of isolated karst lakes as are found in the Crescent City Ridge. Palatka Hill elevations range from 5 feet (15 meters) to 100 feet (30.5 meters) above MSL. The terrane consists of undifferentiated Quaternary sediments on Cypresshead Formation.

St. Johns River Offset

The St. Johns River flows northward from the headwaters in Palm Beach County, flowing into the Atlantic Ocean in Duval County (Figure 4). The upper and lower St. Johns River valleys follow pathways that are closer to the Atlantic coastline than the middle reach of the river between Sanford and Palatka. At the approximate latitude of Sanford, Seminole County, the river jogs westward then northward in a narrow valley bounded in the study area by the Mt. Dora Ridge on the west and the Crescent City Ridge on the east. White (1970)* named and described the St. Johns River Offset. Elevations in the terrane vary from sea level to 75 feet (22.9 meters) above MSL statewide and sea level to 60 feet (18.3 meters) above MSL in the study area. White (1970)* believed that this portion of the St. Johns River's pathway was first developed in the Pliocene or early Pleistocene by dissolution of the underlying Eocene carbonate sediments. Pirkle (1971)* suggested that the dissolution along the west to east trend resulted from faulting and fracturing of the Eocene rocks. White (1970)* believed that a complex geomorphic history was necessary to force the St. Johns River out of its coast parallel course and into a more inland, older valley. Within the Offset there are varying thicknesses of undifferentiated Quaternary sediments overlying the Ocala Limestone.

Trail Ridge

Trail Ridge is a 130 mile (209 kilometer) long sand ridge that extends southward from the Altamaha River in southern Georgia to northern Putnam County in the west-northwest portion of the study area (Figure 4). It is bound to the west by the Southern Okeefenokee Basin, to the east by the Duval upland and to the south by the Hawthorne Lakes Region (Figure 4). This feature as mapped includes the Baywood Promontory of Pirkle et al., (1970)*. Elevations of the terrane range from 50 feet (15.2 meters) above MSL to 305 feet (93.0 meters) above MSL statewide and 50 feet (15.2 meters) to 285 feet (86.9 meters) above MSL within the mapped area. Trail Ridge sands consist of unconsolidated to slightly indurated white to tan, medium to fine quartz beach ridge sands in some areas containing an average of three percent heavy minerals, of which approximately 45 percent are titanium-rich minerals, consisting of ilmenite, leucoxene, and rutile. The average TiO2 content of these minerals is approximately 69 percent. Other common heavy minerals include staurolite, zircon, kyanite, sillimanite, corundum, topaz, and tourmaline.

*Note: See Open-File Report 102 for references

Figure 1. Geomorphic terranes (modified from Scott et al., in preparation), springs, and karst features shown with LiDAR and digital elevation model (DEM) mosaic.

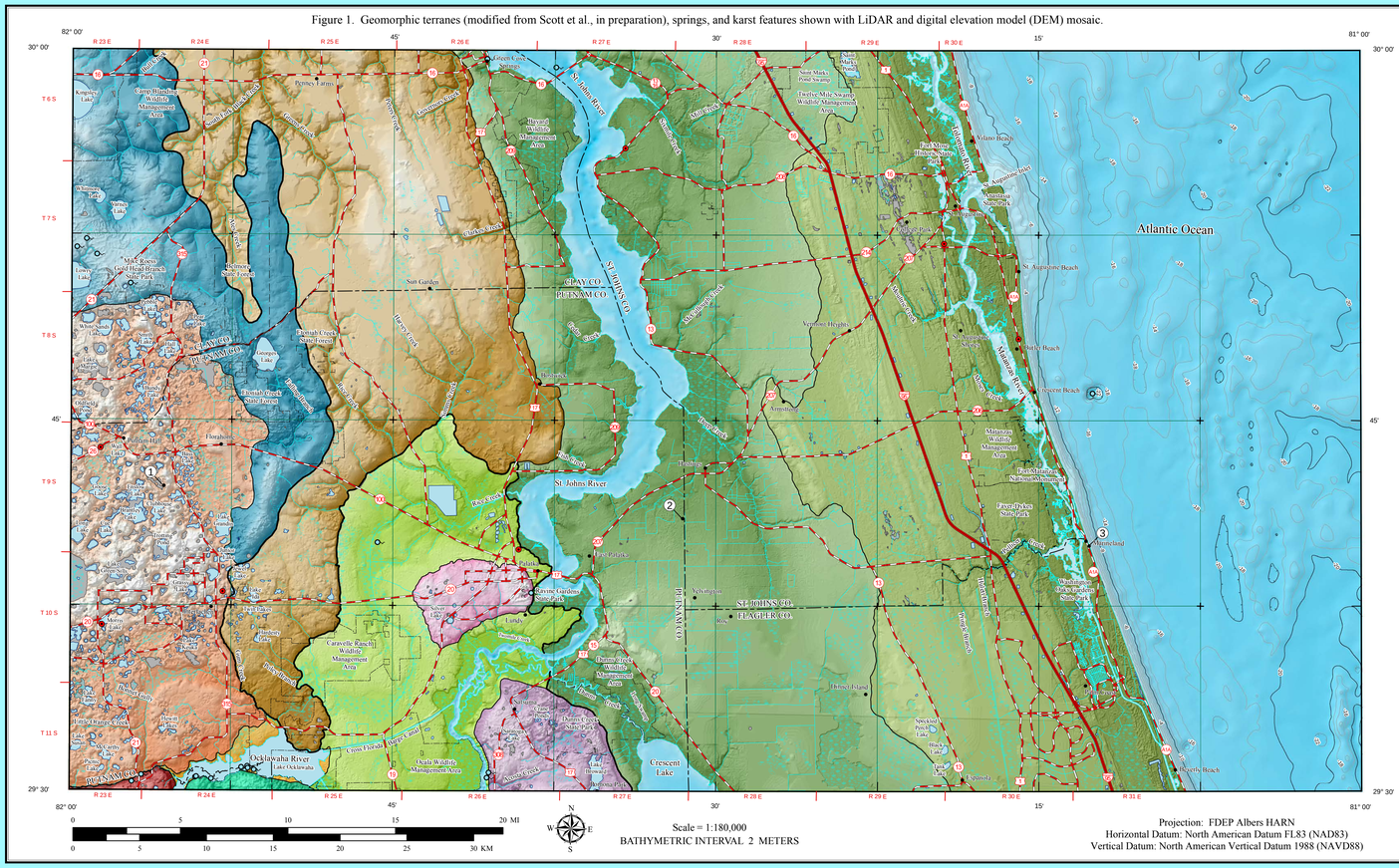


Figure 2. Springs and karst features shown with LiDAR and digital elevation model (DEM) mosaic.

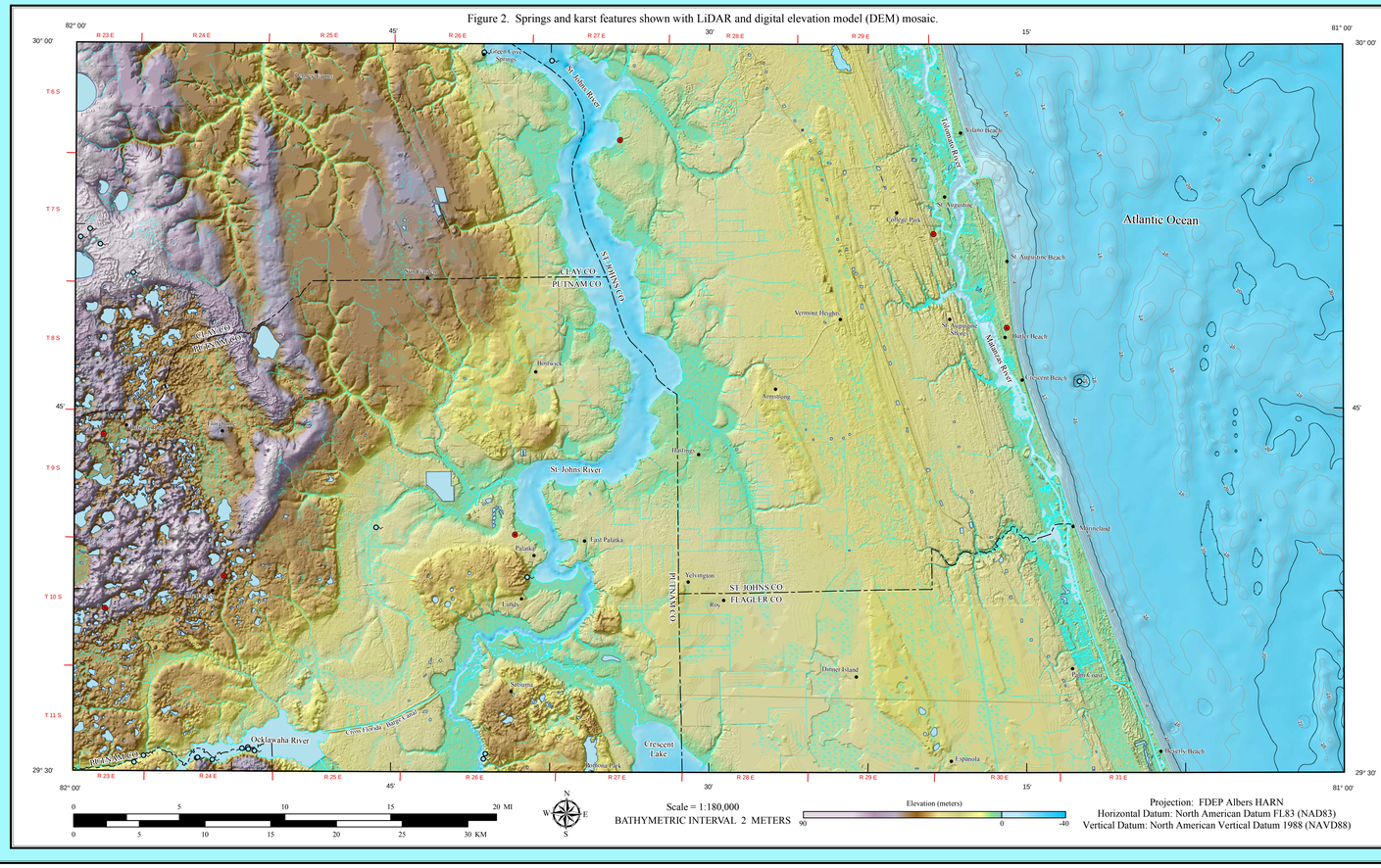


Figure 3. Geomorphic Districts (modified from Scott et al., in preparation)

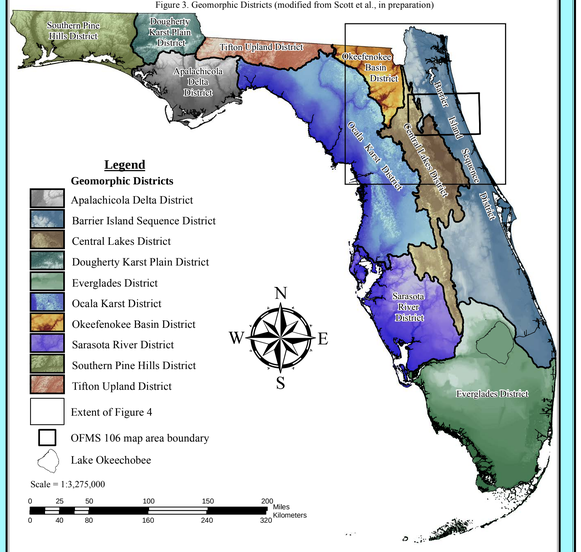
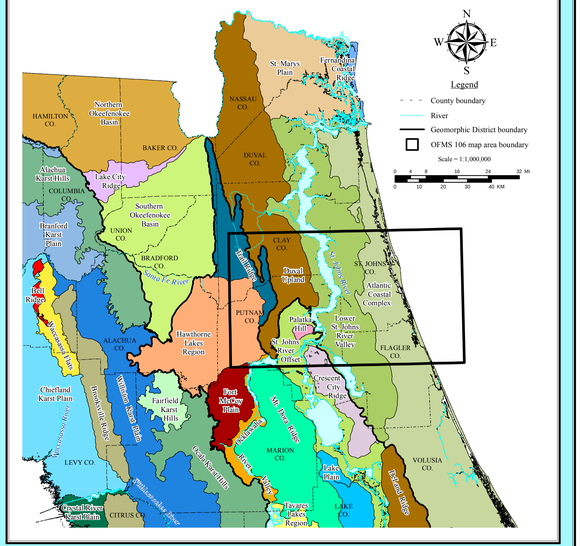


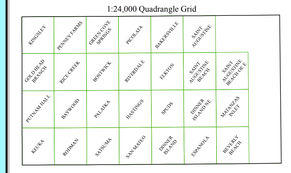
Figure 4. Geomorphic Terranes (modified from Scott et al., in preparation)



Legend for Figure 1 & 2

City
County boundary
Primary highway
Secondary highway
7.5 Minute quadrangle
State park or reserve
River, stream, or canal
Lake or pond
Wetland
Closed Topographic Depressions (CTDs)
Geomorphic District boundary
Geomorphic Terrane boundary
Bathymetry: 2 Meter Interval Index
Intermediate
Photo location callout
Karst Features
Spring
Sinkhole or other karst feature

1:24,000 Quadrangle Grid



ADJOINING MAPS

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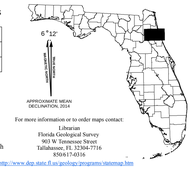
4		6
7	8	9

1 Lake City
2 Jacksonville
3
4 Gainesville
5 Saint Augustine
6
7 Ocala
8 Daytona Beach
9 New Smyrna Beach



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SELECTED PHOTOGRAPHS

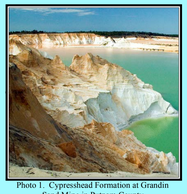

Photo 1. Cypresshead Formation at Grandin Sand Mine in Putnam County.
Location: T 9 S, R 24 E, S 17
Photo by FGS Staff
Date taken: 12/2006

Photo 2. Coring at Big Horse Aggregates.
Location: T 9 S, R 27 E, S 25, SE 1/4 of SE 1/4
Photo by Rick Green
Date taken: 5/14/2014

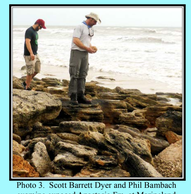

Photo 3. Scott Barrett Dyer and Phil Bambach examine exposed Anastasia Fm. at Marineland.
Location: T 10 S, R 31 E, S 5
Photo by Rick Green
Date taken: 5/15/2014

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