Characterizing Geomorphology of Connected Coral Mounds by Gulf Stream Influence on the Lower Stetson Mesa off the Southeast U.S. Coast.

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Study Areas

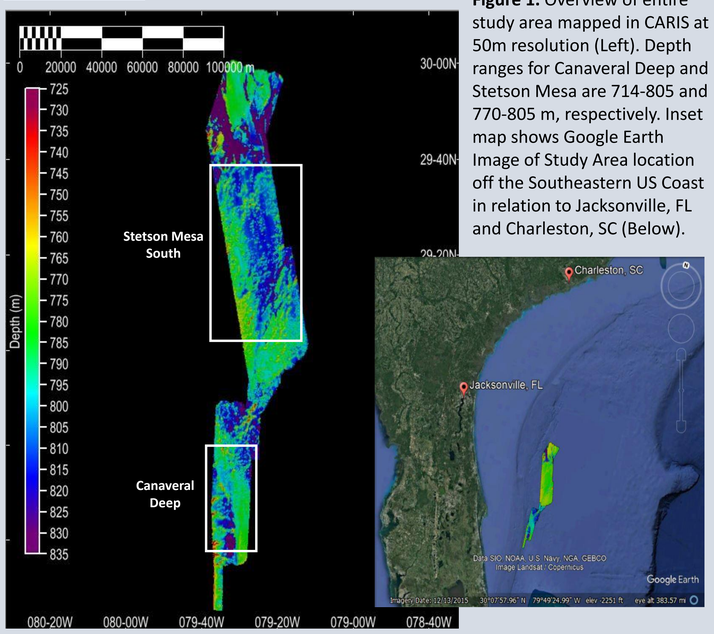


Figure 1. Overview of entire study area mapped in CARIS at 50m resolution (Left). Depth ranges for Canaveral Deep and Stetson Mesa are 714-805 and 770-805 m, respectively. Inset map shows Google Earth Image of Study Area location off the Southeastern US Coast in relation to Jacksonville, FL and Charleston, SC (Below).

Abstract

The Stetson Mesa is an incredibly biodiverse habitat and geomorphological region of great interest to NOAA and the scientific community because of its proximity to the Gulf Stream which provides high-current environments for benthic habitats. The mesa is located on the western portion of the Blake Plateau off the Southeastern U.S. coast. NOAA's Office of Ocean Exploration and Research (OER) conducted seafloor mapping and ROV dives from aboard the NOAA Ship *Okeanos Explorer* during *Windows to the Deep 2019: Exploration of the Deep-Sea Habitats of the Southeastern United States*, EX1903. While mapping this area, the ROV *Deep Discoverer* conducted multiple dives to collect information on the seafloor geomorphology and benthic communities. This study focuses on two portions of the lower Stetson Mesa, at sites referred to as Canaveral Deep and Stetson Mesa South where numerous connected coral mounds, made of deep-sea coral communities built over time on top of stony coral rubble, were mapped. These coral mounds are classified as 'connected mounds' as they are adjacent to one another and aligned across the flow of the Gulf Stream's current. These connected coral mounds and their many features are believed to be influenced by the Gulf Stream's nutrient- and food-rich water. The purpose of this study is to compare and characterize this type of deep-sea mound at two study sites which both lie directly under the main Gulf Stream axis at water depths between 700 and 800 m. Multibeam sonar data were used to observe bathymetry, slope and backscatter in an attempt to classify Gulf Stream influence. Results on the distribution of deep-sea coral connected mounds are presented, including potential sites for other possible deep-sea coral habitat in the region.

Background

In June of 2019, NOAA OER sponsored an expedition to further map and study multiple areas off the Southeastern US coast, including previously mapped areas and ROV Dives at certain sites deemed high priority exploration locations for the expedition. Located 60 miles off the coast of Cape Canaveral Florida (Fig. 1), the Canaveral Deep area is located at the southern end of the "Million Mounds" region, within the Stetson Miami Terrace Deep Water Coral Habitat Area of Particular Concern (HPAC), (NOAA OER, Dive 1 Summary, 2019). Located 98 miles from Jacksonville, Florida and 50 miles north of Canaveral Deep, the Stetson Mesa site is located inside the "Million Mounds" region (Fig. 1). Both dive locations focused on connected coral mounds found between 700-800 m water depth (Fig. 2 & 3). Connected coral mounds are defined as coral mounds consisting of multiple peaks found in lengthy chain-like formations (Horn & Sautter, 2019). The purpose of this study was to compare and contrast mounds based on bathymetry, slope and backscatter intensity in these two high priority research locations.

Methods

- A total of six study sites (labeled as A-F) within two study areas, Canaveral Deep and Stetson Mesa South (Fig. 1) were chosen due to the abundance of connected coral mounds and proximity along the Gulf Stream's axis.
- CARIS 11.2 HIPS and SIPS software was used to create 30m resolution CUBE bathymetric, backscatter intensity and slope surfaces for each of the two study areas.
- Two long-axis profiles, running the length of a series of connected mounds were generated for each study site, as well as cross-profiles, cutting across the shoalest mound for each series.
- Backscatter intensity profiles associated with each long axis profile were generated along the same long axis profile as bathymetry.
- Backscatter intensity (dB) and slope (degrees) were measured at 30 randomly selected points along each long-axis profile.

Canaveral Deep Sites

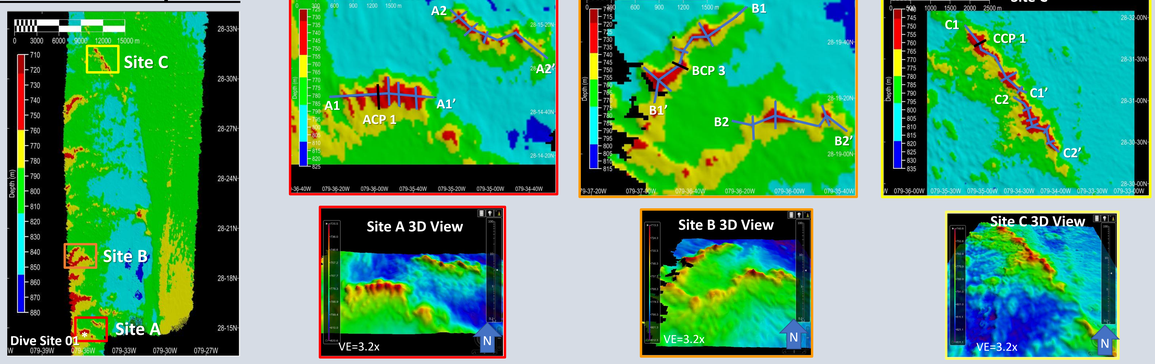
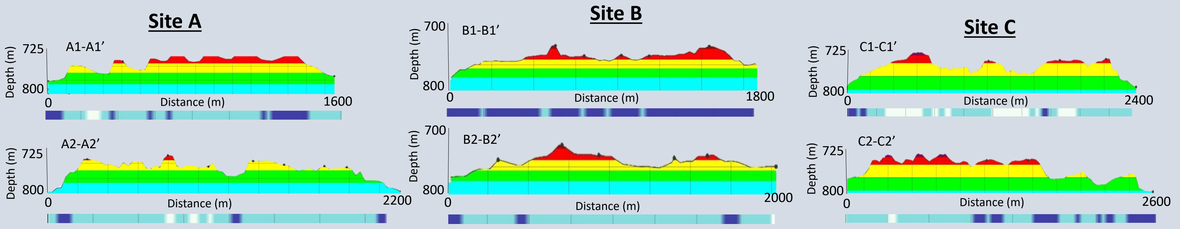


Figure 2. (Above, left) Canaveral Deep 50m interpolated Classified Bathymetric CUBE surface showing location of Study Sites A-C and EX1903 Dive 01 (asterisk). (Above) 30m CUBE surfaces for each study site in classified bathymetry coloring displaying long axis and cross profile locations and 3D view. (Below) Long-axis profiles (VE=6.1x) for study sites A-C shown with classified backscatter intensity profile bars underneath.



Stetson Mesa South Sites

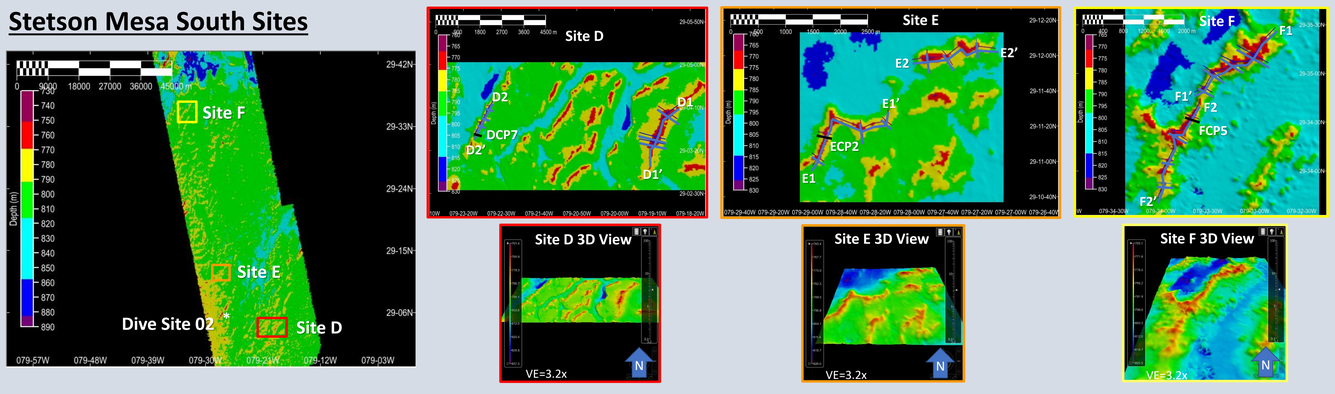
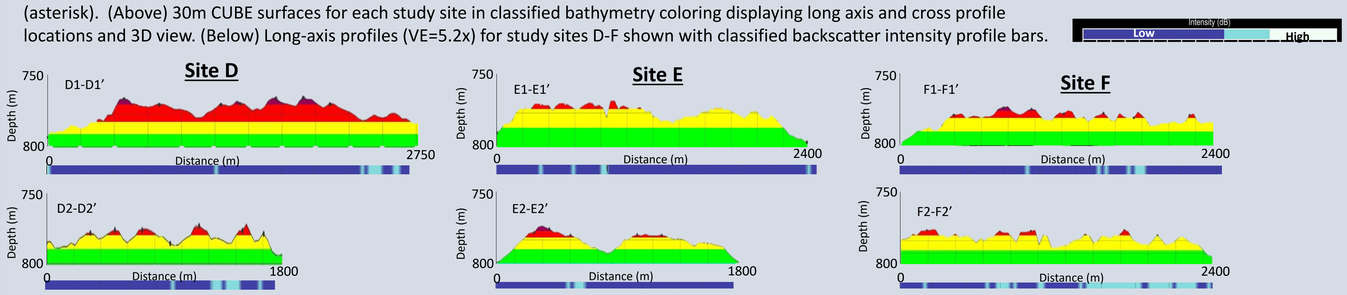


Figure 3. (Above, left) Stetson Mesa 50m interpolated Classified Bathymetric CUBE surface showing location of Study Sites D-F and EX1903 Dive 02 site (asterisk). (Above) 30m CUBE surfaces for each study site in classified bathymetry coloring displaying long axis and cross profile locations and 3D view. (Below) Long-axis profiles (VE=5.2x) for study sites D-F shown with classified backscatter intensity profile bars.



Cross Profiles

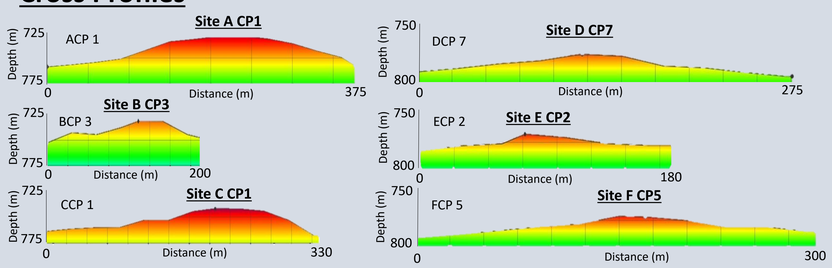


Figure 4. Representative Cross Profiles for mound peaks at each Study Site, showing longer, shallower cross profiles at Canaveral Deep (Fig. 2, Above, left) and deeper shorter cross profiles at Stetson Mesa (Fig. 3, Above left) General geomorphology across all cross profiles showed similar board, dome shaped profiles.

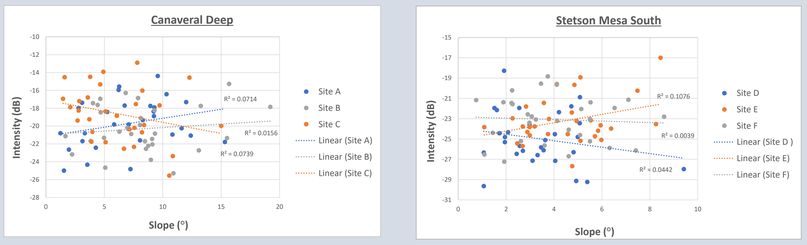


Figure 5. Scatter plots of data collected from three sites at both Canaveral Deep and Stetson Mesa South Study Areas showing no correlation between Backscatter Intensity and Slope for 30 randomly selected pointed along each long axis profile (Figs. 2 and 3).

Results

Canaveral Deep:

Site A

- Cross profiles at A1-A1′ (Fig. 2) showed shallow, broad, dome shaped peaks ranging from 400-275m in width (Fig. 4).

Site B

- B1-B1′ Cross Profiles (Fig. 2) along the long axis profile showed shallow, broad plateau like features ranging from 450-175m in width (Fig. 4).

Site C

- Cross profiles at C1-C1′ (Fig. 2) showed shallow, broad, shield shaped peaks ranging from 450-200m in width (Fig. 4).

Stetson Mesa South:

Site D

- Cross Profiles along D2-D2′ (Fig. 3) showed broad, low relief dome shaped peaks ranging from 300-50m in width (Fig. 4).

Site E

- Cross Profiles along E1-E1′ (Fig. 3) showed sharp, high relief peaks ranging from 200-100m in width (Fig. 4).

Site F

- Cross profiles along F1-F1′ (Fig. 3) showed board, moderate relief dome shaped peaks shaped areas ranging from 300-150m in width (Fig. 4).

Overall Study Areas:

- No correlation between Backscatter Intensity and Slope was seen at either study area (Fig. 5).
- Canaveral Deep Study Area showed a higher average in the range of slope values seen than compared to Stetson Mesa Study Area (Fig. 5).
- Stetson Mesa South showed a higher average in the range of Backscatter Intensity values than compared to Canaveral Deep (Fig. 5).
- Cross profiles along long axis profiles from each study site (Fig. 4) showed similar geomorphology.
- Intensity profiles showed that backscatter intensity values were not associated with areas of high slope along long axis profiles (Fig. 2 & 3).

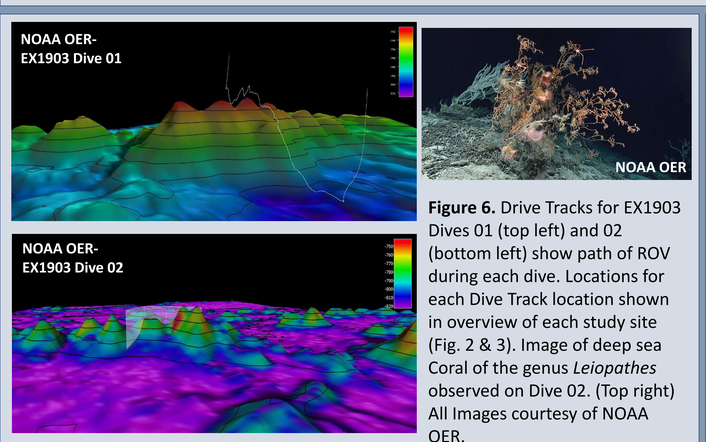


Figure 6. Drive Tracks for EX1903 Dives 01 (top left) and 02 (bottom left) show path of ROV during each dive. Locations for each Dive Track location shown in overview of each study site (Fig. 2 & 3). Image of deep sea Coral of the genus *Leiopathes* observed on Dive 02. (Top right) All Images courtesy of NOAA OER.

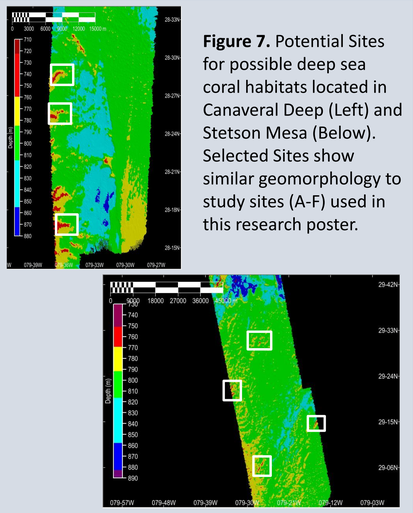


Figure 7. Potential Sites for possible deep sea coral habitats located in Canaveral Deep (Left) and Stetson Mesa (Below). Selected Sites show similar geomorphology to study sites (A-F) used in this research poster.

Conclusions and Discussion

Analysis of the results showed that over both Canaveral Deep and Stetson Mesa, Backscatter Intensity and Slope showed very poor to no correlation (Fig. 5). Similar results were found in an earlier study that examined Backscatter Intensity and Slope along Dive Tracks from NOAA EX 1806 Dive 05 and 06 (DiTommaso & Sautter, 2019). Their results showed that at dive sites with large deep-sea coral communities, acoustic signals may become scattered by coral rugosity and rough dead coral rubble, resulting in a lower return intensity. Dead coral rubble may also explain the low intensity results seen at the connected mounds examined at Canaveral Deep and Stetson Mesa South.

In conclusion, further studies on Canaveral Deep and Stetson Mesa should be conducted without using backscatter intensity as an indicator for the presence of deep sea coral habitats. Distribution of deep-sea connected coral mounds appears to be seen clumped in groups (Fig. 2 & 3). Potential sites for other deep sea coral habitats were observed throughout Canaveral Deep and Stetson Mesa (Fig. 7). Each potential site should be included in future NOAA ROV Dives or future Biological and Geomorphological research.

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