Geomorphologic Analysis of the Southwestern Blake Plateau, Southeast U.S. Continental Margin

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BACKGROUND

Throughout May- July of 2019, the NOAA Office of Ocean Exploration and Research conducted its *Windows to the Deep 2019* expedition on the Southeast U.S. continental margin utilizing the NOAA Ship *Okeanos Explorer*. The goal of the expedition was to collect information of unknown and poorly understood deep-water areas of the region, including the Blake Plateau, and to map areas that could harbor large fishery habitats and deep-sea coral habitats.

The purpose of this study was to analyze the geomorphological characteristics of the southwestern region of the Blake Plateau, 85 km off the coast of Cape Canaveral, FL. Two areas were examined along scarps and a third area included a chain of coral mounds in the middle portion of the study area. The two scarps are likely formed from tectonic activity during the formation of the Mid-Atlantic Ridge which would have caused normal faulting to occur and for the basin to slowly expand and increase in thickness (Shaw, 1992). The coral mound chain site is along the eastern extent of an area referred to as 'million-mounds'. These three study sites were analyzed to characterize their geomorphology.

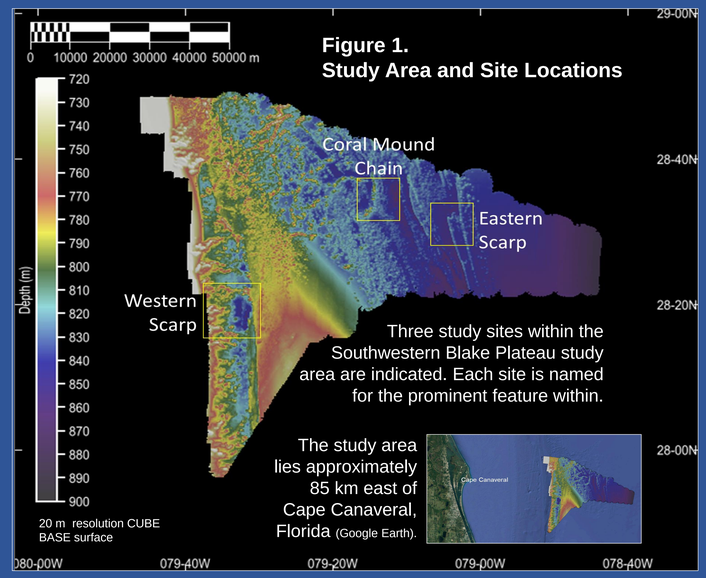

Figure 1.
Study Area and Site Locations

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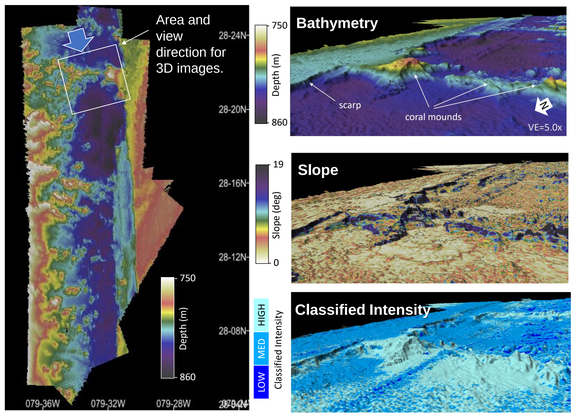
METHODS

- The NOAA Ship *Okeanos Explorer* collected sonar date during EX190303L1, and ROV dives were conducted EX1903L3 (June-July).
- A Kongsberg EM302 multibeam sonar was used.
- ROV Dives were conducted using NOAA's *Deep Discoverer.*
- The NOAA Ship *Nancy Foster* survey dates were between September 3rd – September 7th, 2013.
- CARIS HIPS & SIPS 11.3 was used to process all raw sonar data.
- A 20m resolution CUBE bathymetric surface was created along with slope surfaces to characterize the geomorphology of the three different study sites.
- A SIPS backscatter intensity mosaic was created and manually classified.
- Cross-sectional profiles of features were made for each study area.

Figure 2. Western Scarp Study Site

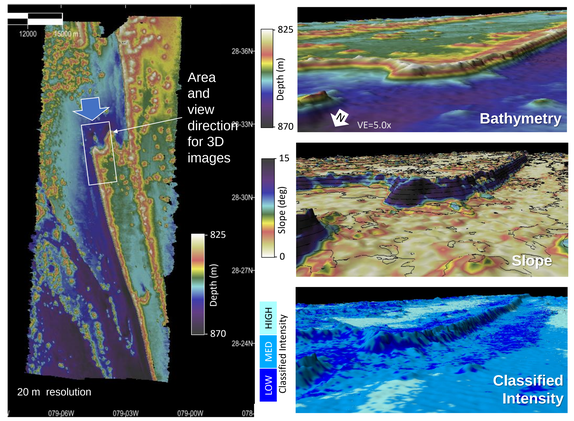


Western Scarp has a vertical relief of 45 m. Several coral mounds occur west of the scarp. All 3D images have VE=5.0x.

The scarp and some of the coral mound slopes are as steep as 19º, whereas most of the region's slope is <2º.

The scarp has variable backscatter intensity, and the coral mounds have high intensity. The flat area above the scarp has a consistent medium intensity.

Figure 3. Eastern Scarp Study Site

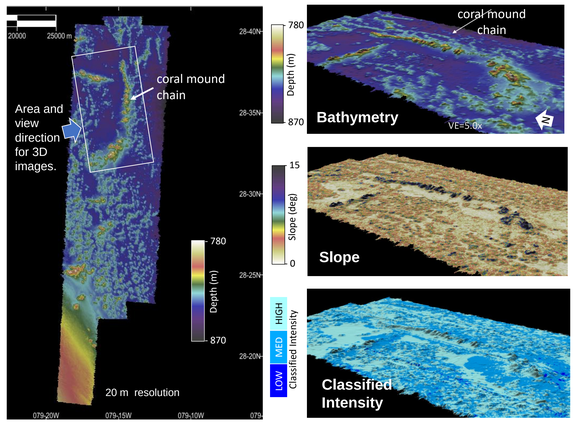


Eastern Scarp has a vertical relief of 20 m. Small, 10 m coral mounds are situated along the top of the scarp, parallel to the scarp edge.

The steepest slope in this area is 11º, found along the scarp face. Depth contours are shown, with an interval of 5 m.

Low intensity returns at this site were found along the scarp's edge. Small coral mounds on the scarp edge may have irregular surfaces (rugose) and may scatter intensity soundings.

Figure 4. Coral Mound Chain Study Site



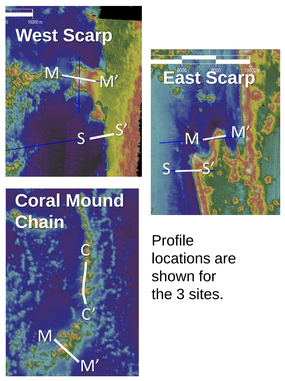
A chain of coral mounds is located in the middle of this study site, with depths ranging 780 to 830 m. This chain is not associated with a scarp.

Coral mound slopes vary with the steepest at 15º. The area around the coral mounds have a significantly lower slope of <5º.

Mounds at this site exhibit high intensity, suggesting they are built on harder surfaces and may not be as rugose as mounds from the East Scarp Site.

Figure 5. Comparative Depth Profiles

Scarps from the West Scarp Site and East Scarp Site were profiled to show their comparative morphology. West Scarp has a vertical relief of 45m, whereas East Scarp is smaller with a VR of 20m. Scarp slopes are similar, approximately 19.8º for the Western Scarp and 11.3º for the Eastern Scarp.

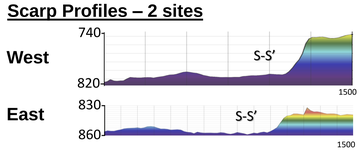


Profile locations are shown for the 3 sites.

All profiles are drawn to the same scale, with VE=5x

Coral Mounds from each Site were also profiled to show their comparative morphology (M-M' for each site). The West Scarp Site mound is significantly larger (VR = 70 m) compared to mounds at other sites (~35 m). The chain of coral mounds (C-C') is also shown for comparison.

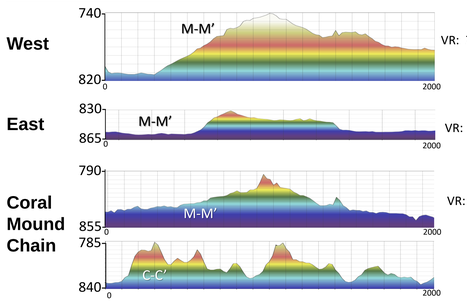
Scarp Profiles – 2 sites



West: VR: 45 m, Slope: 19.8 °

East: VR = 20 m, Slope: 11.3º

Coral Mound Profiles – 3 sites



West: VR: 70 m

East: VR: 30 m

Coral Mound Chain: VR: 35 m

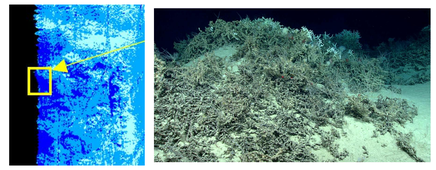
DISCUSSION and CONCLUSIONS

The two scarps are aligned perpendicular to each other but are significantly different in vertical relief. West Scarp's vertical relief is more than twice the vertical relief of East Scarp. West Scarp's higher relief may indicate that it had more faulting activity when it was formed.

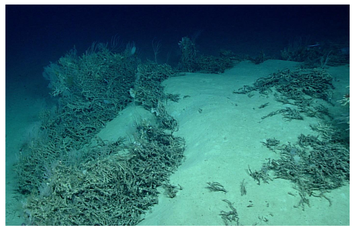
Deep-sea corals have been recorded as having high intensity returns (Roberts et al., 2006) due to the hard substrate on which they attach and the hard carbonate structures that they form (Morgan, 2005). The high intensity returns found at the Coral Mound Chain Site and the Western Scarp Site may be caused by relatively smooth and compacted substrate that the coral are attached to, or possibly a hard substrate made of hard carbonate structures. Debris from the coral mounds could also be surrounding the mounds which would result in the somewhat lower intensity returns observed surrounding the chain. Low intensity returns can also be attributed to the occurrence of highly irregular (rugose) dead coral which may cause sound to scatter resulting in weaker return intensity. ROV dive footage shows coral communities that are rugose, found in an area with low intensity (Figure 6). Different species of coral can also have an affect on intensity returns (Morgan, 2005).

Large commercial fishing has begun to increase off the U.S. East Coast where deep-water coral resides. Further expeditions that study this area and other areas off the Southeast U.S. coast could provide more information on the abundance of these coral communities. Studies could track areas where bottom trawling nets are deployed, and use ROVs to study the affect of nets on bottom features. Deep-sea coral habitats support significant diversity of marine life (NOAA, 2019). Governmental organizations like NOAA could also increase awareness for deep sea coral protection and increase public attention to areas such as the Blake Plateau, emphasizing why these habitats and communities should be protected here and throughout the ocean.

Figure 6. EX1903L2 - Dive 02 Images



(above) The area in the yellow box shows the location of EX1903L2 – Dive 02, located on the Western Scarp Study Site. The video screengrab shows a large patch of dead coral that is infilling with sediments. A small community of live *Lophelia pertusa,* a stony coral, can be seen near to the top. The area of the dive has low intensity.



(above) Another stony coral colony on top of soft unconsolidated sediment substrate. These colonies are irregular, or rugose, and therefore likely scatter the acoustic signal, resulting in low intensity returns.

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