# Geomorphologic Comparison of Deep-Sea Coral Mounds and Scarps on the Stetson Mesa, Southeast U.S. Continental Margin

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### BACKGROUND

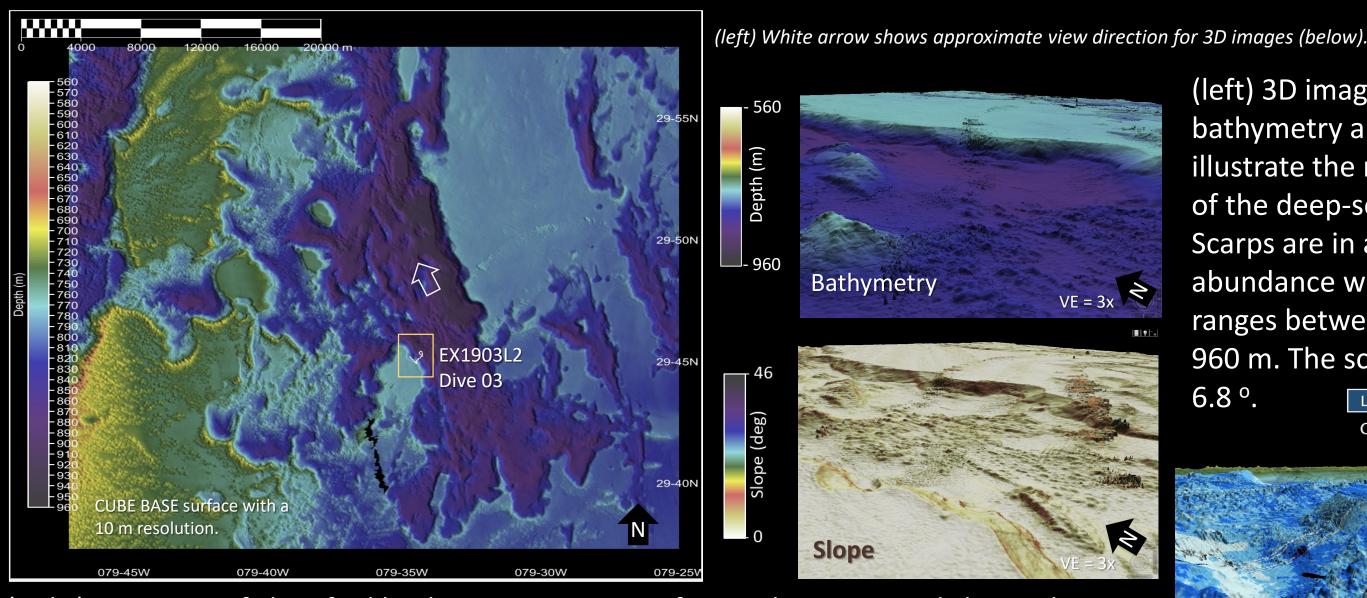
In 2019 the NOAA Windows to the Deep 2019: Exploration of the Deep Sea Habitats of the Southeastern United States conducted research and mapping of the area known as the Blake Plateau using the NOAA Ship Okeanos Explorer. The goal was to further understand the deep-sea biological communities and geological features of interest in an area known as Stetson Mesa located on the western edge of the Blake Plateau. These areas are vulnerable to human interactions such as offshore oil drilling, undersea cable line installations, etc. Deep-sea benthic communities in this region depend on microscopic invertebrates and ocean currents to get nutrition to survive and thrive.

The Stetson Mesa is a flat isolated region within the Blake Plateau that lies directly beneath the Gulf Stream off the coast of Florida, ranging in depth from 600 to 1000 m. The mesa includes hundreds of deep-sea coral mounds, as well as broad canyons with steep scarps. Deep-sea coral mounds are comprised primarily of exoskeletal remains of the stony coral Lophelia pertusa, a stony coral that prefers water below 10°C and grows several meters in diameter and 1 to 3 m high.

Three sites were examined within the Stetson Mesa region approximately 100 to 170 m offshore of Florida's coast between Jacksonville and Cape Canaveral (Fig. 1). The purpose of this study is to compare the deep-sea coral mound abundance and geomorphology among the three sites as well as to characterize the geomorphology of scarps found within the North and Central Sites. This study expands on other research by former BEAMS students to better understand the Blake Plateau, its geomorphologies and biological diversity within the different deep-sea habitats.

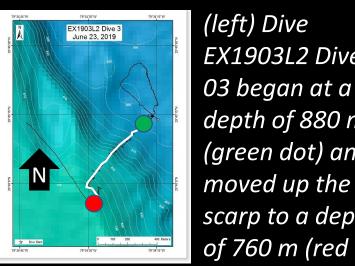
# Figure 2. North Site

North Site is the deepest of the 3 sites studied, and has more plateaus and scarps than coral mounds.



(right) 3D image of classified backscatter intensity of a North Site mound shows the areas of high intensity (white) occurring along the base of the mound, whereas mound crests and flanks, as well as the surrounding seabed are dominated by medium and low intensity.

ROV Scarp Dive: EX1903L2 Dive 03 (See dive location on bathymetry surface, above left)



EX1903L2 Dive 03 began at a depth of 880 m (green dot) and moved up the scarp to a depth

(right) An Atlantic Blackbelly Rosefish and an abundance of brittle stars were seen on the dive This brittle star was found on a glass sponge.

pertusa were observed on this scarp dive.

# Figure 3. Central Site

Central Site is the shallowest of the three sites and has an abundance of thousands of *Lophelia pertusa* coral mounds, and several scarps of

(below) White arrow shows approximate view direction for 3D images (below right).

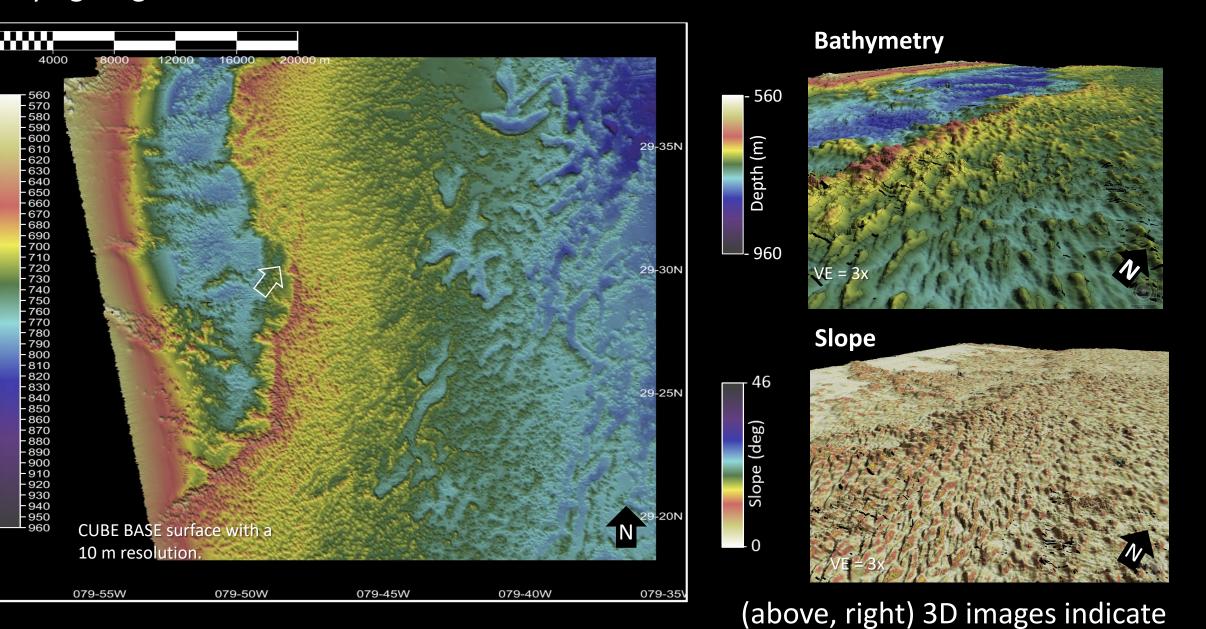


Figure 1. Stetson Mesa and Site Locations

North Site (700-1000 m)

has minimal deep-sea

coral mound clusters.

and an abundance of

**Central Site** 

scarps varying in

morphology.

CUBE surface with a 10m resolution

(right, below) 3D image of classified backscatter intensity of a Central Site mound shows the areas of high intensity (white) occur at mound peaks in shallow depths of 560 to mounds and remaining surface have mostly medium and low intensity at depths of 720 to 800 m.

700 m, whereas deeper coral

mound flanks are only as steep as 9.9°. LOW MED HIGH

thousands of coral mounds occurring at

depths from 560 to 800 m. At this site,



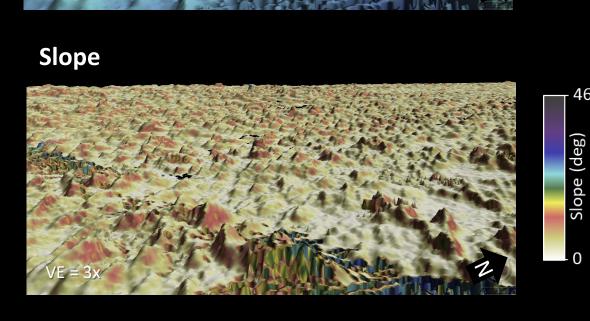
# METHODS

- Multibeam sonar data were collected aboard NOAA Ship Okeanos Explorer using a Kongsberg EM302 during 3 expeditions:
- EX1806 from the 2018 *Windows to the Deep* expedition
- EX1903L1 and EX1903L2 from the 2019 Windows to the Deep expedition.
- 2014 mapping expedition EX1403 CARIS HIPS and SIPS 11.4 was used to create CUBE bathymetric and slope
- surfaces with a 10 m resolution.
- Depth profiles, classified backscatter mosaics, and classified slope images were
- Three study sites were chosen due to their geomorphologic differences in depth, abundance of deep-sea coral mounds, and scarp features.
- HD video collected by the ROV *Deep Discoverer* from EX1903L2-Dives 02 and 03 was used to further interpret the Northern and Southern study sites.

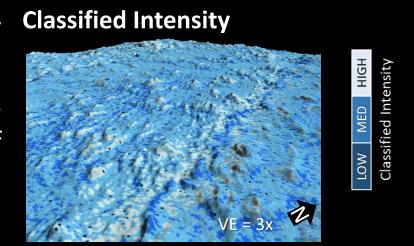
Figure 4. South Site

South Site is the deepest site with depths ranging 720 to 850 m. This site has an abundance of deep-sea coral mounds that occur on an overall flat area of Stetson Mesa. No scarps are found at this site.

(right) South Site has the highest concentration and abundance of Lophelia pertusa coral mounds. Mound flanks have slopes up to 5° whereas the surrounding area slope is

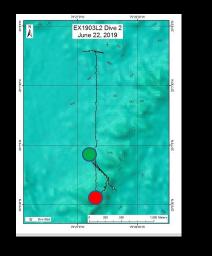


(right) This area has mostly Classified Intensity medium to low intensity, with high intensities located between peaks of coral mound chains and on eastern mound flanks



ROV Scarp Dive: EX1903L2 Dive 02 (See dive location on bathymetry surface, above left)

EX1903L2 Dive 02 29-06N



**Central Site** 

Central Site is the

shallowest of the three

(600-850 m) and has an

abundant variety of deep-

sea coral mounds as well

South Site is the

deepest (800-1000

m) and flattest with

thousands of coral

as canyons and scarps.

(right) Live coral colonies were seen on the mound's coral rubble substrate along with other benthic biota such as anemones, brittle stars, and a type of shrimp.

(above) Dive EX1903L2 Dive 02 began at a depth of 820 m (green dot) and moved up the scarp to a depth of 740 m (red

South Site

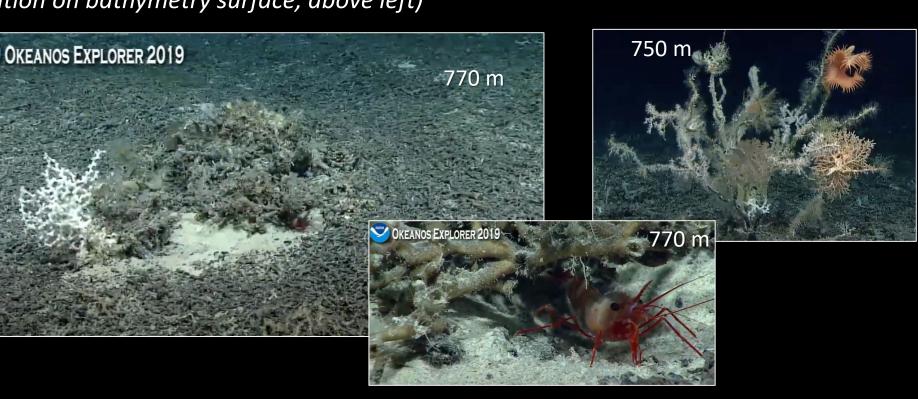
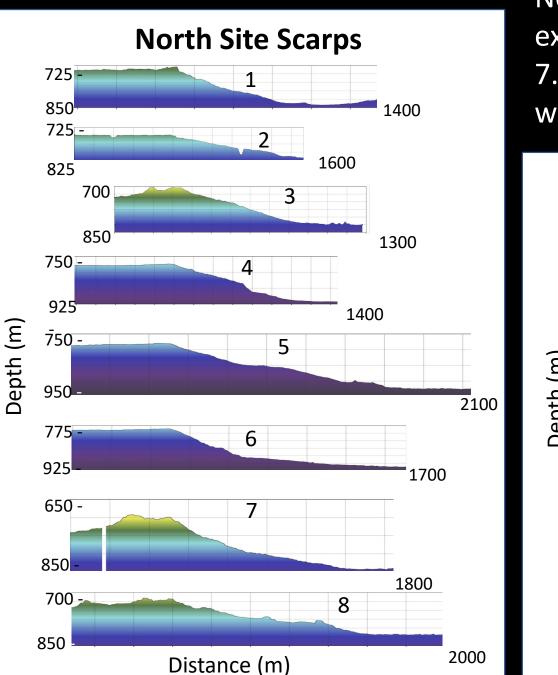


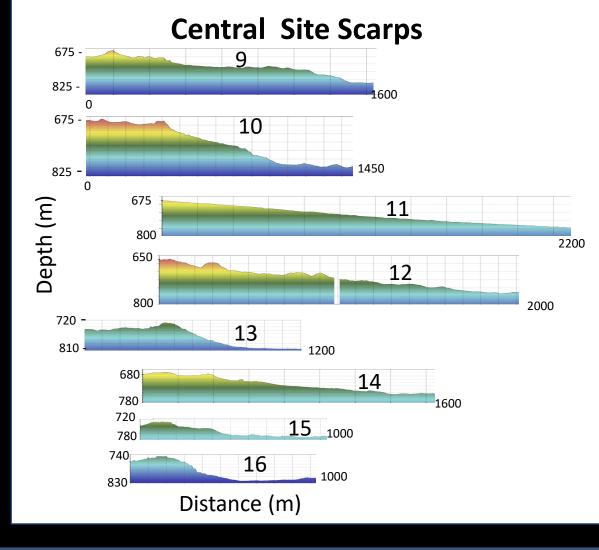
Figure 5. Comparative Scarp Profiles

Profiles from each site were made to compare the scarp slopes and sizes. All profiles are scaled to a VE = 2.0x.

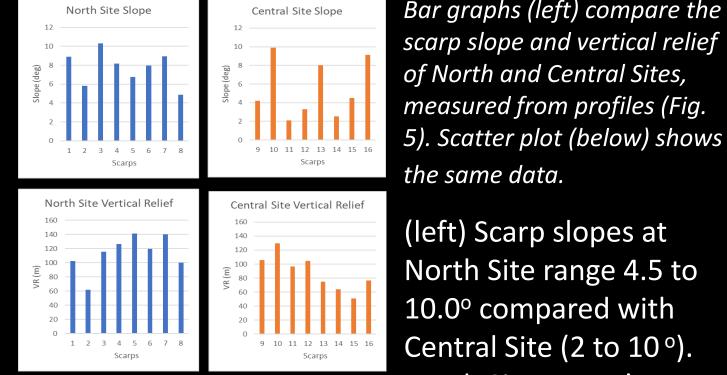


North Site Scarps have steeper more exaggerated slopes with a mean slope of 7.7°. Central Site Scarps are more gradual with an average slope of 5.5°.

Central Site



# Figure 6. Scarp Data Analysis



(left) 3D images of

bathymetry and slope

of the deep-sea scarps.

Scarps are in a greater

abundance with depth

(left) The substrate along the scarp's ridge

communities of the stony coral Lophelia

consists of coral rubble. No living

ranges between 560 m to

960 m. The scarp slope is

illustrate the morphology

Most of the North Site scarps examined have both a greater slope and vertical relief than most of Central Site's scarps examined (right). Central Site's

the same data. (left) Scarp slopes at North Site range 4.5 to 10.0° compared with Central Site (2 to 10°). North Site scarps' vertical relief is 60 to 140 m and Central Site

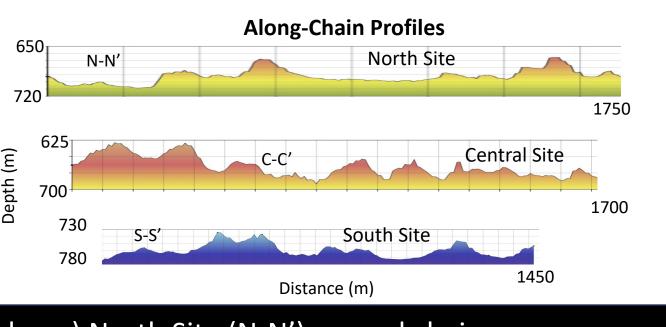
Bar grapns (left) compare the

scarp 10 is an outlier for that site, as it is larger and steeper.

VR ranges 50 to 130 m.

# Figure 7. Comparative Mound Profiles

Profiles from each site were made to compare the coral mounds structures and sizes. All profiles are scaled to a VE = 2.0x.



(above) North Site (N-N') mound chains occur on the edges of scarps, mostly on the western, shallower portion of the site. Central Site mound chains (C-C') are more abundant and shallower than the other sites. Coral mound chains at South Site (S-S') are in greater abundance with hundreds of chains at these depths.

**Cross-Chain Mound Profiles Central Site** 

Longer profiles (white lines) cross several mounds,

whereas red lines indicate short profile across a

single mound.

(above, right) Mound cross-section profiles indicate that the Central, has the greatest density of coral mound chains that are more broad. The North Site has the lowest density of coral mounds, both North and Central Site have the same vertical exaggeration of 75 m. The South Site has the most peaked coral mounds with greater density than the North Site, it has a more condensed base whereas the Central Site is multi-peaked and much broader of a base.

## SUMMARY

Each study site examined has unique geomorphology. Characterizing geomorphologies allows for further understanding of the influences that affect deep-sea habitats. Of the three Stetson Mesa sites, North Site has the most variation in geomorphology. This site has both scarps and deepsea coral mounds that are in abundance closer to the shallower depth ranges (650-720 m). The Central Site is the shallowest of the three study sites, and has the greatest abundance of deep-sea coral mound colonies. The site also has a range of scarps and canyons however they have more gradual, lower slopes in comparison to the North Site. The deepest site, South Site (720-960 m), can be described as having predominantly flat underlying substrate with a high abundance of deepsea coral mounds.

Both North and Central Sites have areas of high backscatter intensity on coral mound peaks and scarp faces, whereas South Site (fig 4.) has areas of high intensity on mound peaks. South Site also has unusually low intensity along a low chain of mounds. Previous studies by Berkimer and Sautter (2020) and Horn and Sautter (2019) have shown a positive correlation between intensity and slope has been used to predict locations of hard, steep substrate that may support biological communities; however coral mounds in our study, for example show inconsistent backscatter

High-definition video filmed on ROV expedition EX1903L2 (Dives 02 and 03), revealed that North Site and South Site contain biological communities inhabiting coral rubble substrate. The North Site dive (EX1903L2 03) on a scarp face revealed little to no living coral colonies and the scarp consisted mostly of coral rubble. Within North Site there are more scarps with a greater density and abundance of coral mound chains along the scarp face. The South Site dive (EX1903L2) 02) was on a coral mound chain. This dive showed a greater density of live coral colonies on the mound crest.

In the future, more dives should be conducted in this area to better understand a connection between its geological features and where biological communities occur.

### REFERENCES

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