

# Comparative Geomorphologies within Central Blake Plateau Knolls Coral Mounds, Southeast U.S. Continental Margin

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## BACKGROUND

The Blake Plateau is a large, broad, relatively flat area of the seabed located off the Southeastern United States, running from North Carolina to Florida. NOAA Ocean Exploration conducted the *Windows to the Deep 2021: Southeast ROV and Mapping Expedition* on the NOAA Ship *Okeanos Explorer* to expand on previously mapped areas and explore the region's seafloor. The expedition built on previous *Windows to the Deep* expeditions conducted in 2018 and 2019 which revealed one of the largest, continuous deep-sea coral mound environments in the world (NOAA OE).

The Central Blake Plateau was previously thought to be nearly featureless. Recent mapping between 2018 and 2021 discovered over 50 large mounds referred to as the Knolls, in an area ranging 30 by 53 km (1150km<sup>2</sup>) where depths range 730 to 850 m. During EX2107-Dive 12, the ROV *Deep Discoverer* was used to explore a 50 m tall coral mound within the Knolls that is composed mostly of dead coral exoskeleton rubble of the stony coral *Lophelia pertusa*. The purpose of this study is to characterize geomorphology and distribution of the Knolls coral mounds. Mounds were examined at three sites of equal size (342 km<sup>2</sup>) and varying depths (ranging from 730 to 850 m) to distinguish and compare mound geomorphologies and account for the observed differences in size and shape, as well as their orientation on the plateau to infer current direction.

## METHODS

- Multibeam bathymetric data were collected by NOAA OE during EX2107 in October-November 2021 using a Kongsberg EM304 multibeam sonar system aboard the NOAA Ship *Okeanos Explorer*.
- Raw data from EX2107 were processed using CARIS HIPS AND SIPS 11.4 generating CUBE surfaces of 50 m for each of three study sites and 84 m for the entire surface. 3D images and slope surfaces were also captured to illustrate the size and landscape of the areas.
- Classified backscatter intensity mosaic was generated.
- Depth profiles of coral mounds at each site were made to compare orientation and geomorphology.
- ROV *Deep Discoverer* collected HD video imagery of benthic habitats during EX2107-Dive 12.
- A shape index (SI) was calculated for coral mounds by measuring the distance of the mound's long axis and dividing it by the short axis. A value of 1 indicates a circular mound shape, and numbers >1 indicate elongate shapes.
- A peakedness index (PI) was calculated by dividing the maximum vertical relief of a coral mound peak by the distance of the mound's base. The greater the PI value, the more peaked is the mound.

## SUMMARY

Within each site, geomorphologies of the Central Blake Plateau Knolls are consistent. There is no apparent relationship between mound peakedness and shape, and mounds are both circular and elongate at each site. The shoalest points stayed consistent throughout each site. However, the distributions and abundances vary across sites. Based on the evidence collected, coral mound geomorphology and distribution show that coral mounds are larger and more abundant in shallower depths. North Knolls is the shallowest site and South Knolls is deepest. With the exception of an outlier in South Knolls (mound 12), mounds generally decreased in size from North to South. As depth becomes greater moving southward, the mound abundance decreases and mounds cover less area. The increase in abundance from South to North could be attributed to the Gulf Stream's northward flow and greater impact on the benthic environment in shallower depths.

Central Blake Plateau Knolls mounds may not have abundant modern live coral growing. As observed during the ROV dive on a North Knoll mound, the substrate is mostly composed of dead coral framework. These mounds are located well east of the Gulf Stream's main axis. The existence of the mounds are likely due to the Gulf Stream having been located east of where it is today. As the stream moved westward, the mounds were not receiving the same flow as it once was causing the coral to die off.

To continue this study, profiles can be taken from every mound at each knoll site to produce data and further compare the geomorphologies of the region's features. Data from SI and PI values can also be compared to other coral mounds on the Blake Plateau to observe trends and advance the understanding of shape and peakedness. SI and PI values would be interesting to compare to coral mounds off the west coast as well to account for differences in completely different regions with different geomorphological factors.

## REFERENCES

- NOAA OE, 2021, *Windows to the Deep 2021: Southeast U.S. ROV and Mapping*; NOAA Ocean Exploration  
NOAA OER, 2019, *Windows to the Deep 2019: Exploration of the Deep-sea Habitats of the Southeastern United States*; NOAA Office of Ocean Exploration and Research  
NOAA OER, 2021, *Windows to the Deep 2021: Southeast U.S. ROV and Mapping (EX-21-07) Expedition Summary* (noaa.gov)

## ACKNOWLEDGEMENTS

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Figure 2. North Knolls

The northern Knolls study site has a depth range of 805 to 830 m and includes approximately 34 mounds. Mounds in this site cover approximately 4.91% of the total area.

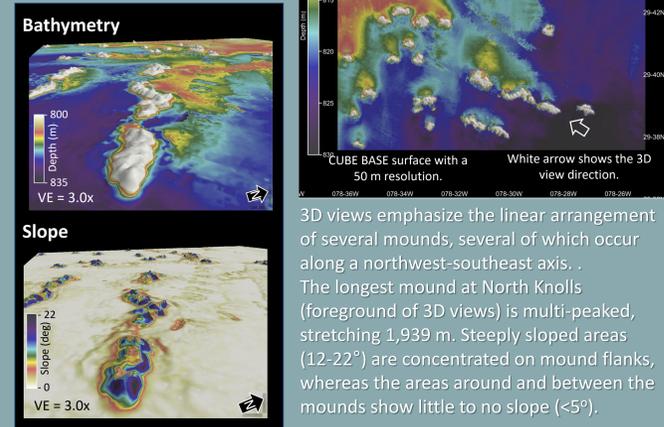


Figure 3. Central Knolls

Central Knolls depths range from 815 to 845 m has approximately 17 mounds. Mounds at Central Knolls cover approximately 1.5% of the site's total area.

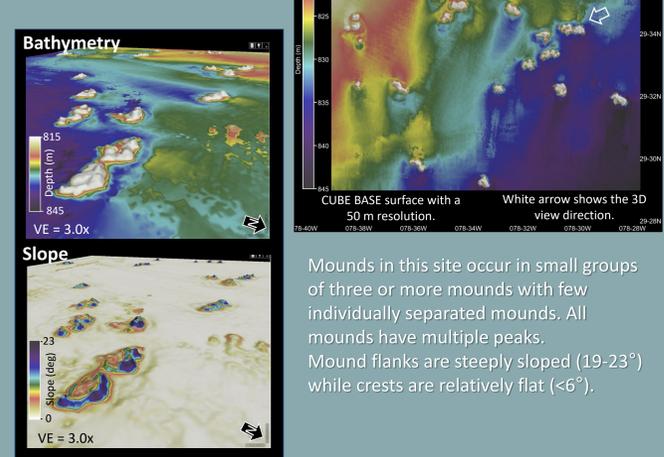
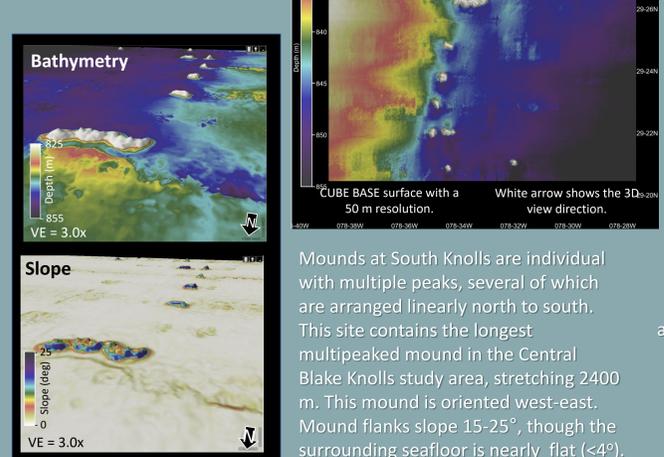
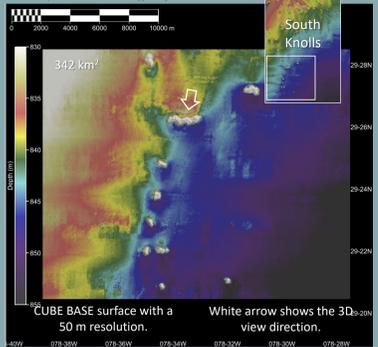


Figure 4. South Knolls

South Knolls mounds occur at depths ranging from 830 to 855 m. There are 10 mounds at this site, accounting for ~0.87% of the site's total area.



The depth color scale differs for each site.



Mounds at South Knolls are individual with multiple peaks, several of which are arranged linearly north to south. This site contains the longest multi-peaked mound in the Central Blake Knolls study area, stretching 2400 m. This mound is oriented west-east. Mound flanks slope 15-25°, though the surrounding seafloor is nearly flat (<4°).

(above) A classified backscatter intensity mosaic of the northern portion of South Knolls shows areas of high intensity (light blue) occurring on the south side of the mounds' bases. High intensity areas that are also sloped indicate that hard substrate may be present.

Figure 1. Study Area and Site Locations

The Knolls on the Central Blake Plateau are 242 km off of Florida's coast between St. Augustine and Daytona Beach. The Central Blake Plateau coral mound study area was separated into three separate study sites, here referred to as North Site, Central Site, and South Site. Each site is approximately 19 by 18 km (342 km<sup>2</sup>) and collectively range 53 km from north to south.

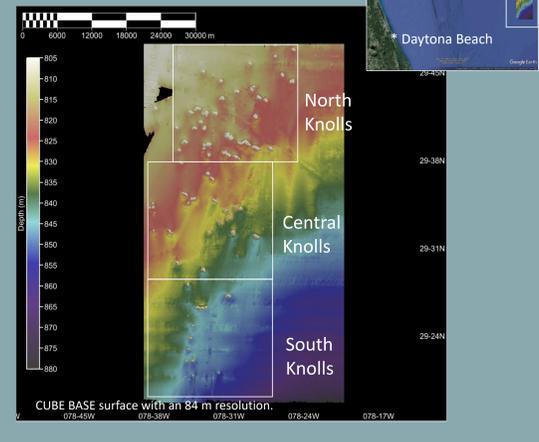


Figure 5. Comparative Profiles

For each site, profiles were made along the long axis of 5 mounds. Profiles are shown at the same scale, with VE=2.0x.

Many mounds in the Knolls study area are long with numerous peaks while some are shorter in length with a few peaks. South Knolls included the longest multi-peaked mound, stretching 2400 m. There are variations in length and shape within and among sites (see Fig. 6). The shoalest point of each mound ranges between 750 and 780 m. Mounds show similar vertical reliefs ranging 50-100 m.

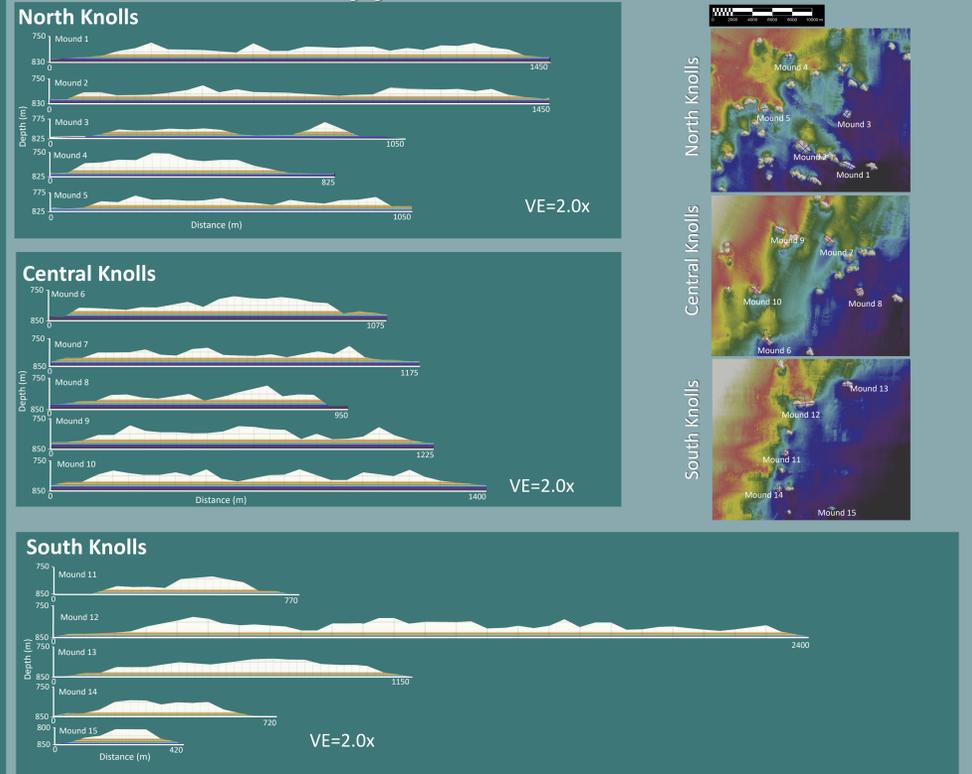
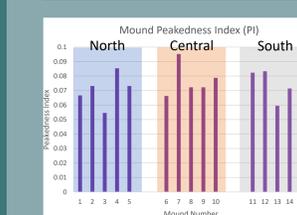
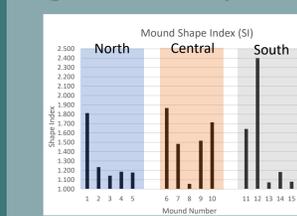
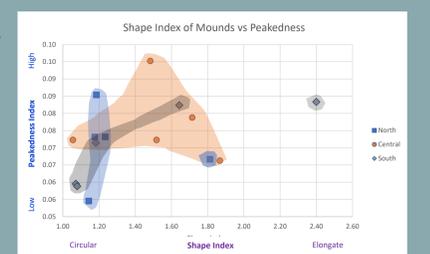


Figure 6. Data Analysis



An SI value of 1 indicates a mound with circular periphery (see Methods). The more elongate a mound is, the greater the SI. Larger PI values indicate increasing peakedness.

Only 5 mounds were measured for this analysis.

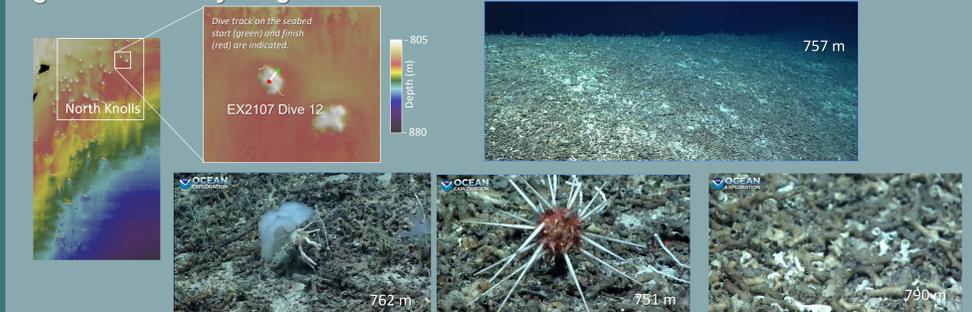


Four of the 5 North Knolls mounds measured are nearly circular, as are 1 from Central Knolls and 3 from South Knolls. Elongate, multi-peaked mounds occur at all three sites, with the most elongate at South Knolls.

Peakedness of these 15 mounds showed great variation, with mound 3 (North Knolls) having lowest value and mound 7 (Central Knolls) having the greatest. Central Knolls mounds have the smallest range of peakedness.

No trend between SI and PI was observed with the limited amount of data.

Figure 7. Summary images



Dive footage from EX2107 Dive 12

This dive was located on the northeast portion of North Knolls. The ROV *Deep Discoverer* moved slowly up the slope from depths of ~820 to 750 m. The bottom substrate was mostly composed of dead coral exoskeleton rubble. The white rubble indicate fresh dead coral. The unconsolidated bottom is home to a variety of species including decorator crabs and pencil urchins. There were very few patches of living stony coral *Lophelia pertusa* which are known to inhabit these areas and depths.