South Florida Geological Site Guide series
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BRICKELL METRO/PEOPLE MOVER STATION

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What there is to see

Composition and sedimentary structures in the Miami Formation (Miami Oolite). This site is one of the best places to view the sedimentary structures of the Miami Formation.

Location and access

South of downtown Miami at SW 13th Street(Coral Way) and SW 1st Avenue; parking available on the south side of 13th St or east side of 1st Ave one way sounthbound). Take care in crossing these busy roads.

Background

Excavations made in the late 1970's to install the supporting pylons for the Miami Metro and People Mover have created excellent artificial outcrops of the Miami Formation.

Rock type

Observations

The rock is a white to cream-colored rock composed mainly of spherical grains and shell fragments. It effervesces when acid is applied, indicating that the grains are composed of calcite (calcium carbonate – $CaCO_3$), and therefore the rock is a limestone. This particular type of limestone, composed of grains cemented together, is referred to by sedimentologists as a *grainstone*. The majority of fragments are nearly spherical sand grains called *ooids*. A grainstone composed predominantly of ooids is termed an *oolite*. Microscopic examination shows that these sand grains are made up of concentric layers around a small central nucleus of either shell fragments or small quartz grains.

Fossil studies and uranium-lead dating indicated that the limestones of the Miami Formation were produced in the Pleistocene epoch, about 125,000 years ago – very young by geological standards.

Mapping of the oolite shows that it made up a continuous *oolite bank* that forms the Atlantic Coastal Ridge which is in the eastern parts of Miami-Dade and the southern part of Broward county.

Interpretation

Oolitic sand banks are forming at the present time in the shallow waters of the Bahama Banks. Calcite is more soluble in cold water than warm water, so the warm conditions in tropical to subtropical seas encourages the precipitation of calcite from dissolved calcium bicarbonate in seawater. The reaction is:

$$Ca(HCO_3)_2 \rightarrow CaCO_3 + H_2O + CO_2$$

It is also possible that this reaction is not entirely inorganic and algae may play an important role in the precipitation of calcite in ooids. The agitation caused by the Atlantic oceanic swell rolls the grains around during calcite precipitation producing the concentric pattern observed in the ooids.

Thus, the Miami Formation is considered to have formed in conditions very similar to the present day Bahamas. If this is the case, then sea level at the time of the deposition of the Miami Formation would have been about 10m (~30 ft.) higher relative to the land than a present. As Florida is tectonically very stable it is more likely that this higher level was the result of global sea level rise rather than uplift of South Florida. This view is supported by many other studies that indicate that the Miami Formation was deposited in the last interglacial stage (Sangamon) when sea level was indeed about 10m above the present sea level.

Sedimentary structures

Observation

The main bedding surfaces are horizontal and about 20-30cm thick. These surfaces define "packets" within which are subsidiary laminations which dip at an angle of about 25^0 to the main bedding surfaces. These subsidiary strata are known as cross beds. Note that the majority of the cross beds dip toward the E or SE, but that a few cross beds dip W to NW.

Within the cross bedded packets, there is single rubble layer composed of large clasts of limestone. One of these clasts is a small head of star coral (genus *Montastrea*).

Interpretation

Cross bedding has been shown to result from deposition by horizontally moving water or air. The cross laminations dip in the direction of the movement of the currents. In this case, this suggests that the majority of the currents were roughly perpendicular to the trend of the oolite bank and the ancient coastline.

The detailed topography supports this view. The generally N-S trending Atlantic Coastal Ridge is transected erosional channels (Figure 1) that formed due to currents draining the lagoonal area on the landward side of the ridge. Similar topography is seen on the actively forming oolite sand banks in the Bahamas at the present day.

The cause of these currents is uncertain. One possibility is that they are caused by tides, allowing water to drain from the lagoon behind the oolite bank during low tide, and for ocean water to drain into the lagoon during high tide.

This author thinks that it is more likely that the cross-bedded packets were deposited after seasonal, or extreme weather events. High summer rainfall, or tropical storms, would fill up the lagoon and produce land-to-ocean currents lasting many days. Storm surges could cause ocean-to-land currents, but these would probably be much more short-lived than the lagoon draining events.

The rubbly layer is probably the result of a storm event in which coarse material from the coastline was moved inland by high energy oceans waves.

References and further reading

Evans, C.C., 1987, The relationship between the topography and internal structure of an ooid shoal sand complex: the upper Pleistocene Miami Limestone, p. 18-41 *in* Maurasse, F. J-M. R.(ed) Symposium on South Florida Geology, Miami Geological Society, Miami, 233pp.

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Figure 1 Detailed topography of eastern Miami-Dade county produced from airborne laser ranging experiments conducted at the International Hurricane Research (IHRC) center at Florida International University and imaged by a team led Dr. Dean Whitman of the Dept of Earth Sciences/IHRC. Note how the high standing Atlantic Coastal Ridge (red) is dissected by NW-SE channels.