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Geology and Paleontology of the Ocala Limestone Exposed in the Cemex Center Hill Quarry, Sumter County, FL

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Geology and Paleontology of the Ocala Limestone Exposed in the Cemex Center Hill Quarry, Sumter County, FL.

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A Field Trip of the Southeastern Geological Society

December 3, 2016

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Acknowledgements

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The CEMEX Center Hill Quarry

The Center Hill quarry has been in production since 1972. It produces approximately 750,000 tons of base rock annually using a Bucyrus-Erie Model 770 dragline, powered by 4160 volts of electricity. The large bucket on the dragline has a capacity of 18 cubic yards or about 20 tons of excavated material. The plant operates 10 hours a day, 5 days a week, with material shipped throughout the state.

With a rigorous maintenance program, the natural setting surrounding the mine has been preserved, creating a habitat for reptiles and wading birds, such as the endangered sand hill crane and the great blue heron. Center Hill recently earned their Gold Tier Certification from the Wildlife Habitat Council, an organization which recognizes exceptional educational and biodiversity programs at quarries. The certification is good for three years and is the top certification that can be received.

Local mining terminology denotes a soft limestone called “top rock” overlying a higher quality limestone called “bottom rock.” The “bottom rock” is blended with “top rock” to reduce waste. Material from this quarry is used in several applications: highway building (as a sub-base to support the final surface product of asphalt or concrete), commercial construction and home building. It is also used at local power plants as a scrubber rock that cleans up power plant exhaust gases from the burning of coal to produce electricity.

Geologic Overview of Florida

The Florida Platform is delimited by the 200 m (600 ft) isobath at the shelf break to the approximate location of the Paleozoic suture beneath southern Georgia and Alabama (Figure 1).

The platform is constructed of Middle Jurassic to Quaternary evaporite, carbonate, and siliciclastic sediments unconformably deposited upon the basement rocks on a relatively stable, passive margin of the North American Plate.

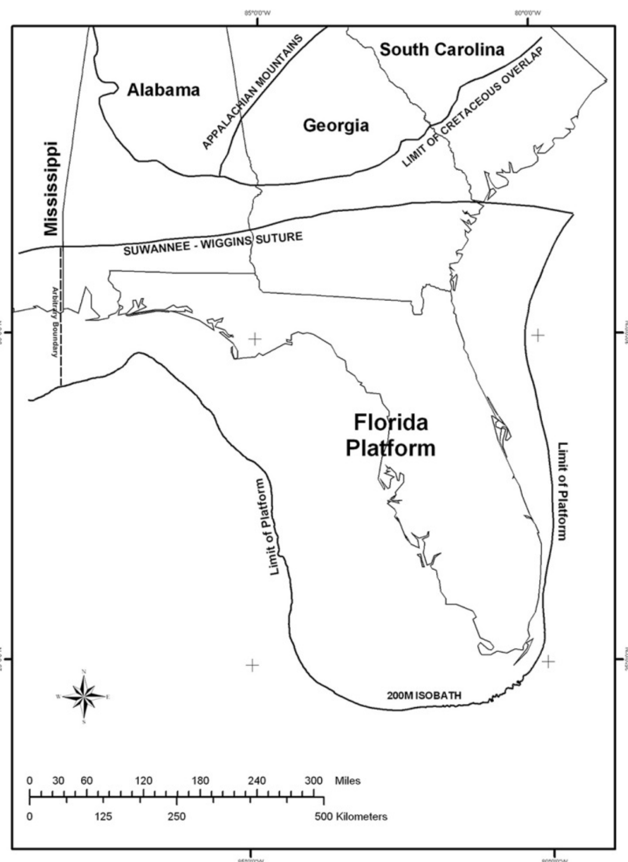

Figure 1 – Limits of the Florida Platform (from Scott, 2016).

Cenozoic deposition was affected by a number of subsurface "structural" features (Figure 2). One of the more important structural features of the Florida Platform is a southwest-to-northeast trending low that has affected deposition from the mid-Jurassic until at least the Middle Miocene. The Georgia Channel System is the name that has been applied to this feature by Huddlestun (1993). The Georgia Channel System provided an effective barrier to the transport of siliciclastic sediments on to the Florida Platform until the earliest Neogene.

Within the general area of the field trip, the Ocala Platform forms a prominent subsurface feature in peninsular Florida. Formerly referred to as the Ocala Uplift or Arch, the feature is neither an uplift nor an arch. Scott (1988) utilized the term platform since it does not have a structural connotation. The Avon Park Formation is the oldest geologic unit exposed or occurring in the shallow subsurface in peninsular Florida. This occurs on the crest of the Ocala Platform in Levy County. The Ocala Limestone and younger sediments have been eroded from the crest of the Ocala Platform. The Ocala Limestone and younger sediments occur on the eastern flank of the Ocala Platform. These units dip and thicken towards the east.

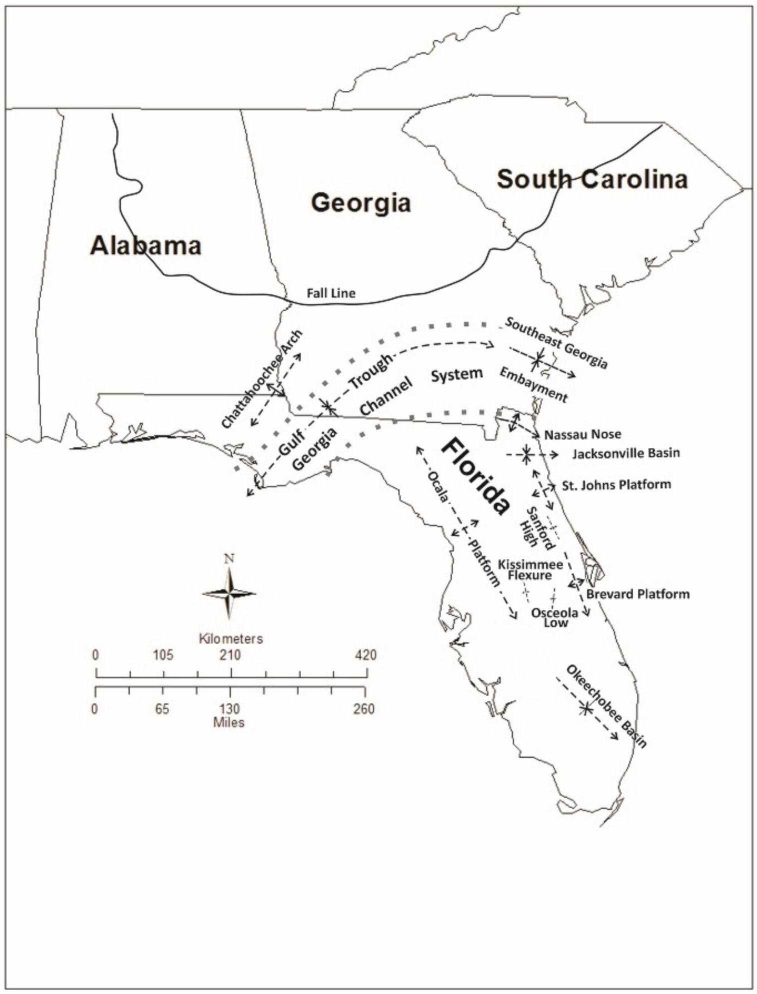

Figure 2 – Cenozoic subsurface features (from Scott, 2016).

In the early Cenozoic (Paleogene), the siliciclastic sediment supply was limited due to the highlands of the Appalachian trend having been reduced by erosion, and carbonate deposition expanded to cover the entire Florida Platform. Later in the Cenozoic, siliciclastic sediments were deposited over broad areas of the platform. Cenozoic stratigraphic units recognized in Florida are shown on Figure 3 (for indications of stratigraphic unit thickness, see Miller 1986; Braunstein et al. 1988). Refer to the geologic map of Florida (Figure 4) for the distribution of surface and near-surface lithostratigraphic units (Green et al., 2015; Williams et al., 2011; Scott et al., 2001; Scott 2001).

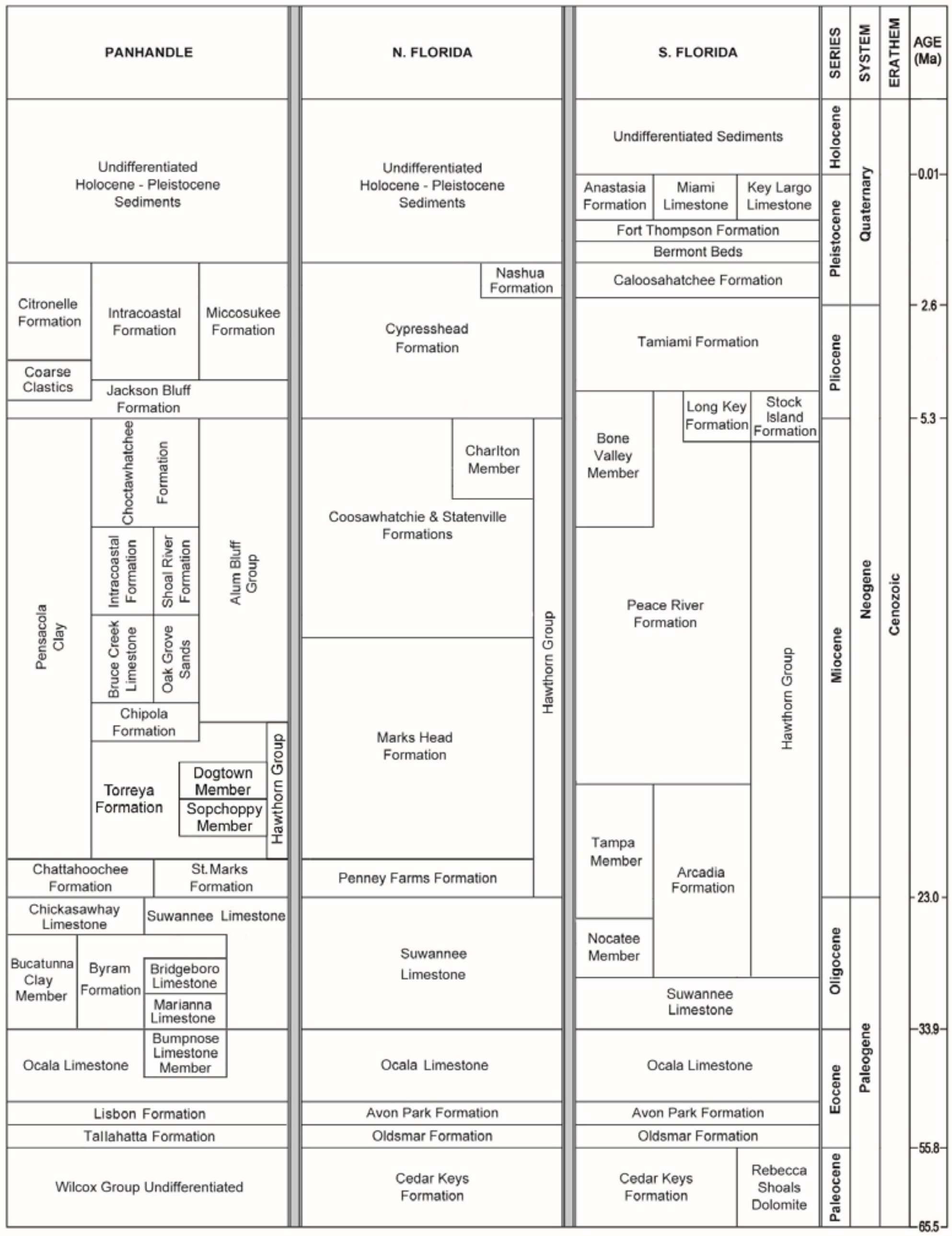

Figure 3 – Cenozoic stratigraphic columns (modified after Braunstein et al., 1988).

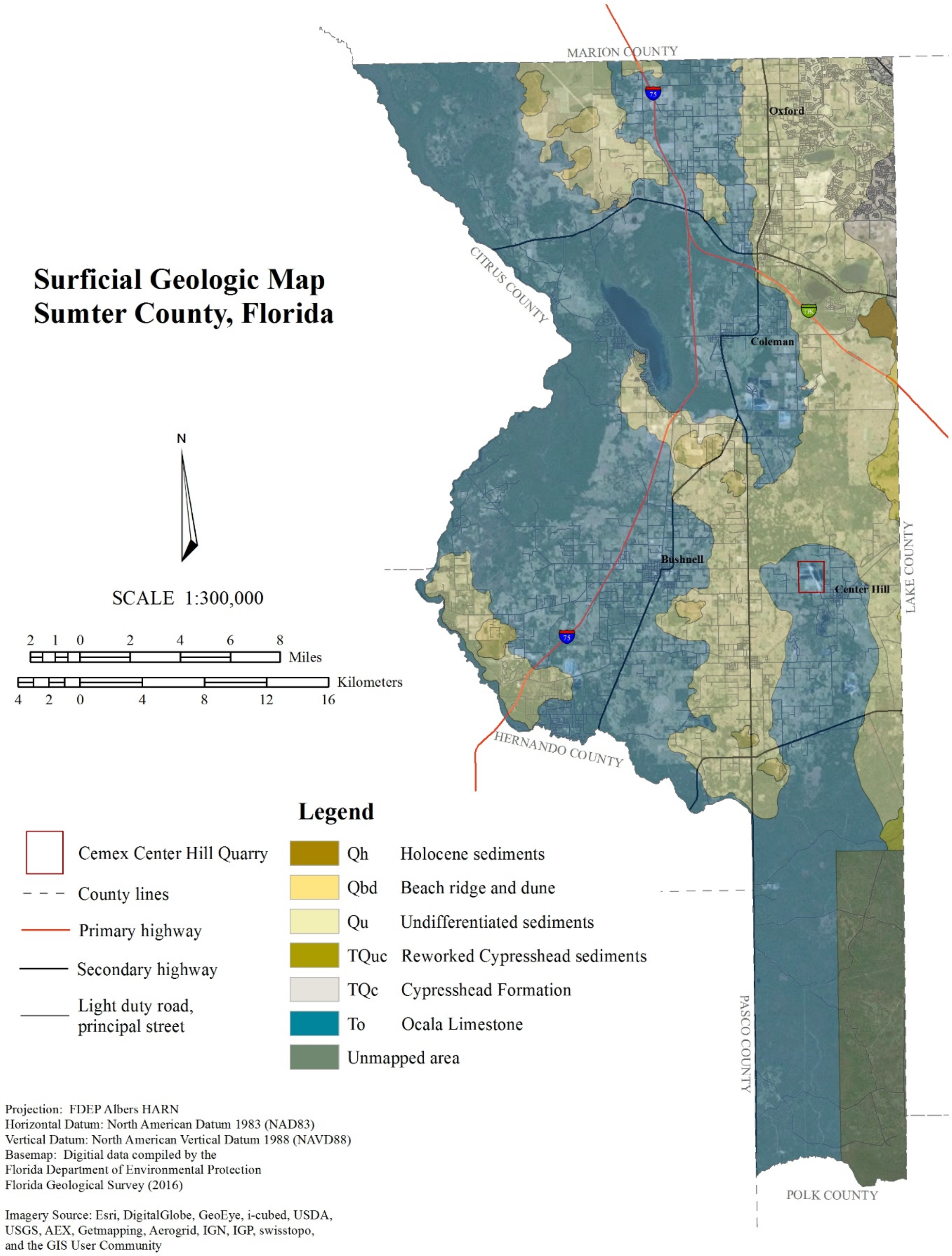

Figure 4 – Surficial geology of Sumter County (after Green et al., 2015 & Williams et al., 2011).

Local Geologic Framework

The geology of Sumter County is discussed by Campbell (1989). Please refer to this Florida Geological Survey publication for a more detailed discussion of Sumter County's geology. The entire county is underlain by Paleogene carbonates excluding the Suwannee Limestone. It is not known if the Suwannee Limestone was deposited in this part of the state and removed by erosion or if it was never deposited. Overlying the Ocala Limestone throughout most of Sumter County are undifferentiated siliciclastic sediments of presumed Tertiary/Quaternary age. Along the eastern edge of the county, Hawthorn Group sediments overlie the Ocala Limestone. The Hawthorn Group is in turn overlain by the Cypresshead Formation (Figure 5).

Dall and Harris (1892) referred to the limestones exposed near Ocala, Marion County, in central peninsular Florida as the Ocala Limestone. Puri (1953, 1957) elevated the Ocala Limestone to group status recognizing its component formations on the basis of foraminiferal faunas (biozones). Scott (1991) reduced the Ocala Group to formational status in accordance with the North American Stratigraphic Code (North American Commission on Stratigraphic Nomenclature, 1983).

The Ocala Limestone consists of nearly pure limestones and occasional dolostones. It can be subdivided into lower and upper facies on the basis of lithology. The lower member is composed of a white to cream-colored, fine to medium grained, poorly to moderately indurated, very fossiliferous limestone (grainstone and packstone). The lower facies may not be present throughout the areal extent of the Ocala Limestone and may be partially to completely dolomitized in some regions (Miller, 1986). The upper facies is a white, poorly to well indurated, poorly sorted, very fossiliferous limestone (grainstone, packstone and wackestone).

Silicified limestone (chert) is common in the upper facies. Fossils present in the Ocala Limestone include abundant large and smaller foraminifers, echinoids, bryozoans and mollusks.

The large foraminifera *Lepidocyclina* sp. is abundant in the upper facies and extremely limited in the lower facies. The presence of these large foraminifers in the upper facies is quite distinctive.

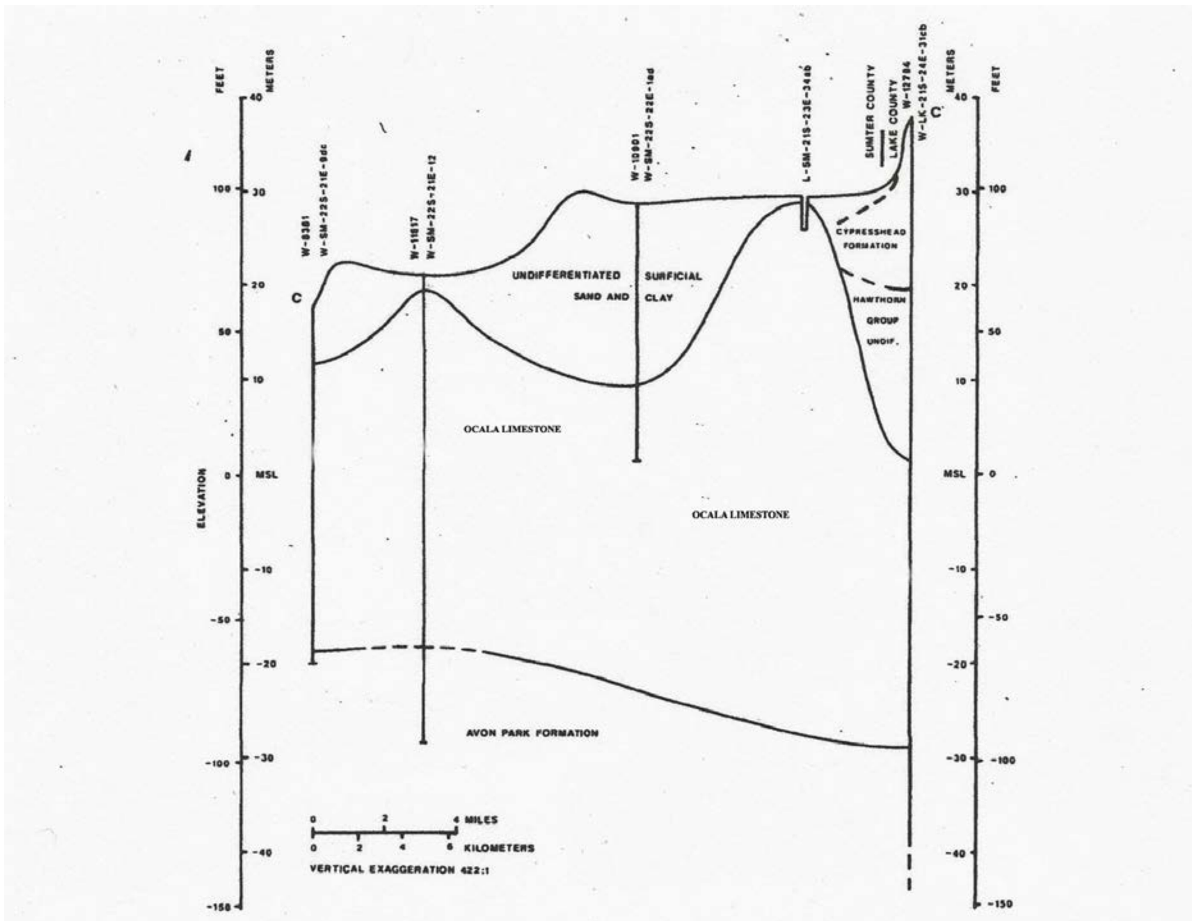

Figure 5 – West-east cross section through the Center Hill mine area (modified from Campbell, 1989).

The Ocala Limestone exhibits extensive karstification. These karst features often have tens of feet (meters) of relief, dramatically influencing the topography of the Ocala Karst District and the Dougherty Plain District (Williams et al., in preparation). Numerous disappearing streams and springs occur within these areas. The Ocala Limestone is the upper-most unit of the Floridan aquifer system (FAS) in this portion of west-central peninsular Florida.

Undifferentiated Tertiary-Quaternary Sediments are siliciclastics that are separated from undifferentiated Quaternary sediments solely on the basis of elevation. Based on the suggestion that the Pleistocene sea levels reached a maximum of approximately 100 feet (30 meters) msl (Colquhoun, 1969), these sediments, which occur above 100 feet (30 meters) msl, are predominantly older than Pleistocene but contain some sediments reworked during the Pleistocene. This unit may include fluvial and aeolian deposits.

These sediments are variably colored, unconsolidated to poorly consolidated, fine to coarse grained, clean to clayey, unfossiliferous sands, sandy clays and clays. Organic debris and disseminated organics may be present in these sediments.

The undifferentiated Tertiary-Quaternary sediments are part of the surficial aquifer system.

Geomorphology

The field trip site is located within the Ocala Karst District (Williams et al., 2011). 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. Elevations within the district range from sea level along the Gulf of Mexico coast to a maximum of 300 feet (91.4 meters) above MSL on the Brooksville Ridge.

Carbonate sediments of the Middle Eocene Avon Park Formation and the Upper Eocene Ocala Limestone lie at or near the land surface in west-central peninsular Florida. Miocene undifferentiated Hawthorn Group, undifferentiated Tertiary/Quaternary sediments, and Quaternary Beach Ridge and Dune sands also occur in the district.

The Ocala Karst District is dominated by sinkholes and shallow bowl-shaped depressions, producing a rolling topography. Generally, a variably permeable siliciclastic cover allows downward migration of groundwater to slowly dissolve the underlying limestone, leading to cover-collapse sinkholes and cover-subsidence features (Sinclair and Stewart, 1985). Cover-collapse sinkholes form rather abruptly from the structural failure of an underlying cavern roof. An excellent example of this is at Devil’s Millhopper Geological State Park, located in Alachua County. Cover-subsidence features generally occur in areas where sediments sag as carbonates dissolve underneath. Typically, areas such as these have shallow sinks formed by the downward raveling of the siliciclastic overburden filling voids created by dissolution of underlying carbonates or by dissolution of the carbonate surface. Springs, sinks, sinking (swallets) and resurgent streams, and caverns commonly occur within the Ocala Karst District.

In Sumter County, the Ocala Karst District consists of the Green Swamp, Ocala Karst Hills, Tavares Lakes, Tsala Apopka Plain and the Williston Karst Plain terrains. The Center Hill mine is located on the Tsala Apopka Plain (Figure 6).

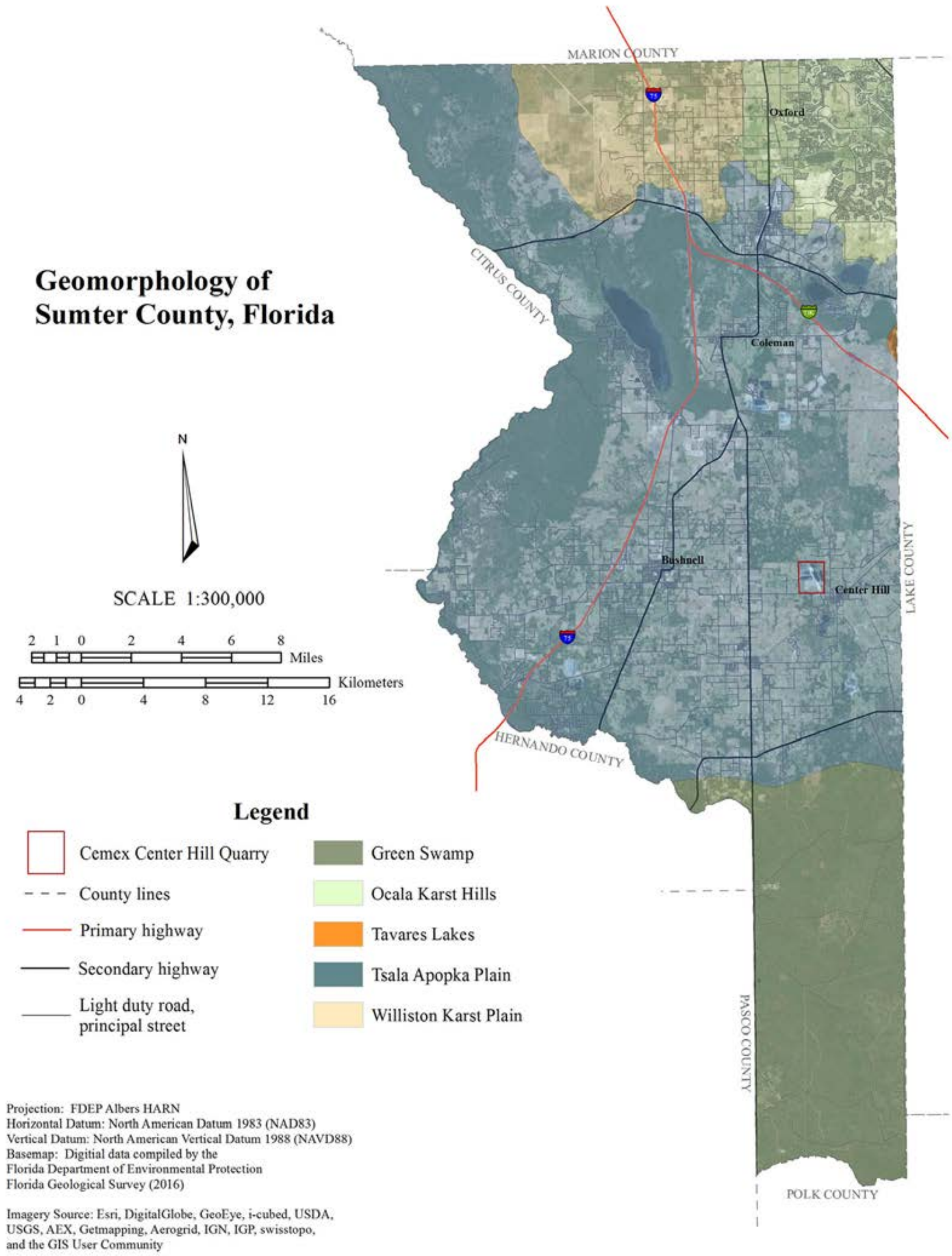

Figure 6 – Geomorphic units in Sumter County (modified from Williams et al., 2011; Green et al., 2015; Williams et al., in preparation).

Invertebrate Paleontology

Overall, the invertebrate fossil record of the shallow, marine, upper Eocene Ocala Limestone is poorly known. Most studies so far have centered on the faunal constituents that were originally calcitic. Thus, organisms such as foraminifera, oysters, scallops, and echinoderms are better studied. However, few reports have been published regarding the once aragonitic-shelled taxa found mostly as internal and external molds; although it may be the largest component. Here, at the Cemex Center Hill Quarry and nearby Sumter County quarries, little paleontological field work has been conducted. Thus, remains of only 29 taxa of trace fossil, bryozoan, corals, mollusks, and echinoderms have been recorded by the FLMNH from the excavated Lower and Upper Ocala Limestone (Table 1). Given that there are nearly 500 taxa of micro- and macro-invertebrates in the Ocala Limestone (Portell, in prep.) it should be easy to greatly expand Table 1. See Plates 1 and 2 for some examples of what may be found here.

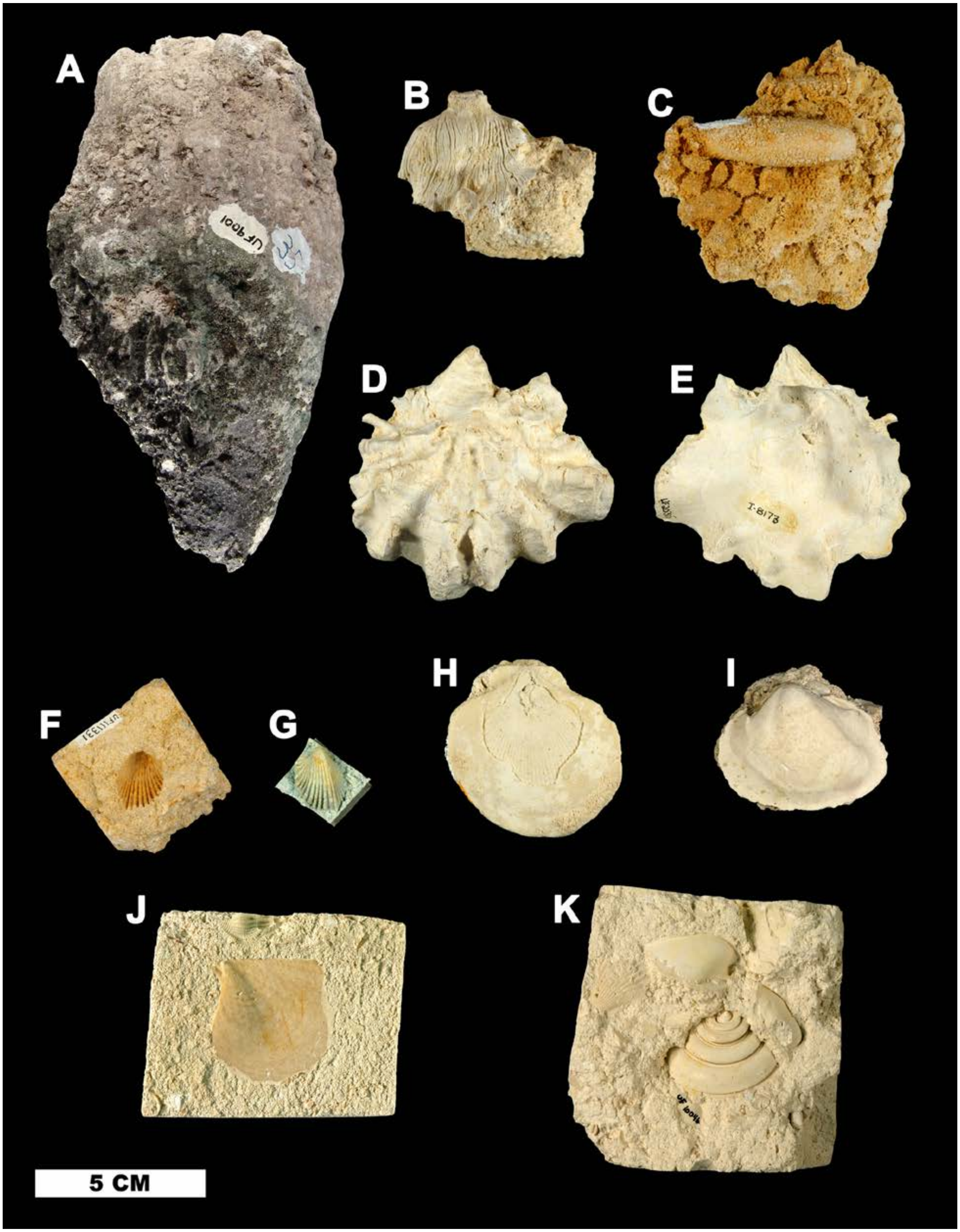
A
B
C
D
E
F
G
H
I
J
K
5 CM

Plate 1 -

A. *Lithoplaision ocalae* Diblin et al., 1991. Side view of ichnofossil; possibly a trace of a sponge or echinoid burrow. UF 9001.

B. Alcyonacea (order). Side view of sea fan holdfast (base). UF 67858.

C. *Lithophaga palmerae* Krumm & Jones, 1993. Date clam embedded in moldic coral, *Astrocenia incrustans* (Duncan, 1873). UF 43650.

D. *Hyotissa podagrina* (Dall, 1896). Exterior view of oyster valve. UF 20305.

E. *Hyotissa podagrina* (Dall, 1896). Interior view of oyster valve. UF 20305.

F. *Sawkinsia* sp. External mold of valve in limestone. UF 111331.

G. *Sawkinsia* sp. RTV silicone rubber cast of external mold of valve. UF 111331.

H. *Amusium ocalanum* Dall, 1898. Scallop shell commonly found in the uppermost Ocala Limestone. UF 58062.

I. *Crassatella ocordia* Harris, 1951. Internal mold of common bivalve. UF 276143.

J. *Pteria* sp. Valve embedded in limestone. UF 159216.

K. *Architectonica* sp. internal mold of a sundial snail. UF 10046.

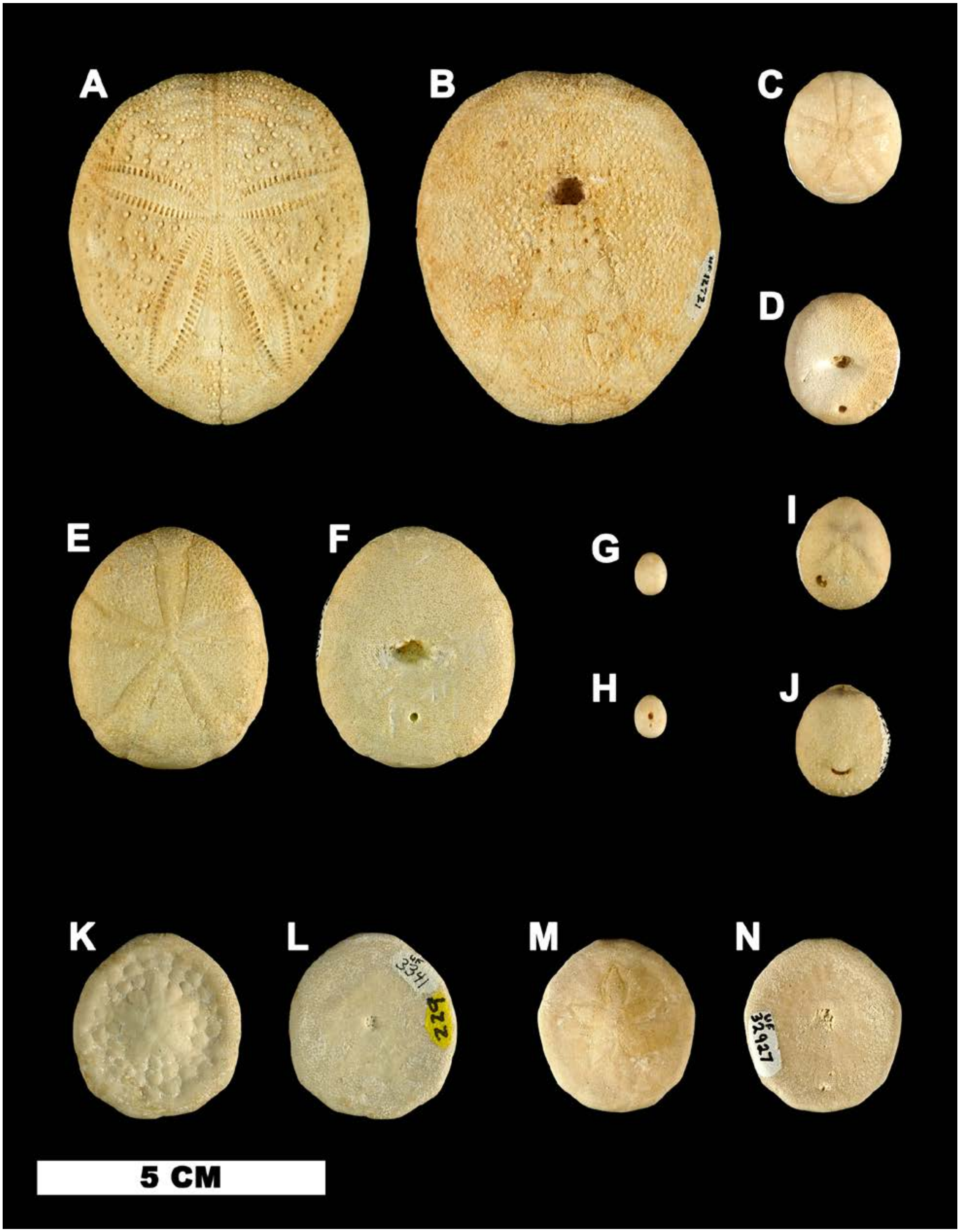
A
B
C
D
E
F
G
H
I
J
K
L
UF 3341
229
M
N
UF 32927
5 CM

Plate 2 -

A. *Eupatagus antillarum* (Cotteau, 1875). Dorsal view of test. UF 12721.

B. *Eupatagus antillarum* (Cotteau, 1875). Ventral view of test. UF 12721.

C. *Oligopygus haldemani* (Conrad, 1850). Dorsal view of test. UF 64401.

D. *Oligopygus haldemani* (Conrad, 1850). Ventral view of test. UF 64401.

E. *Oligopygus wetherbyi* de Loriol, 1887. Dorsal view of test. UF 62675.

F. *Oligopygus wetherbyi* de Loriol, 1887. Ventral view of test. UF 62675.

G. *Fibularia vaughani* (Twitchell, 1915). Dorsal view of test. UF 170030.

H. *Fibularia vaughani* (Twitchell, 1915). Ventral view of test. UF 170030.

I. *Agassizia clevei* Cotteau, 1875. Dorsal view of test. UF 210433.

J. *Agassizia clevei* Cotteau, 1875. Ventral view of test. UF 210433.

K. *Durhamella ocalana* (Cooke, 1942). Dorsal view of test. UF 3341.

L. *Durhamella ocalana* (Cooke, 1942). Ventral view of test. UF 3341.

M. *Weisbordella cubae* (Weisbord, 1934). Dorsal view of test. UF 32927.

N. *Weisbordella cubae* (Weisbord, 1934). Ventral view of test. UF 32927.

Table 1. List of Florida Eocene Ocala Limestone invertebrate species in the Florida Museum of Natural History, Invertebrate Paleontology, collections from Cemex Center Hill Quarry (FLMNH SM010) and surrounding Sumter County quarries.

TRACE FOSSILS

Lithoplaision ocalae Diblin et al., 1991

CNIDARIA

ALCYONACEA

family, genus, and species undetermined

SCLERACTINIA

ASTROCOENIIDAE

Astrocenia incrustans (Duncan, 1873)

BRYOZOA

family, genus, and species undetermined

MOLLUSCA - BIVALVIA

OSTREIDAE

genus and sp. undetermined

GRYPHAEIDAE

Hyotissa podagrina (Dall, 1896)

PECTINIDAE

Amusium ocalanum Dall, 1898

Chlamys spillmani (Gabb, 1860)

PTERIIDAE

Pteria sp.

MYTILIDAE

Lithophaga palmerae Krumm & Jones, 1993

ANOMIIDAE

Anomia sp.

CARDIIDAE

Sawkinsia sp.

CRASSATELLIDAE

Crassatella ocordia Harris, 1951

MOLLUSCA - GASTROPODA

ARCHITECHTONICIDAE

Architectonica sp.

XENOPHORIDAE
Xenophora sp.

ECHINODERMATA - ASTEROIDEA
GONIASTERIDAE
genus and species undetermined

ECHINODERMATA – ECHINOIDEA
CIDARIDAE
Phyllacanthus mortoni (Conrad, 1850)

OLIGOPYGIDAE
Oligopygus haldemani (Conrad, 1850)
Oligopygus phelani Kier, 1967
Oligopygus wetherbyi de Loriol, 1887

FIBULARIIDAE
Fibularia vaughani (Twitchell, 1915)

NEOLAGANIDAE
Durhamella ocalana (Cooke, 1942)
Neolaganum durhami Cooke, 1959
Weisbordella cubae (Weisbord, 1934)

PROTOSCUTELLIDAE
Periarchus floridanus Fischer, 1951

CASSIDULIDAE
Rhyncholampas sp.

SCHIZASTERIDAE
Agassizia clevei Cotteau, 1875
Schizaster ocalanus Cooke, 1942

BRISSIDAE
Eupatagus antillarum (Cotteau, 1875)

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