

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.

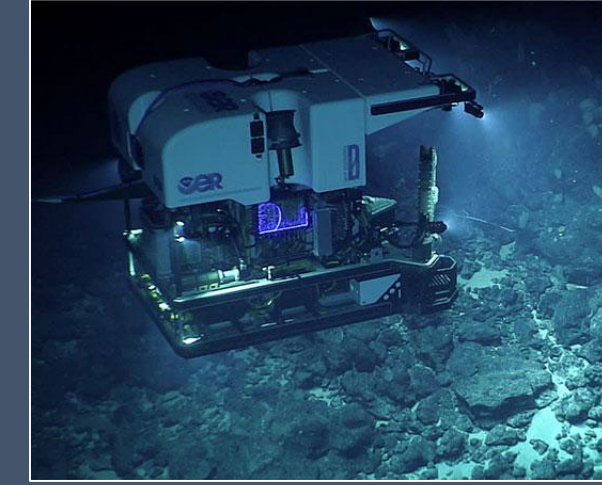
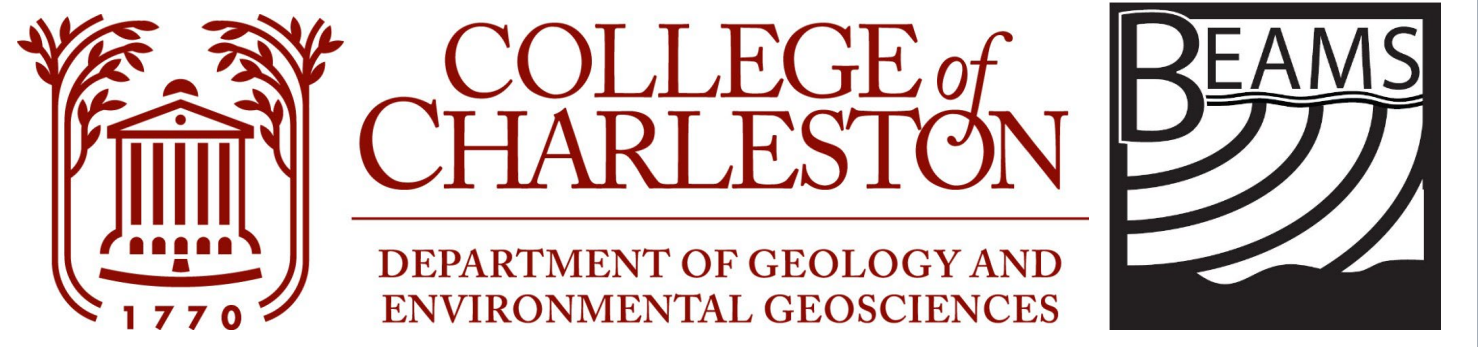


Figure 1. Stetson Mesa and Site Locations

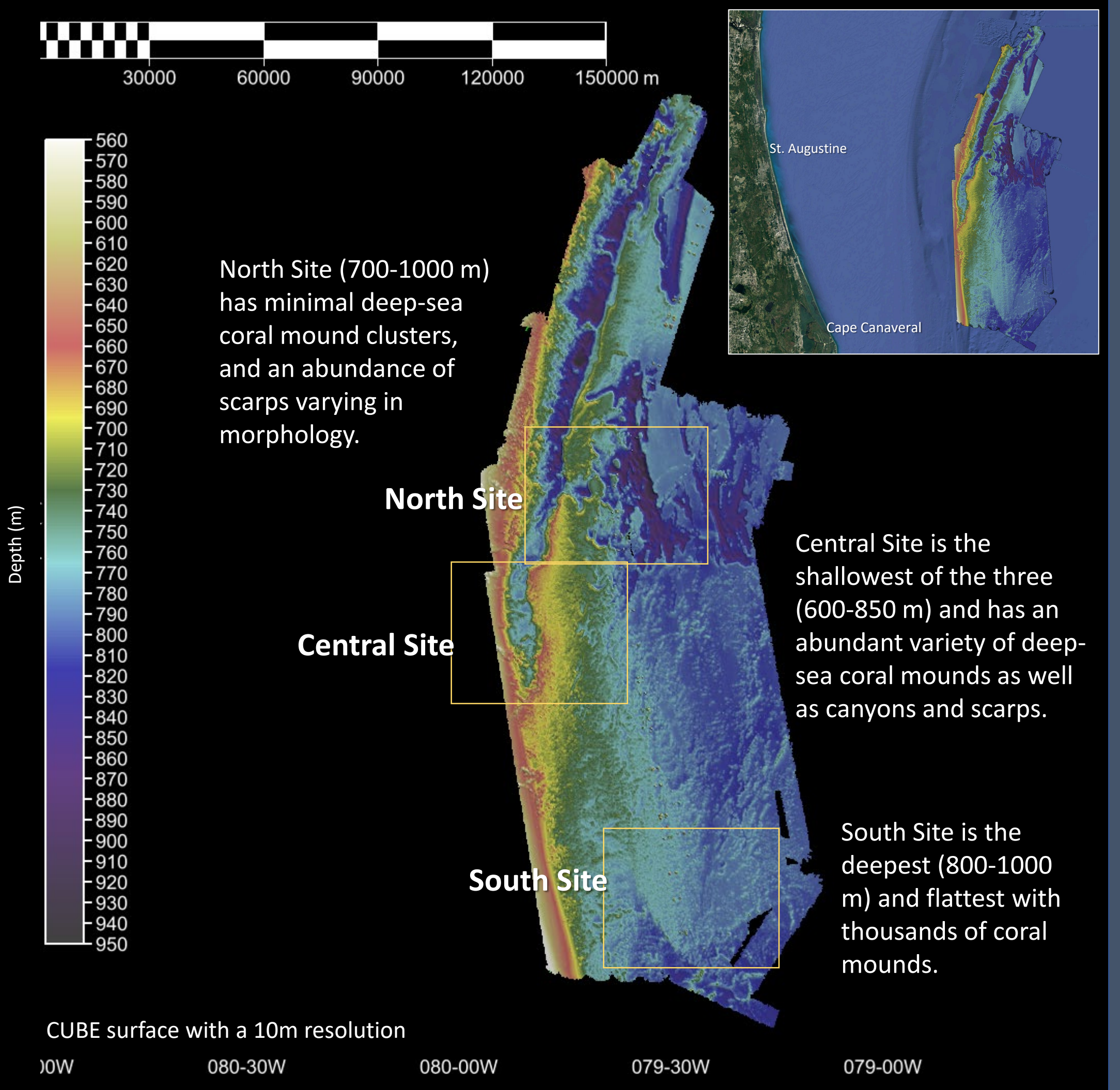


Figure 2. North Site

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

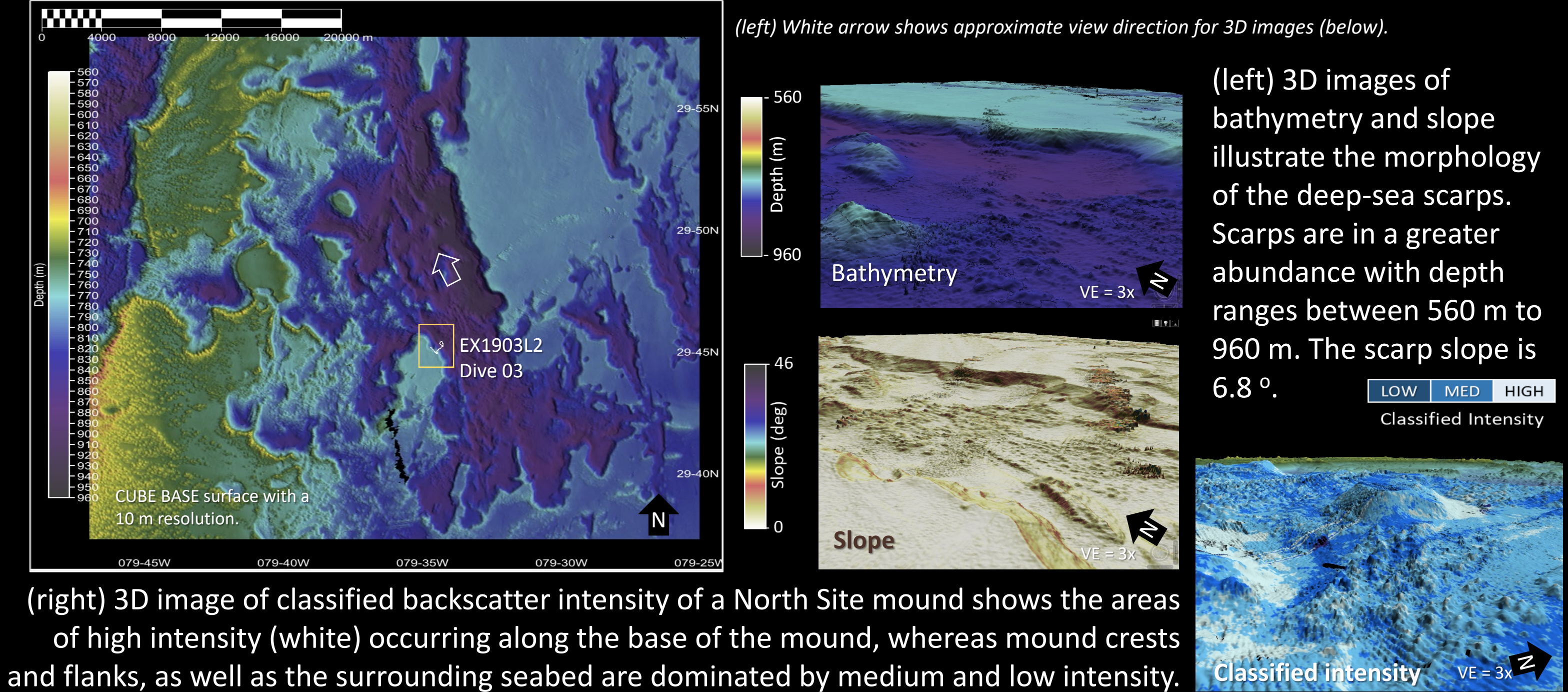
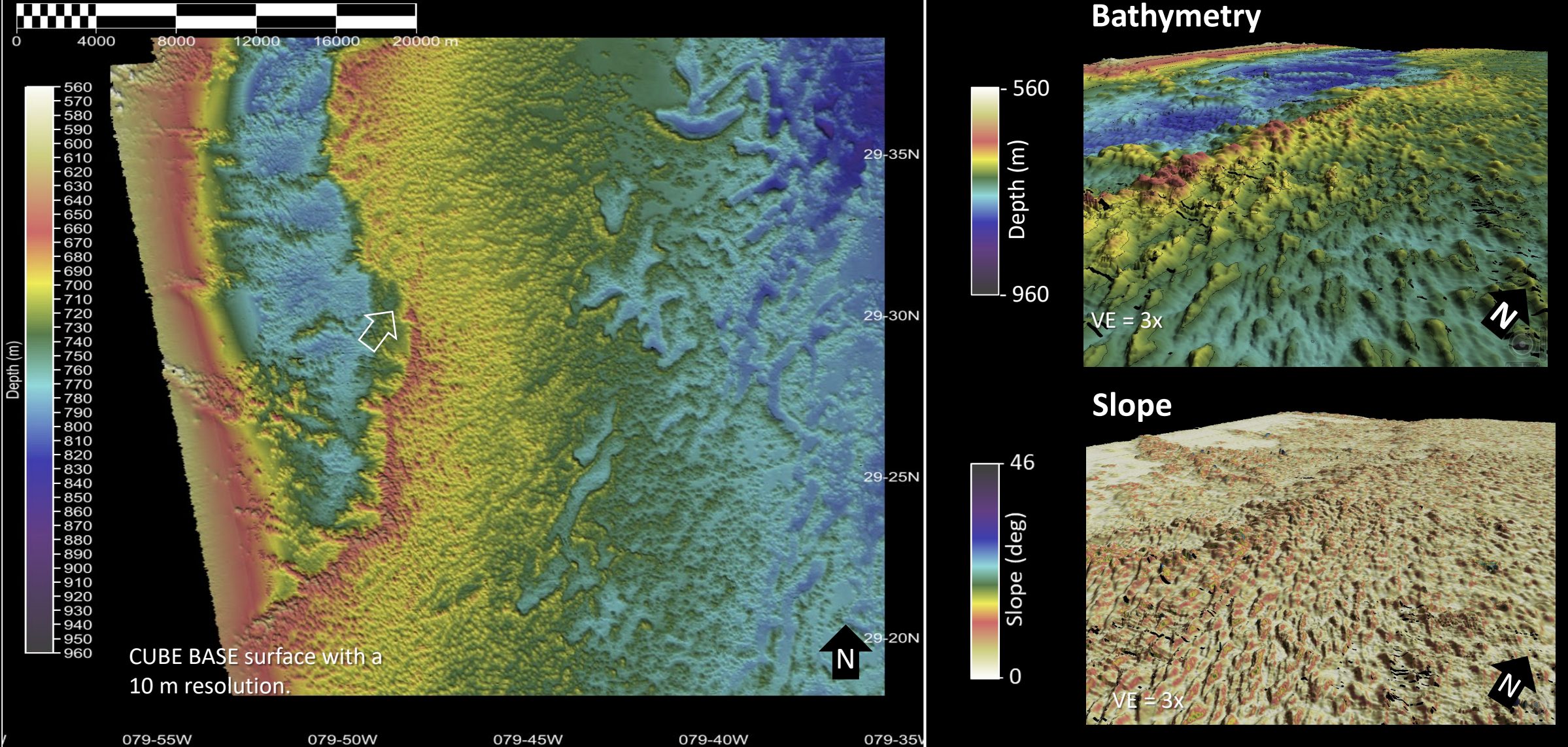


Figure 3. Central Site

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

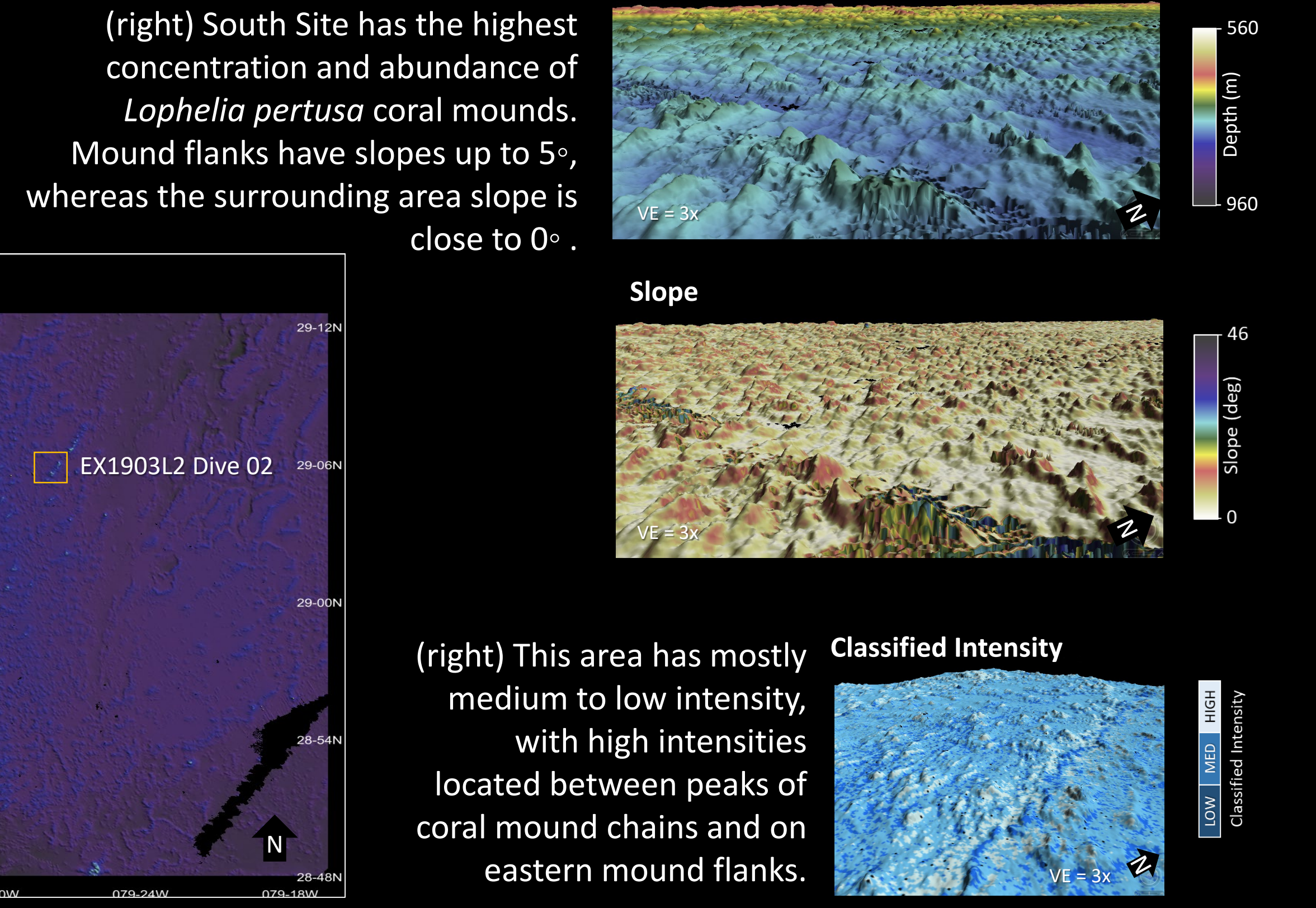


METHODS

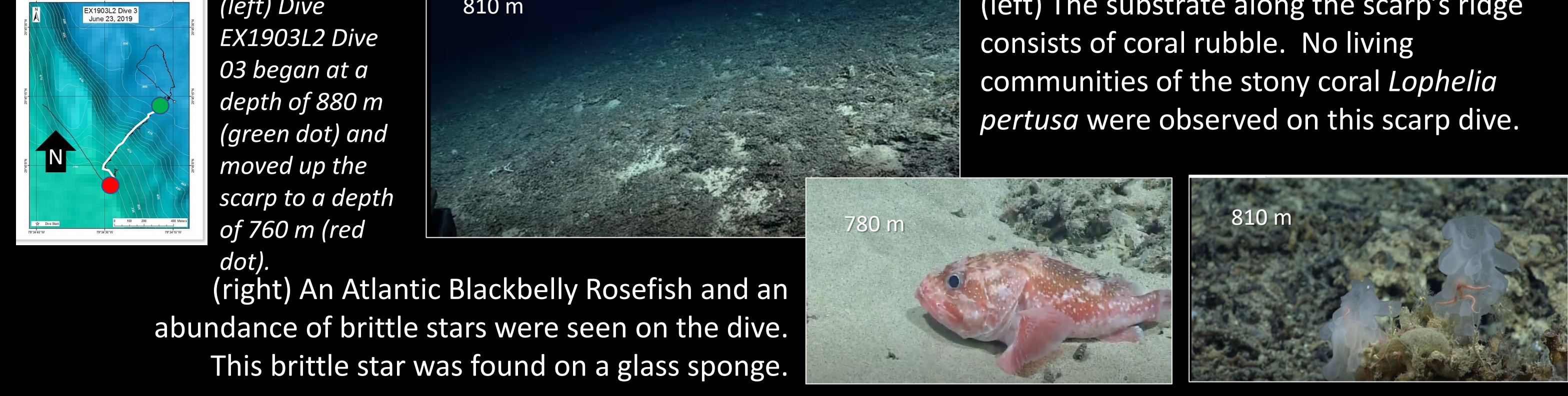
- Multibeam sonar data were collected aboard NOAA Ship *Okeanos Explorer* using a Kongsberg EM302 during 3 expeditions:
 - EX1806 from the 2018 *Windows to the Deep* expedition
 - EX1903L1 and EX1903L2 from the 2019 *Windows to the Deep* expedition.
 - 2014 mapping expedition EX1403
- CARIS HIPS and 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 generated.
- 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.



ROV Scarp Dive: EX1903L2 Dive 03



ROV Scarp Dive: EX1903L2 Dive 02

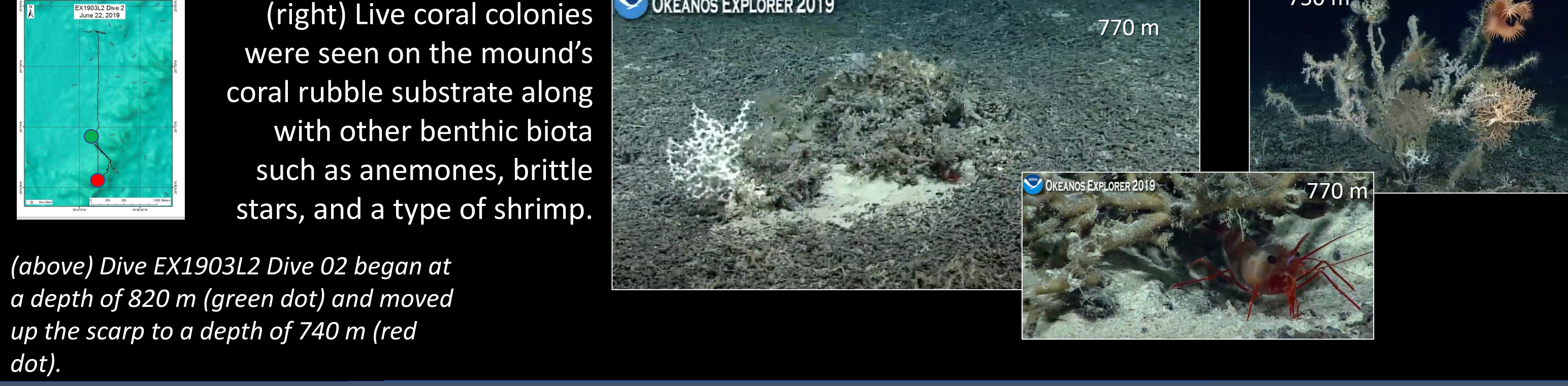


Figure 5. Comparative Scarp Profiles

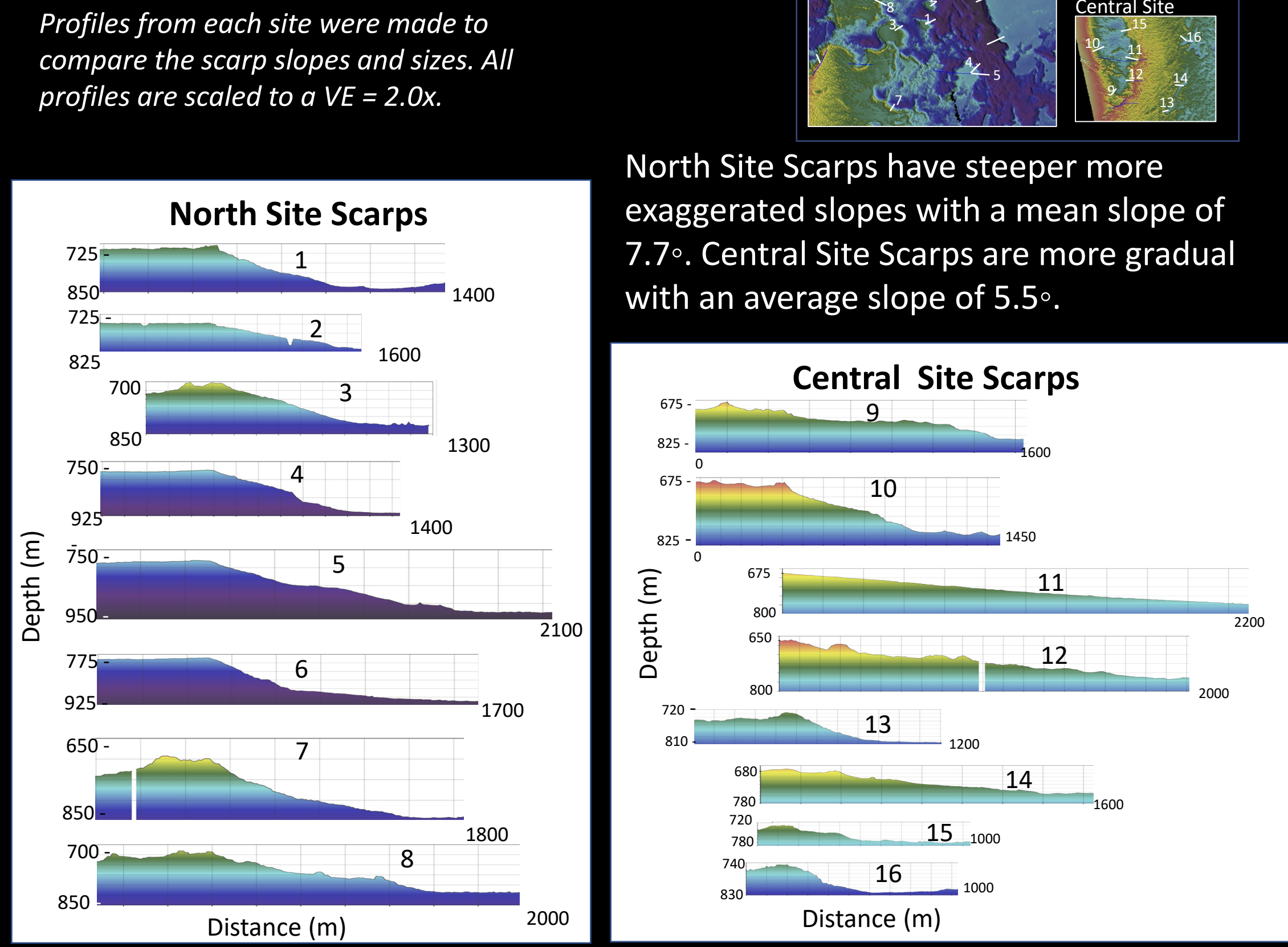


Figure 6. Scarp Data Analysis

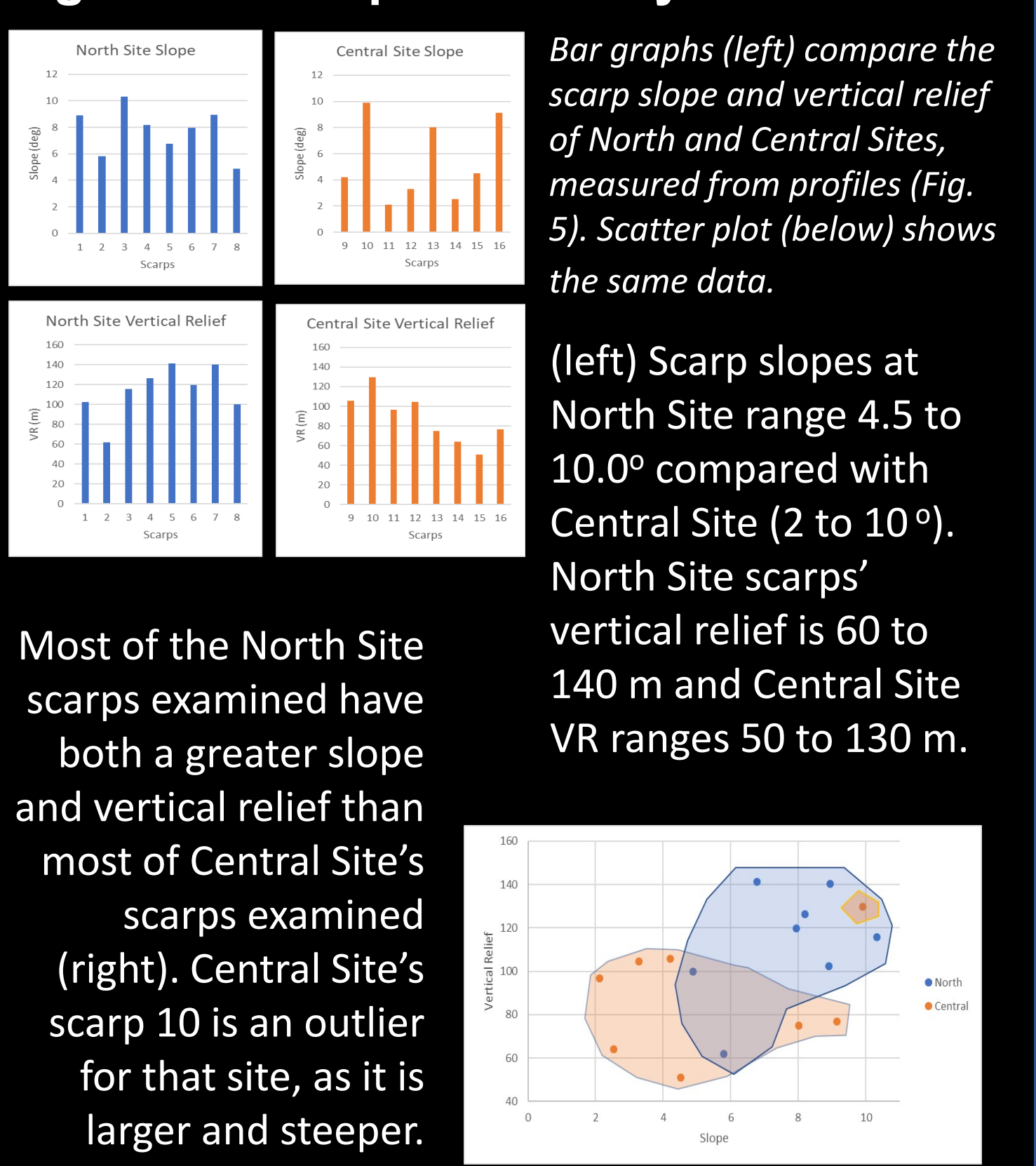
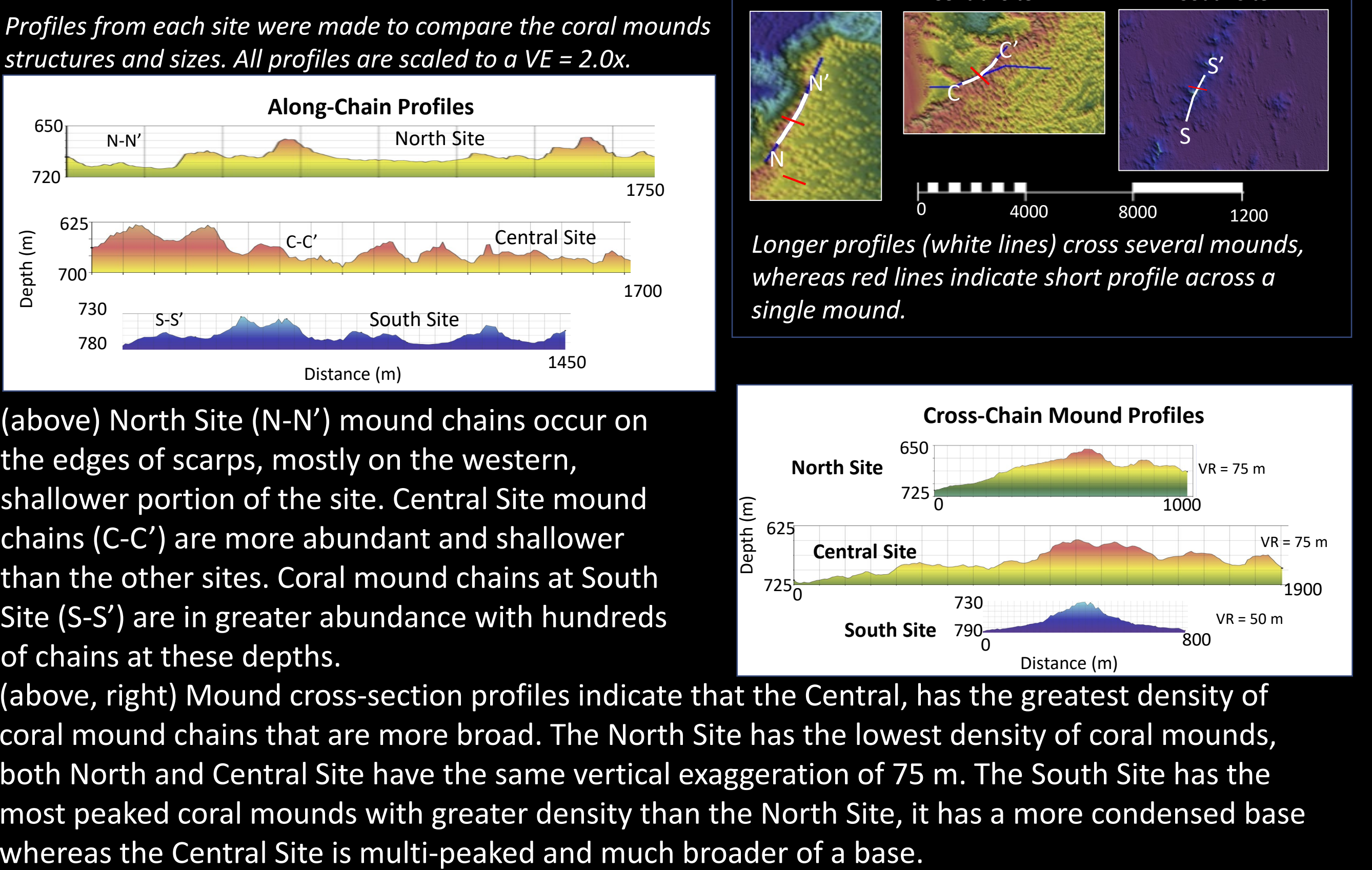


Figure 7. Comparative Mound Profiles



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 deep-sea 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 deep-sea 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 intensities.

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.

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