Open-File Map Series 107, Plate 3
*See Open-File Report 104 for accompanying text

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Florida Department of Environmental Protection
Florida Geological Survey

Jonathan P. Steverson
Secretary

OPEN-FILE MAP SERIES 107, Plate 3

GEOMORPHOLOGY, SPRINGS, AND KARST FEATURES OF THE USGS ORLANDO 30 X 60 MINUTE QUADRANGLE, CENTRAL FLORIDA

2015

BY

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Barrier Island Sequence District

The Barrier Island Sequence District is characterized by beach ridges, dunes and relict (or paleo-) lagoons. The district extends into Florida from Georgia southward to the vicinity of Lake Okeechobee (Figure 3). Within the mapped area, the District is divided into three terrains (Figures 1 and 4): the Atlantic Coastal Complex, the Osceola Plain and the Upper St. Johns River Valley. Elevations within the district range from mean sea level (MSL) to 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 Miocene Hawthorn Group. Beach ridge plains occur in several areas of the Barrier Island Sequence District at elevations ranging from near MSL to more than 75 feet (22.9 meters) above MSL. In the study area, these occur within the Atlantic Coastal Complex and portions of the Lower St. Johns River Valley (Figures 1 and 4). Drainage patterns in these areas are strongly controlled by relict beach ridges, in some cases forming a distinct trellis pattern. The beach ridge swales are often swampy and control development of lakes on portions of the Osceola Plain. The Barrier Island Sequence District contains paleo-lagoons. The occurrence of 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 shell material. He stated that there were relict beach ridges in the area which controlled the drainage. Modern topographic maps, LiDAR and digital elevation models do not show the beach ridges, nor do they reveal a drainage pattern indicative of beach ridges. This paleo-lagoon lies between the Atlantic coast 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, the relict lagoon is either interrupted or partially covered by beach ridges. However, it can be recognized as far north as the vicinity of Jacksonville.

Atlantic Coastal Complex

The Atlantic Coastal Complex extends from the St. Johns River at Jacksonville to northern Palm Beach County (Figure 4). In the map area, this terrain consists of Pliocene through Recent barrier beach ridges and dunes that are consistent with the terrain as a whole. Elevations range from MSL to 90 feet (27.4 meters) above MSL. Within the mapped area, elevations range from less than five feet (1.5 meters) MSL to 55 feet (16.8 meters) above MSL. In the study area, the terrain is underlain by varying thickness of undifferentiated Tertiary/Quaternary shelly sediments, undifferentiated Quaternary sediments and Quaternary beach ridge and dune sediments (OFMS 107, Plate 1).

Osceola Plain

The Osceola Plain has the topographic form of a terrace overall, but it may not be related to a specific stand of sea level (White, 1970). Most of its eastern border with the Upper St. Johns River Valley is a scarp with a toe at 25-30 feet (7.6-9.1 meters) above MSL and a crest as high as 75 feet (22.9 meters) above MSL (Figures 1 and 4). The crest elevations are reduced at the southernmost end of the Osceola Plain in Martin County. Most of the terrain is relatively level, with elevations 60-70 feet (18.3-21.3 meters) above MSL. Overall elevation ranges from five feet (1.5 meters) to 120 feet (36.6 meters) above MSL in the Osceola Plain. The Kissimmee River drains much of the western portion of the Osceola Plain southward to Lake Okeechobee and the Everglades. White (1970) suggested that much of the Osceola Plain was developed subaqueously and thus does not have as strong a trellis drainage control as many of the surrounding terrains. Nonetheless, as seen in the Kissimmee River and on the eastern portion of the terrain, much of the drainage, particularly the larger streams and rivers, is still coast parallel to the Atlantic Ocean. Elevation and local relief increase at the north end of the Osceola Plain in Orange and Seminole counties where the Econlockhatchee River and other tributaries of the St. Johns River are more developed than other drainages in the terrain. Elevations within the study area range from 5 feet (1.5 meters) to 110 feet (33.5 meters) above MSL. The Osceola Plain is underlain by undifferentiated Hawthorn Group sediments, Tertiary/Quaternary shelly sediments and Quaternary beach ridge and dune sediments in the mapped area.

Upper St. Johns River Valley

The Upper St. Johns River Valley includes the paleo-lagoon and modern fluvial valley from the headwaters of the St. Johns River in the vicinity of the St. Lucie-Martin County boundary, northward to the westward bend in the vicinity of Geneva Hill where the St. Johns River Offset begins. Elevations range from less than five feet (1.5 meters) to 60 feet (18.3 meters) above MSL (Figures 1 and 4). Much of the terrain has Holocene sediment overlying a broader region of Tertiary/Quaternary shelly sediments and undifferentiated Quaternary sediments. Whether by stream capture (White, 1970), deflection around the more resistant Avon Park Formation near the Sanford High, or a combination of these factors, the Upper St. Johns River Valley ends where the river trends west and then north again through a more western valley. Elevations within the study area range from less than five feet (1.5 meters) to 45 feet (13.7 meters) above MSL.

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 4). A thick sequence of up to 200 feet (61 meters) of siliciclastic and carbonate sediments of the Hawthorn Group, siliciclastic sediments of the Cypresshead Formation and undifferentiated Quaternary sediments overlie undifferentiated Tertiary/Quaternary shelly sediments in the Central Lakes District. Dissolution of carbonates and subsequent subsidence or collapse has created the characteristic rolling hills, sinkhole lakes and dry sinks that dominate the landscape. Portions of the district are internally drained due to the karst features and the permeable sand cover. Due to significant dissolution, elevations in the Central Lakes District vary from less than five feet (1.5 meters) above MSL to nearly 315 feet (96 meters) above MSL. In the study area, the Central Lakes District includes the DeLand Ridge, Geneva Hill, the Lake Plain, the Lake Wales Ridge Complex, the Mt. Dora Ridge, the Ocklawaha River Valley, the Orlando Ridge, the St. Johns River Offset, the Tavares Lakes, and the Wekiva Plain (Figure 4).

DeLand Ridge

The DeLand Ridge occurs in western Volusia County extending north-south from northern Volusia County to the Seminole County line (Figure 4). Elevations on the DeLand Ridge vary from approximately 20 feet (6.1 meters) to 120 feet (36.6 meters) above MSL within and outside the mapped area. Locally, relief on the ridge approaches 50 feet (15.2 meters). The terrain is a rolling karstic landscape with closed-basin lakes. A paleo-sand dune field occurs in the south-central portion of the ridge (OFMS 107, Plate 1). The DeLand Ridge lies on top of the Sanford High. In portions of Volusia County, the Miocene Hawthorn Group and the Upper Eocene Ocala Limestone are absent due to erosion or non-deposition. Pliocene/Pleistocene Cypresshead Formation and undifferentiated Tertiary/Quaternary shelly sediments overlie the Middle Eocene Avon Park Formation in this area. Thin remnants of the Ocala Limestone are present under limited portions of the DeLand Ridge.

Geneva Hill

Geneva Hill is a remnant of a broader undifferentiated Quaternary sediment deposit that has been mostly eroded out, presumably by fluvial migration, at the bend in the St. Johns River where the Upper St. Johns River Valley and the St. Johns River Offset merge (Figure 1). Morphologically, it has more affinity to the DeLand Ridge to the north than the Osceola Plain to the south due to its subtle ridges and karst swales. The terrain is not significantly higher in elevation than the surrounding St. Johns River Valley, nor does it have distinct fluvial scour on its edges, both of which are found at Palatka Hill where the St. Johns River Offset merges with the Lower St. Johns River Valley (Green, et al., 2014a, Green et al., 2014b). Elevations in the terrain range from 20 feet (6.1 meters) to 85 feet (25.9 meters) above MSL.

Lake Plain

The Lake Plain includes transitional regions between the Mt. Dora Ridge to the west, the St. Johns River Offset to the east and the Wekiva Plain to the south (Figures 1 and 4). It is underlain by Hawthorn Group, Cypresshead Formation and undifferentiated Quaternary sediments. Elevations of the Lake Plain vary from five feet (1.5 meters) to 115 feet (35.1 meters) above MSL both within the mapped area and statewide. It is an area of overall low relief that includes numerous springs and spring runs, such as Salt Spring and Alexander Spring. The lower elevation portions in the Lake Plain are clearly influenced by karst, leaving various irregularly spaced higher elevation regions within the plain where karst is less evident.

Lake Wales Ridge Complex

The Lake Wales Ridge Complex is an area of higher elevation rising above the Green Swamp to the south and east (Figures 1 and 4). The ridge area is the remnant of a broader upland that has been eroded and lowered by sea level fluctuations, fluvial erosion, karst processes and aeolian redistribution of sediments. Elevations generally range from 50 feet (15.2 meters) to 315 feet (96 meters) above MSL statewide. Within the study area they range from 60 feet (18.3 meters) to 310 feet (94.5 meters) above MSL. The complex is predominantly well-drained internally, primarily through the numerous karst features present. Sediments of the Cypresshead Formation overlie the Hawthorn Group within the mapped area (OFMS 107, Plates 1 and 2). In some areas, aeolian sand dunes are present. Though lower in elevation, the karst lakes of the headwaters of the Palatlakaha River are included in the Lake Wales Ridge Complex due to their similar karst lake morphology, paleo-beach ridge morphology and the presence of underlying Cypresshead Formation. However, this region of the Lake Wales Ridge Complex is somewhat transitional to the Green Swamp.

Mt. Dora Ridge

The Mt. Dora Ridge occurs in the central portion of the study area in Lake, Marion, Orange and Seminole counties (Figures 1 and 4). The terrain is a rolling karstic landscape with numerous lakes. Elevations on the Mt. Dora Ridge within and outside the mapped area vary from 10 feet (3 meters) to more than 200 feet (61 meters) above MSL. Relief often exceeds 100 feet (30.5 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.

Ocklawaha River Valley

The Ocklawaha River Valley is a narrow valley extending from near the Lake-Marion County line northward to the Marion-Putnam County line (Figures 1 and 4). It is only present in a very small area along the northwest edge of the study area (Figure 1). The headwaters of the Ocklawaha River, included in the Lake Wales Ridge Complex, occur just south of the southwest edge of the mapped area near Lake Louisa. As it enters the Ocklawaha River Valley, the river becomes confined to a narrow valley to the north (near the northwestern edge of the mapped area). The terrain is underlain by Hawthorn Group sediments, Cypresshead Formation and undifferentiated Quaternary and Holocene sediments. Elevations of the valley within the study area range from 50 feet (15.2 meters) to 100 feet (30.5 meters) above MSL.

Orlando Ridge

The Orlando Ridge includes sandy highlands north and west of the lower and flatter Osceola Plain (Figures 1 and 4). It is distinguished from the Mt. Dora Ridge, a much larger, continuous ridge to the west, by its lower elevation and relief. Much like the other ridges in central Florida, the Orlando Ridge has numerous karst lakes. Elevations in the terrain range from 20 feet (6.1 meters) to 125 feet (38.1 meters) above MSL. White (1970) hypothesized that the Orlando Ridge may be the remnant of something akin to the Merritt Island/Cape Canaveral area during a higher sea level stand than present conditions. Most of the Orlando Ridge consists of undifferentiated Quaternary sediments, but some of the northwestern portion consists of moderately weathered Cypresshead Formation (OFMS 107, Plate 1).

St. Johns River Offset

The St. Johns River flows northward from its headwaters near the St. Lucie County and Martin County boundary flowing into the Atlantic Ocean near Jacksonville in Duval County (Figures 1 and 4). The Upper and Lower St. Johns River valleys follow a pathway that is closer to and aligned with 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 Orlando Ridge on the south, the Lake Plain and Wekiva Plain on the west and the DeLand Ridge on the east. White (1970) named and described this as the St. Johns River Offset. Elevations in the study area range from less than five feet (1.5 meters) to 75 feet (22.9 meters) above MSL. White believed that this portion of the St. Johns River's course was first developed in the Pliocene or early Pleistocene by dissolution of the underlying Eocene carbonate sediments and a complex geomorphic history ending with stream piracy to force it into a more inland, older valley. Pirkle (1971) suggested that the dissolution along the west-to-east trend resulted from faulting and fracturing of the Eocene rocks. Within the St. Johns River Offset there are varying thicknesses of undifferentiated Quaternary and Holocene sediments or Tertiary/Quaternary shelly sediments overlying the Hawthorn Group and Ocala Limestone, or Avon Park Formation where the Hawthorn Group and Ocala Limestone are missing near the Sanford High (OFMS 107, Plate 2).

Tavares Lakes

Centered mostly in Lake County, the Tavares Lakes terrain includes many of the large lakes that stretch northwest from Orlando to Leesburg. Elevations in the Tavares Lakes range from 55 feet (16.8 meters) to 165 feet (50.3 meters) above MSL. Significant karst activity has formed the intricate patchwork of lakes and interlaced lands between the lakes. This region is the southern end of the Central Valley and part of the Lake Harris Cross Valley of White (1970). The terrain is distinguished from adjacent terrains due to its overall lower elevations and abundance of large lakes. Some of the adjacent terrains, particularly the Mt. Dora Ridge and Lake Wales Ridge Complex contain lakes, but they tend to be smaller and the overall elevations of these terrains are higher. The terrain also includes many of the connected karst lakes that make up the headwaters of the Ocklawaha River and is underlain by a mix of Cypresshead Formation and Holocene sediments, the latter common in the lake basins.

Wekiva Plain

The Wekiva Plain, located in the central portion of the mapped area, is a karst basin. It is distinguished from the Lake Plain by the surficial geology where the Hawthorn Group is exposed over parts of the basin floor. This area is largely the drainage of Rock Springs Run and the Wekiva River, both of which are spring fed, but it also includes some remnant hills and areas adjacent to the St. Johns River Offset of undifferentiated Quaternary sediments. Elevations in the Wekiva Plain range from five feet (1.5 meters) to 75 feet (22.9 meters) above MSL.

Ocala Karst District

The Ocala Karst District encompasses a broad area from central Wakulla County in the panhandle of Florida, south to Hillsborough and Pinellas counties in the west-central peninsula and inland to nearly the center of the peninsula (Figure 3). Elevations within the district range from MSL along the Gulf of Mexico coast to over 300 feet (91.4 meters) above MSL on the Brooksville Ridge. In the study area, the Ocala Karst District includes the Green Swamp, the Ocala Karst Hills and the Williston Karst Plain. Within the mapped area, elevations range from 10 feet (3 meters) to 180 feet (54.9 meters) above MSL. Carbonate rocks of the Upper Eocene Ocala Limestone lie at or near the land surface in this district within the study area. The Ocala Karst District is dominated by cover-collapse and cover-subsidence sinkholes, the latter forming shallow bowl-shaped depressions, producing a rolling topography. Generally, a variably permeable siliciclastic cover allows downward percolating groundwater to slowly dissolve the underlying limestone, leading to the cover-collapse and cover-subsidence sinkholes (Sinclair and Stewart, 1985). Cover-collapse sinkholes form rather abruptly from the structural failure of an overlying cavern roof. Typically, cover-subsidence sinkholes form by the downward raveling of the siliciclastic overburden filling voids created by slow dissolution of underlying carbonates or by slow dissolution of the carbonate surface. Springs, sinks, sinking (swallets) and resurgent streams, and caverns commonly occur within the Ocala Karst District.

Green Swamp

The Green Swamp occurs in parts of Hernando, Pasco, Sumter, Lake, Polk and Hillsborough counties (Figures 1 and 4). Elevations within the Green Swamp range from 40 feet (12.2 meters) to 180 feet (54.9 meters) above MSL. The entire area is very poorly drained and swamp conditions prevail due to the high potentiometric surface of the Floridan aquifer system. A few areas of sand dunes are found in the terrain. Karst features are common throughout the Green Swamp but there are few springs. The Green Swamp occurs in the southwestern part of the study area where elevations range from 85 feet (25.9 meters) to 155 feet (47.2 meters) above MSL. The Green Swamp is primarily underlain by the Upper Eocene Ocala Limestone with the Lower Oligocene Suwannee Limestone only under the southwestern most part of the terrain. Hawthorn Group sediments occur scattered throughout the terrain. Tertiary/Quaternary Cypresshead Formation, reworked Cypresshead Formation and Undifferentiated Tertiary/Quaternary siliciclastic sediments cover much of the Green Swamp. Within the study area, the terrain is underlain by the Ocala Limestone.

Ocala Karst Hills

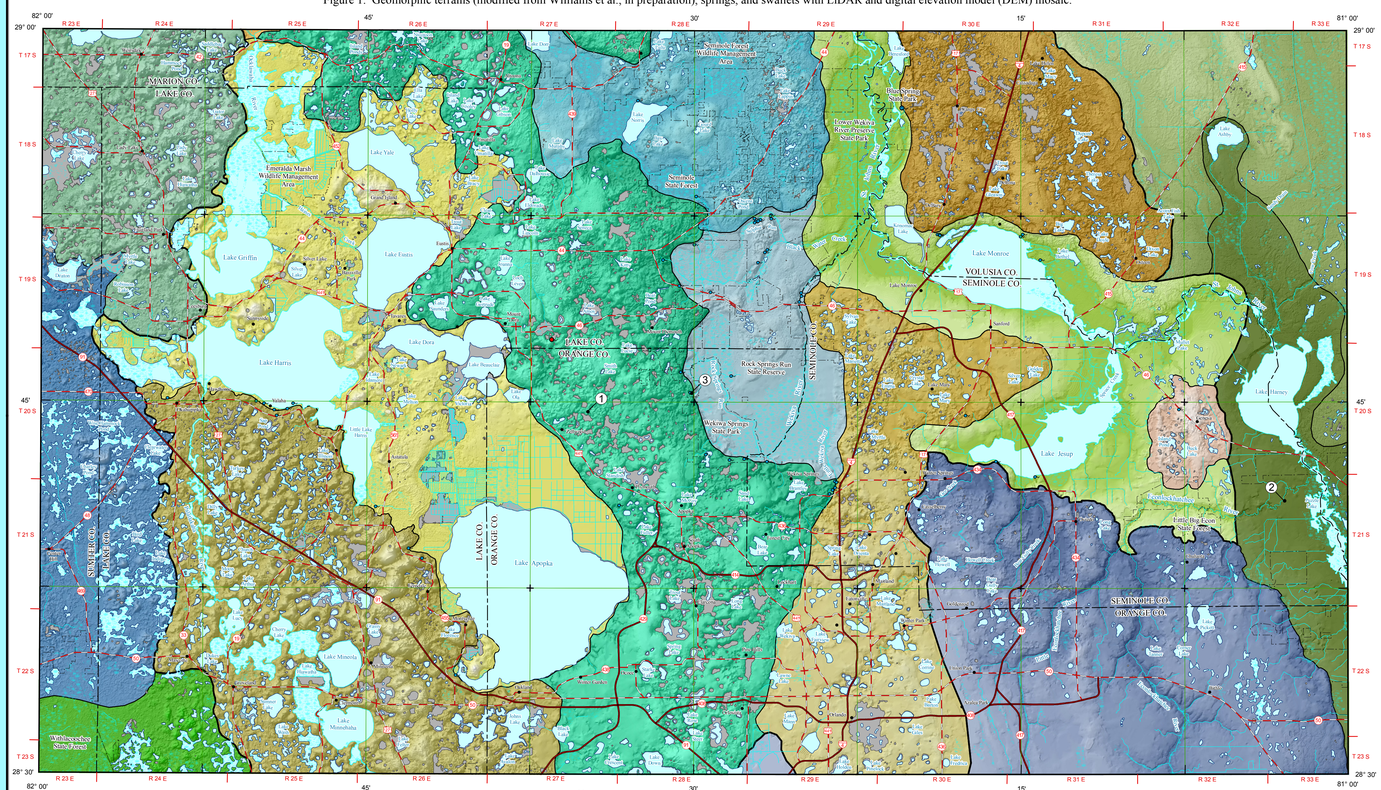
The Ocala Karst Hills terrain occurs from north-central Marion County southward to northeastern Sumter County (Figures 1 and 4). Elevations in the Ocala Karst Hills range from 20 feet (6.1 meters) to 190 feet (57.9 meters) above MSL. Elevations within the study area range from 50 feet (15.2 meters) to 180 feet (54.9 meters) above MSL. Several large springs are present in the Ocala Karst Hills west of the study area, including Silver Springs. The karst in this terrain is not mature as the terrain still has significant topographic variability. The Upper Eocene Ocala Limestone underlies either Quaternary siliciclastic sediments or Tertiary/Quaternary Cypresshead Formation of varying thicknesses, while undifferentiated Miocene Hawthorn Group sediments are thin, where present.

Williston Karst Plain

The Williston Karst Plain occurs from northwestern Gilchrist County southward to Hernando County (Figures 1 and 4). It has very little overland drainage as most precipitation is captured and internally drained via karst features common throughout the terrain. Elevations of the Williston Karst Plain range from 10 feet (3 meters) to 160 feet (48.8 meters) above MSL. Within the mapped area, elevations of the terrain range from 30 feet (9.1 meters) to 160 feet (48.8 meters) above MSL. The Williston Karst Plain has thin siliciclastic cover underlain by the Upper Eocene Ocala Limestone. The current study area is covered with variable thicknesses of Cypresshead Formation, reworked Cypresshead Formation, or undifferentiated Quaternary sediments.

*Note: See Open-File Report 104 for references

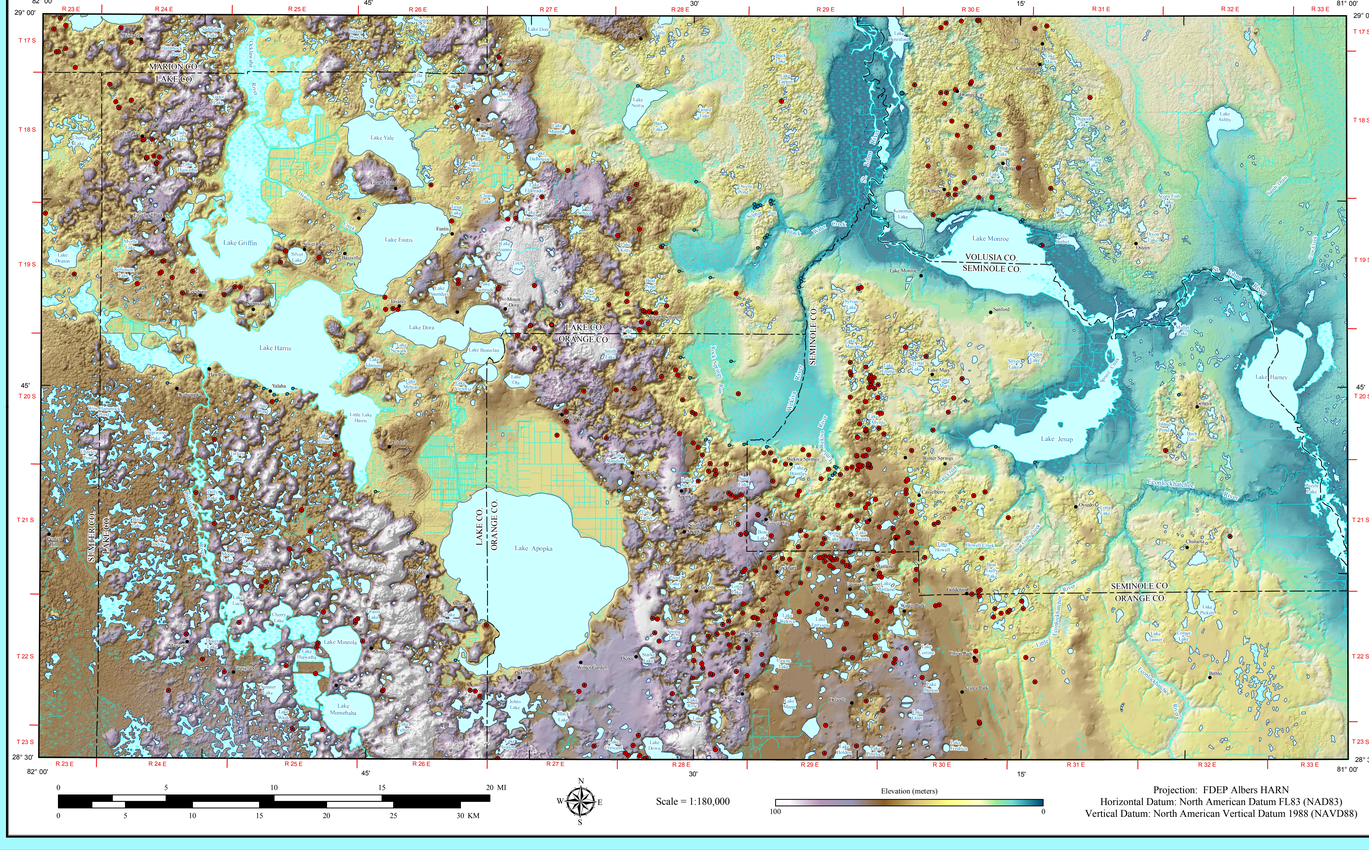
Figure 1. Geomorphic terrains (modified from Williams et al., in preparation), springs, and swallets with LiDAR and digital elevation model (DEM) mosaic.



Scale = 1:180,000

Projection: FDEP Albers HARN
Horizontal Datum: North American Datum FL83 (NAD83)
Vertical Datum: North American Vertical Datum 1988 (NAVD88)

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



Scale = 1:180,000

Elevation (meters): 100 — 0

Projection: FDEP Albers HARN
Horizontal Datum: North American Datum FL83 (NAD83)
Vertical Datum: North American Vertical Datum 1988 (NAVD88)

Figure 3. Geomorphic districts (modified from Williams et al., in preparation)

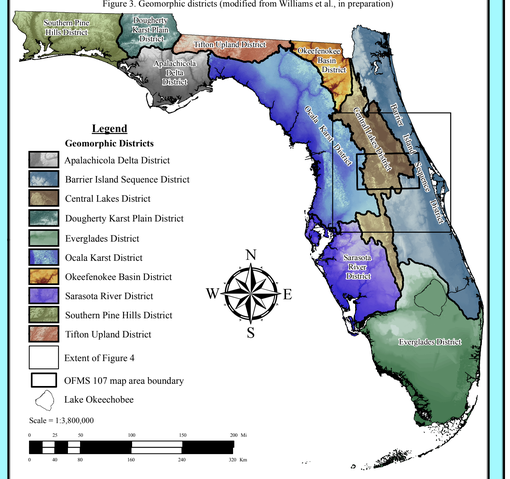
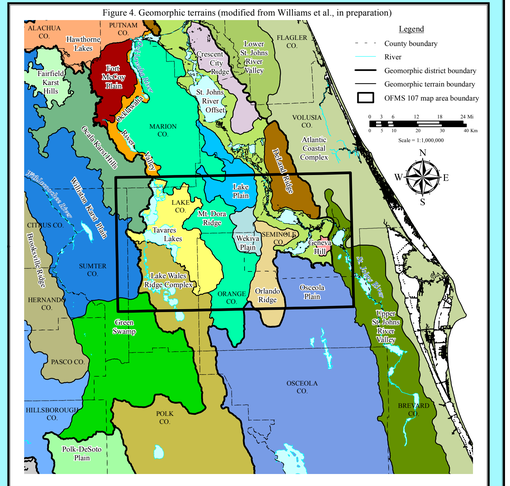


Figure 4. Geomorphic terrains (modified from Williams et al., in preparation)



Legend for Figures 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 terrain boundary
- Photo location callout

Karst Features

- First magnitude spring
- Spring
- Swallet
- Sinkhole or other karst feature

1:24,000 Quadrangle Grid

LAKE LAKE	PIERSON	OAKHILL	PAOLA	PINE LAKES	ORANGE CITY	LAKE HELEN	LAKE ASHBY
LEESBURG WEST	LEESBURG EAST	ESTIS	MORRISTO	KNOWLES SW	KNOWLES	OSTEEN	OSCEOLA
CENTER HILL	HOWEY-IN-THE-HILLS	ASTATULA	APOPKA	FOREST CITY	CASSELBERRY	OVIEDO	GENEVA
MASCOTTE	CLERMONT WEST	CLERMONT EAST	ENTER-PRISE	ORLANDO WEST	ORLANDO EAST	OVIEDO SW	BITHLO

ADJOINING MAPS

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4		6
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1 Ocala
2 Daytona Beach
3 New Smyrna Beach
4 Inverness
5 Orlando
6 Titusville
7 Tarpon Springs
8 Kissimmee
9 Cape Canaveral

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SELECTED PHOTOGRAPHS

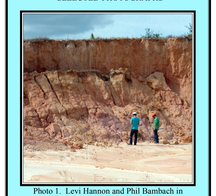

Photo 1. Levi Hannon and Phil Bambach in Cypresshead Formation sand pit.
Location: T 20 S, R 27 E, S 14
SW 1/4 of SE 1/4
Photo by Rick Green
Date taken: 11/5/2014

Photo 2. Phil Bambach investigates TQsu outcrop along the Econlockhatchee River.
Location: T 20 S, R 28 E, S 15,
NE 1/4 of NW 1/4
Photo by Rick Green
Date taken: 6/4/2015

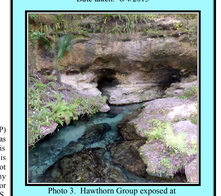

Photo 3. Hawthorn Group exposed at Rock Springs.
Location: T 21 S, R 33 E, S 07,
NE 1/4 of NE 1/4
Photo by Rick Green
Date taken: 6/2/2015

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