# Analysis of Potential Deep Sea Coral Habitats on the Mid-Pacific Seamounts

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## ABSTRACT

Multibeam sonar surveys were conducted by NOAA near Wake Island in the Pacific Ocean between March and September 2016. Bathymetric data were obtained using a Kongsberg EM302 aboard the NOAA Ship *Okeanos Explorer* and were post-processed in CARIS HIPS and SIPS 10.4. The data revealed various seamount types that each included different sections of high intensity backscatter along highly sloped areas. These regions often provide hard substrate favorable for deep sea coral attachment. The purpose of this study is to locate the potential coral habitats by focusing on sites that contained high intensity backscatter and steep slopes. Determining this information would be beneficial for ROV dives to quickly locate and observe possible coral habitats. All eleven of the studied seamounts displayed properties for potential coral habitats, however one seamount had significantly more sites to explore. Additional research should be conducted to support these findings.

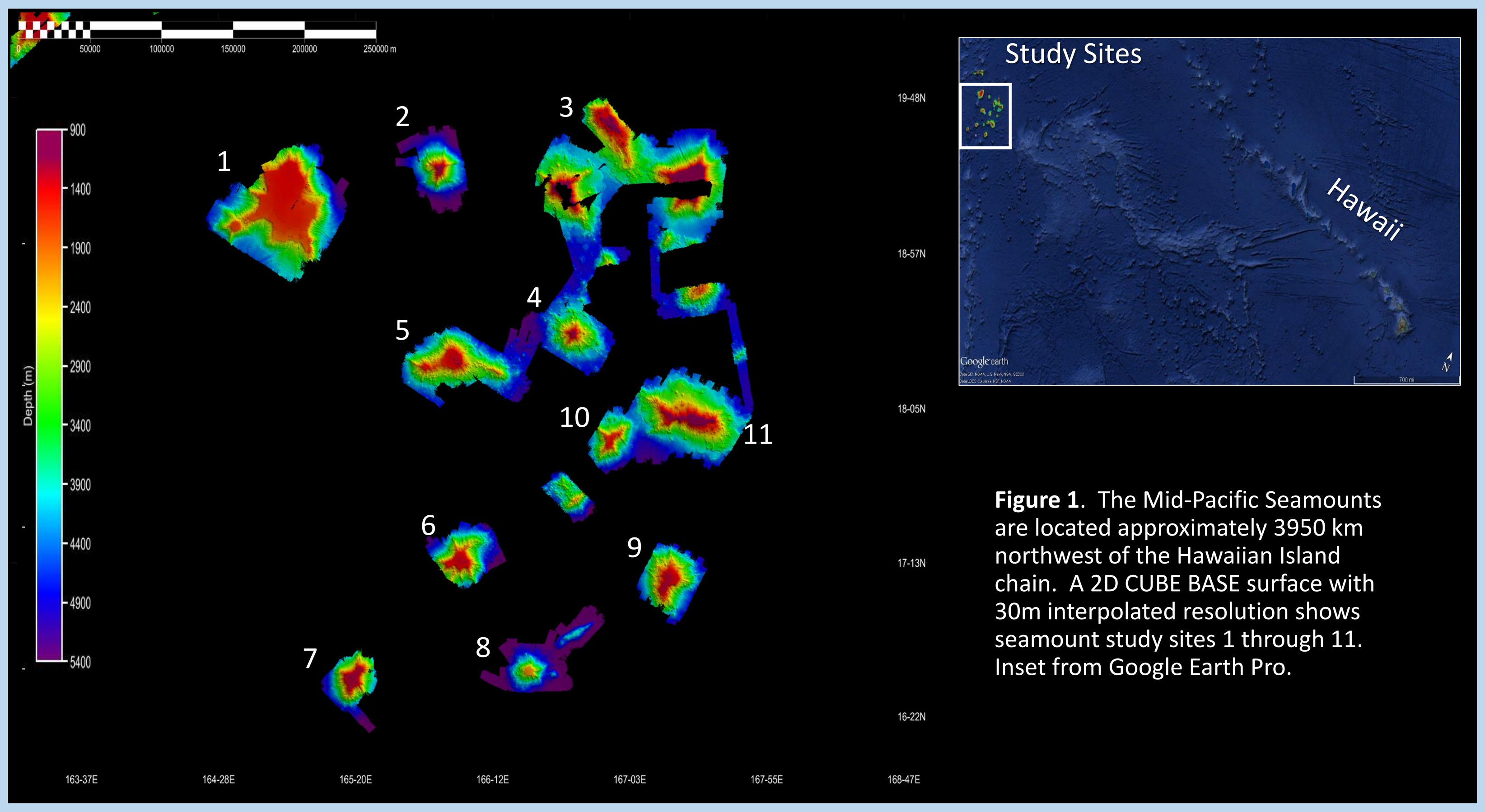




**Figure 1.** The Mid-Pacific Seamounts are located approximately 3950 km northwest of the Hawaiian Island chain. A 2D CUBE BASE surface with 30m interpolated resolution shows seamount study sites 1 through 11. Inset from Google Earth Pro.

## BACKGROUND

Seamounts are significant areas that provide habitat for a variety of marine life. The Pacific Remote Islands Marine National Monument (PRIMNM) is one of the many areas that protects an extensive portion of the Mid-Pacific region. This national monument is the largest marine protected region on the planet and is located to the southwest of the Hawaiian Islands (Marine National). PRIMNM was expanded to include the surrounding waters near Jarvis Island, Wake Island and Johnston atoll (US Department).

The Pacific Ocean consists of many submerged volcanoes, or seamounts, with steep slopes that supply hard substrates that the corals utilize (Stone and Shotwell, 2007). Areas that contain hard substrates are essential for the attachment of deep corals (Rogers et al. 2007). The PRIMNM's 406,307 square kilometer area is comprised of many seamounts that provide favorable environments for deep-sea corals, invertebrates, fishes, and other organisms (US Department). The purpose of this study is to explore potential areas of deep coral habitat sites by observing the relationship between the high backscatter intensity and steep slopes along the varying seamounts.

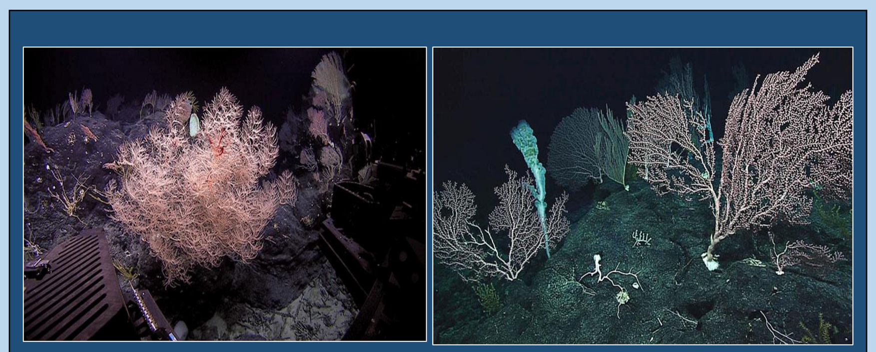


**Figure 2.** Some of the deep sea corals, primnoid octacorals (*Pleurogorgia militaris*), *Hemicorallium sp.* and *Acanthogorgia sp.*, found on EX1606 along the Mid-Pacific Seamounts (Images from NOAA's Office of Ocean Exploration and Research).

## METHODS

- Multibeam data were used from cruises EX1604, EX1606, EX1607 collected by NOAA Office of Ocean Exploration and Research (OER) using a Kongsberg EM302 sonar aboard the NOAA Ship *Okeanos Explorer.*
- Post-processing was conducted with CARIS 10.4 to produce a 30 m interpolated CUBE BASE surface, SIPS classified backscatter and slope layer.
- Profiles were made perpendicular to each seamount's slope, using the depth and intensity layers, to match where high intensity backscatter occurred along steeply sloped areas of the bathymetric profile.
- Slopes were measured for areas containing high intensity backscatter.

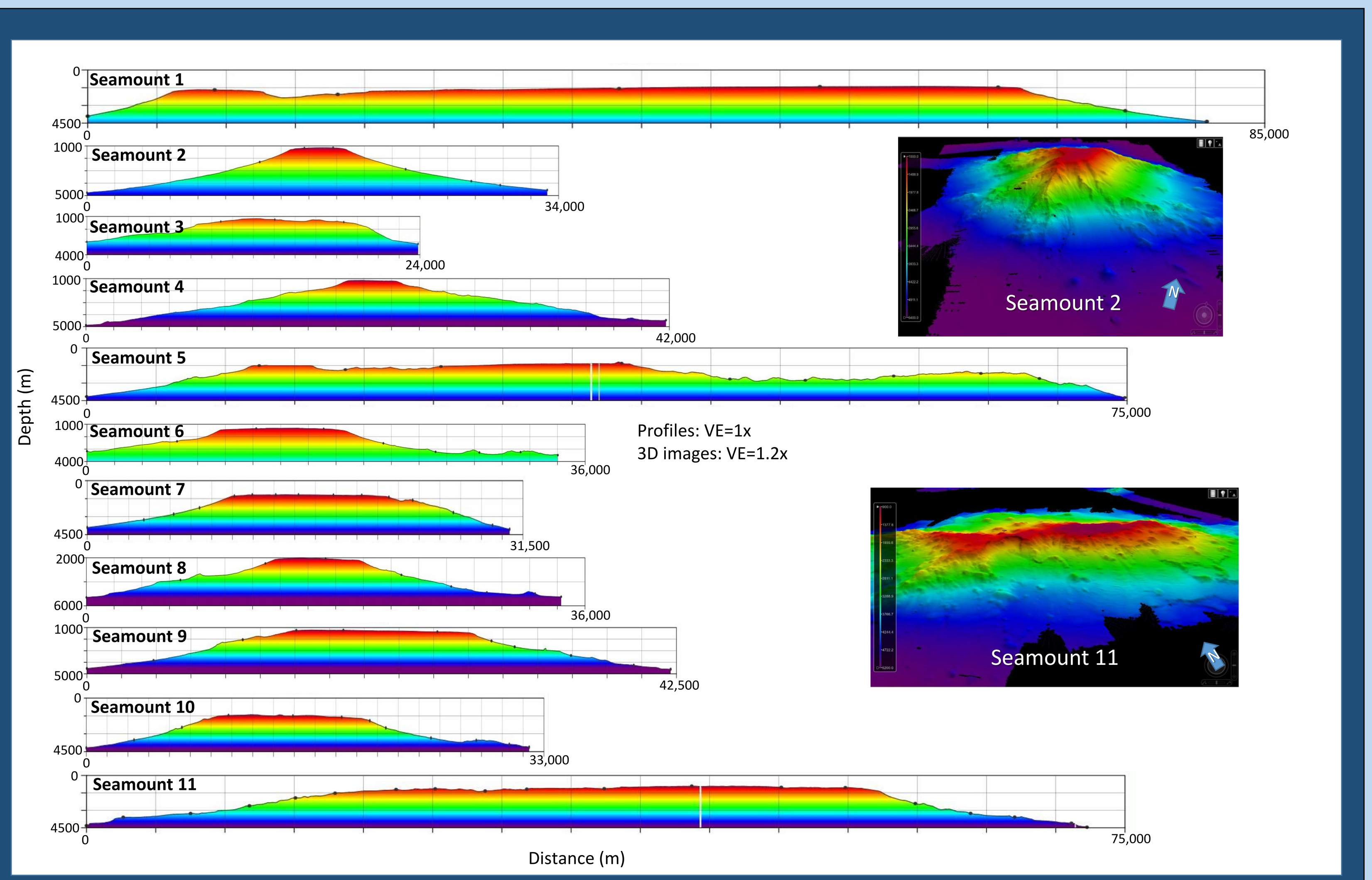



**Figure 3.** Profiles of Seamounts 1 through 11 demonstrating the differences in shape and size, VE=1x. 3D images of Seamounts 2 and 11 included for shape and size comparison between conical seamount (2) and guyot (11) with VE=1.2x.

**Figure 4.** Methods for analyzing potential deep coral habitat areas are illustrated using Seamounts 2 and 7 as examples. A) Profiles across 30m interpolated CUBE surfaces. B) Profiles across SIPS classified backscatter layers. C) Profiles of both the depth and backscatter layers with highlighted areas where both high slope and high intensity occur.

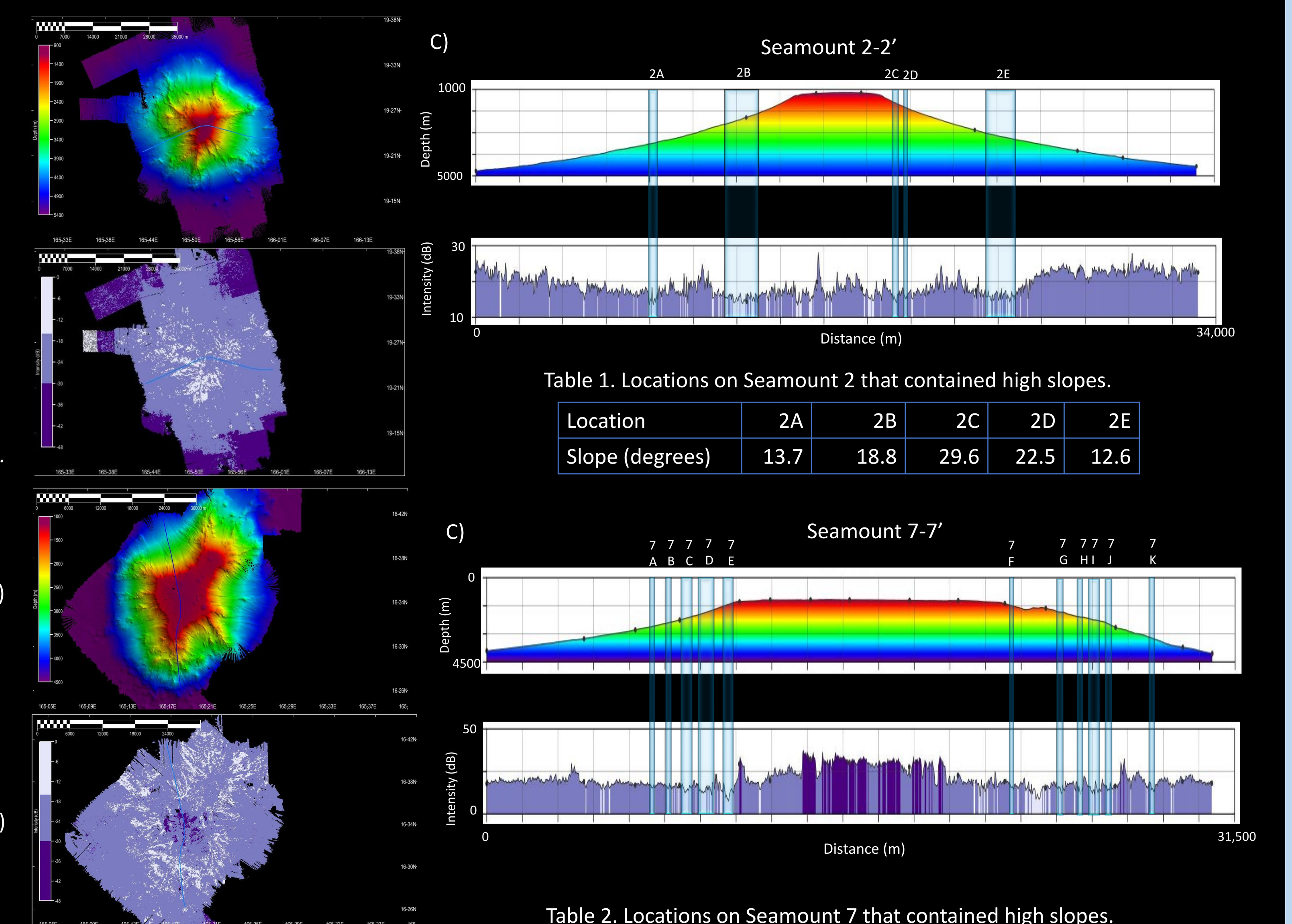



Table 1. Locations on Seamount 2 that contained high slopes.

| Location | 2A | 2B | 2C | 2D | 2E |
|---|---|---|---|---|---|
| Slope (degrees) | 13.7 | 18.8 | 29.6 | 22.5 | 12.6 |

Table 2. Locations on Seamount 7 that contained high slopes.

| Location | 7A | 7B | 7C | 7D | 7E | 7F | 7G | 7H | 7I | 7J | 7K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Slope (degrees) | 20.3 | 14.5 | 20.6 | 25.6 | 21.2 | 20.3 | 10.3 | 10.3 | 13.9 | 29.8 | 27.0 |

## RESULTS

- Classified areas of high backscatter intensity ranged from 0 to -16 dB.
- High slopes ranged from 9.0 to 30.1° for all of the profiles.
- Some of the classified high backscatter intensity areas contained low slopes, under 9.0°, demonstrating that high intensity does not always correlate with high slope (Figs. 4B and C, and Fig. 6).
- Each seamount varied with the amount of potential habitat areas for deep corals, with Seamount 7 having the most potential habitat sites and Seamount 10 having the least (Fig. 5).
- The number of sites exhibiting both high intensity and high slope, suitable for deep sea corals are as follows: Seamount 1: 5 sites (9.7-28.4°); Seamount 2: 5 sites (12.6-29.6°); Seamount 3: 5 sites (10.3-30.0°); Seamount 4: 4 sites (10.2-20.6°); Seamount 5: 5 sites (11.0-21.2°); Seamount 6: 7 sites (9.0-21.7°); Seamount 7: 11 sites (10.3-29.8°); Seamount 8: 5 sites (13.7-26.7°); Seamount 9: 6 sites (9.3-27.2°); Seamount 10: 3 sites (16.2-30.1°); and Seamount 11: 7 sites (10.4-30.0°) (Fig. 5).

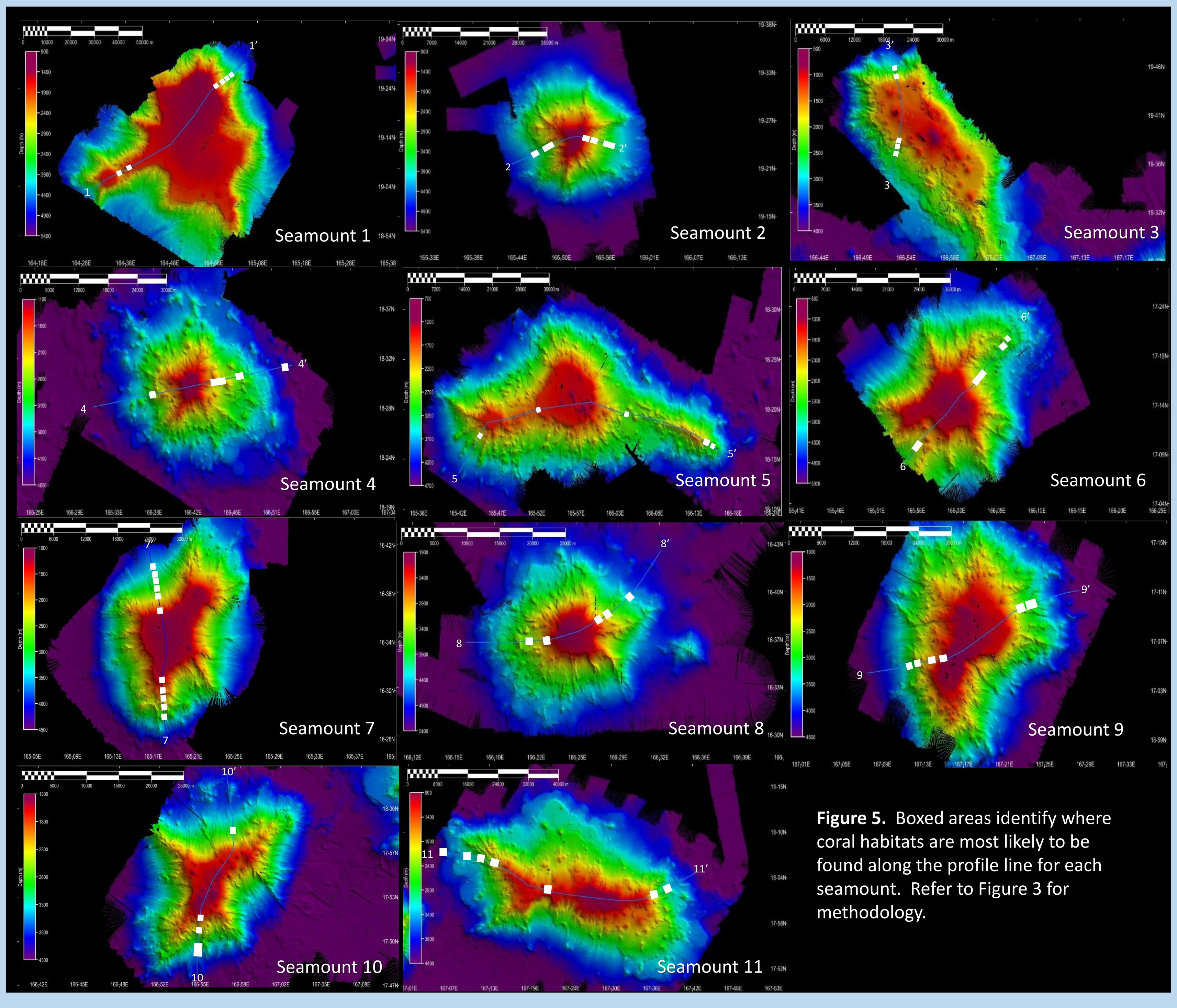



**Figure 5.** Boxed areas identify where coral habitats are most likely to be found along the profile line for each seamount. Refer to Figure 3 for methodology.

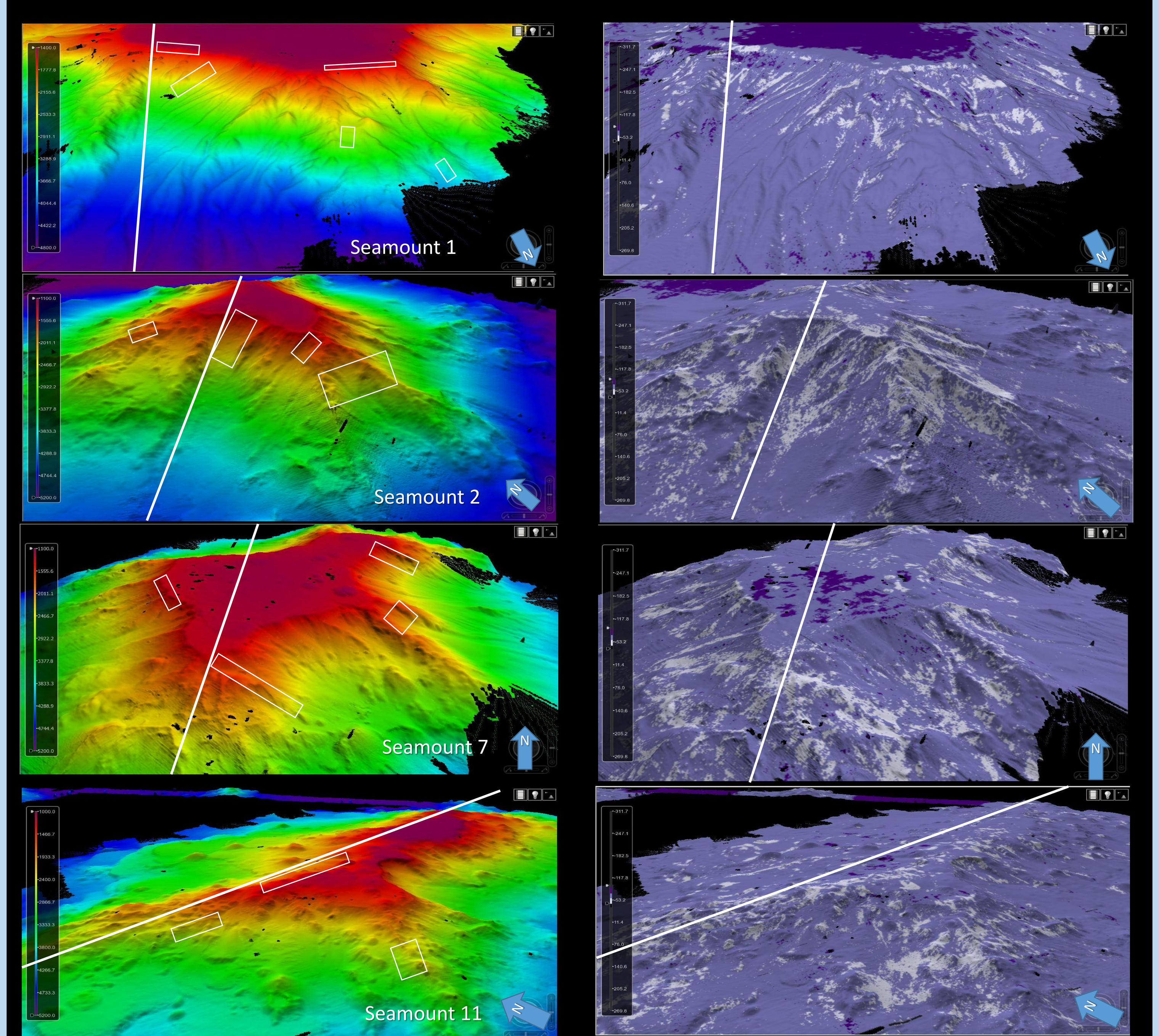
## DISCUSSION and CONCLUSIONS

This study explored the relationship between high intensity backscatter and high slopes to understand where hard substrate promoting deep sea coral attachment could be found. Most of the seamounts within the study contained areas that had both high intensity backscatter and high slopes, however some had locations where the high intensity backscatter did not correlate with a high slope (Figs. 4B and C and Fig. 6). Areas that had high intensity backscatter in low-slope areas still consisted of hard substrate or consolidated sediment, however would be less likely to provide a habitat for deep sea corals. High slope did not always indicate that there was hard substrate available and therefore cannot be directly correlated with high intensity.

Each seamount varied in size and shape and therefore had different associated slope values (Fig. 3). Seamount 7 had the greatest number of potential coral habitats (Fig. 5). This seamount has steep flanks, where most of the high intensity backscatter was located, that would allow for corals to attach and thrive at these locations. Other seamounts that had similarly steep sloped areas were Seamounts 1, 2 and 11 (Fig. 6). These sites would be the most beneficial areas to revisit with an ROV to search for deep coral habitats.

Observing and analyzing where high intensity backscatter and high slope areas occur would assist in discovering the coral habitats without having to sample the entire seamount which would be time consuming and expensive. Additional research in this field would greatly benefit not only the PRIMNM, but also other areas with seamounts by discovering the exact deep sea coral habitat locations and implementing ways to protect them in the future.

**Figure 6.** 3D 30m interpolated CUBE surfaces and classified backscatter intensity draped over depth layer for seamounts containing steeper slopes and higher amounts of potential sites for deep corals. White lines reference where profiles were taken and boxed areas predict other probable areas for deep coral habitats based off of high intensity and high slope. VE=1.2x.





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