Deep Sea Coral Habitat Throughout Perth Canyon, Australia

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ABSTRACT

In March 2015 Dr. Malcolm McCulloch from the University of Western Australia led an expedition to map Perth Canyon, Australia on board the Schmidt Ocean Institute's R/V *Falkor*. Little was known about Perth Canyon prior to this expedition. The researchers wanted to learn more about the bathymetry and benthic marine life throughout the canyon, with a particular emphasis on examining deep coral habitats. With the use of CARIS HIPS and SIPS 9.1, bathymetry and backscatter surfaces were generated from multibeam sonar data in order to characterize and classify the canyon's seafloor. Based on the backscatter intensity and depth ranges of seven known coral locations, ArcGIS was used to produce a map showing additional potential deep sea coral habitat sites.

BACKGROUND

Perth Canyon is located approximately 50 km off of the coast of Perth, Australia (Figure 1B). The canyon ranges from depths of 100 to 4000 m in a span of ~40 km. Deep sea coral is typically found near the top edge of a steep slope where nutrient- rich sediments are deposited. Over time sediments will drain from the uppermost layer onto the coral immediately below. This form of transport is known as Ekman drainage, and provides nutrients and food for the coral at the upper most areas of the slope (Roberts et al., 2006). Dr. Julie Trotter and her team at the University of Western Australia (UWA) located seven coral habitats, and the surrounding seafloor was remotely mapped using multibeam sonar (figure 1A). One of the goals of UWA's expedition was to obtain coral samples for geochemical observations to further understand the ocean's history of pH, temperature, salinity, elemental ratios, specific radiogenic isotopes, as well as trace water temperature, carbonate chemistry parameters, and water mass circulation (Schoepf and Ross, 2015). These proxies can be used to analyze the rate at which the ocean is warming and increasing in acidity. The purpose of this study was to use backscatter intensity, depth and slope data to identify possible deep sea coral habitats, using information from the UWA-collected ground truth sample seafloor characteristics.

STUDY SITE

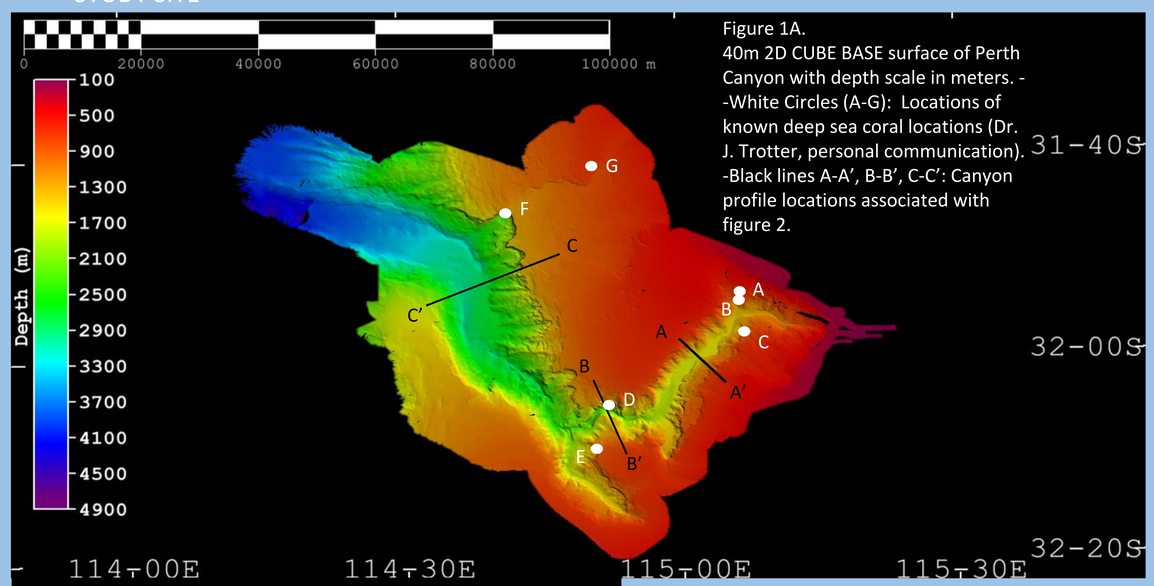


Figure 1A.
40m 2D CUBE BASE surface of Perth Canyon with depth scale in meters. --White Circles (A-G): Locations of known deep sea coral locations (Dr. J. Trotter, personal communication). -Black lines A-A', B-B', C-C': Canyon profile locations associated with figure 2.

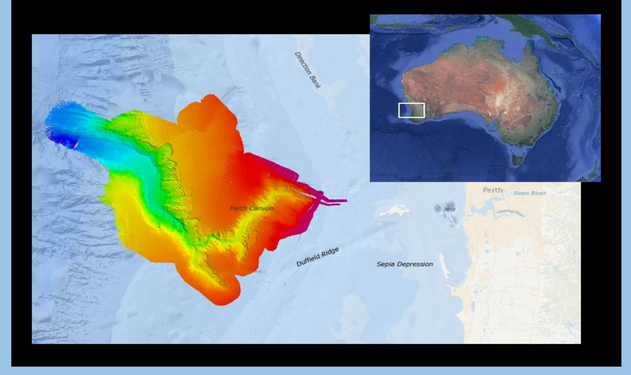


Figure 1B.
40m CUBE BASE surface draped on world ocean base map of Study site on the southwest coast of Australia.

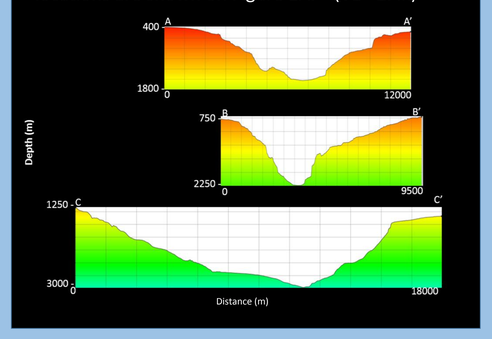


Figure 2. Canyon profiles were generated to show the general canyon channel geomorphology. Profile locations are shown on Figure 1A. (VE= 2.4x)

METHODS

- The UWA worked with, the Institute of Marine Sciences in Italy, the Western Australian Museum, and the Commonwealth Scientific and Industrial Research Organization onboard the Schmidt Ocean Institute's R/V *Falkor* using Kongsberg EM302 and EM307 transducers in March 2015.
- CARIS HIPS 9.1 and ArcMap 10.3.1 were used to generate CUBE BASE, backscatter intensity, and slope surfaces, each at a 40 m resolution.
- Depth and intensity range polygons were brought into ArcMap for further manipulation (Figures 5A & 5B). In ArcMap the two polygons were overlaid and the union of the two was represented as a third GeoTiff polygon (Figure 5C).

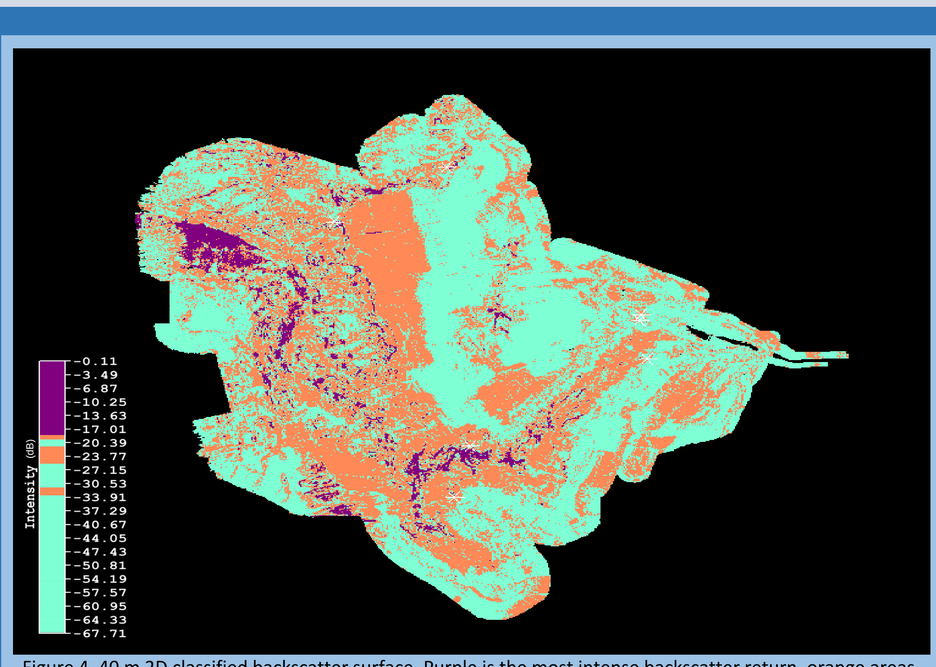
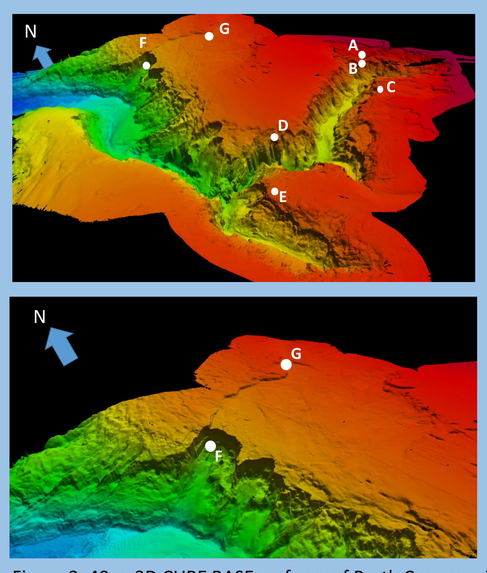
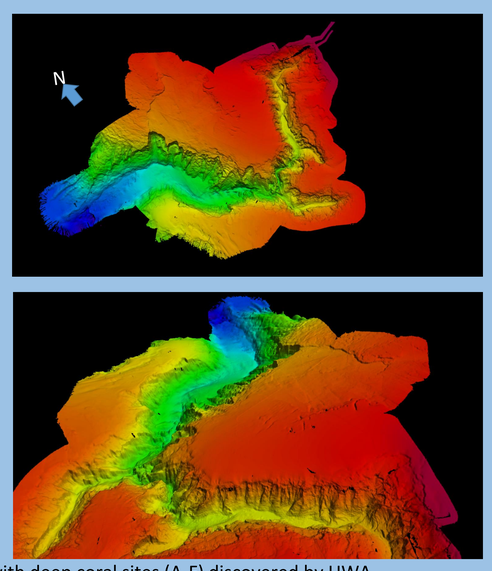


Figure 4. 40 m 2D classified backscatter surface. Purple is the most intense backscatter return, orange areas show the intensity ranges that match where coral has been found by UWA investigators, and turquoise represents intermediate and low intensity areas.





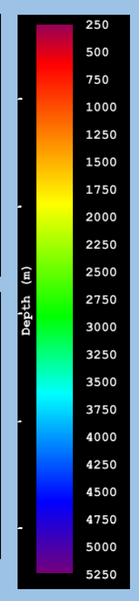


Figure 3. 40 m 3D CUBE BASE surfaces of Perth Canyon with deep coral sites (A-F) discovered by UWA investigators (personal communication, J. Trotter). VE 3.5x

RESULTS

- Deep coral was found by UWA in 2015 near the top edge of Perth Canyon's walls (Fig. 3).
- Backscatter intensities show that areas of highest return are found near the canyon thalweg (Fig. 4).
- No observable correlation exists between slope and intensity, or slope and depth. The majority of the area was sloped.
- Coral found by UWA tended to be located near the edge of canyon walls (Fig. 3). This same trend can be observed in the red polygon generated to find possible deep sea coral habitats (Fig. 5C).

Figure 5A

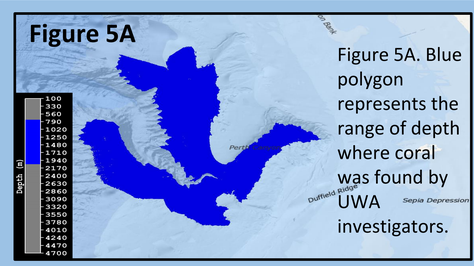


Figure 5A. Blue polygon represents the range of depth where coral was found by UWA investigators.

Figure 5B

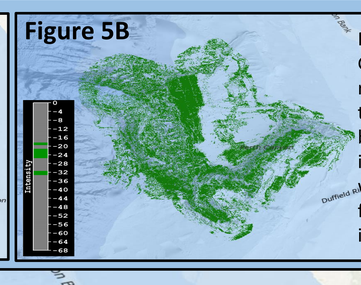


Figure 5B. Green areas represent the total range of backscatter intensities (dB) where coral was found (orange in Fig. 4).

Figure 5C

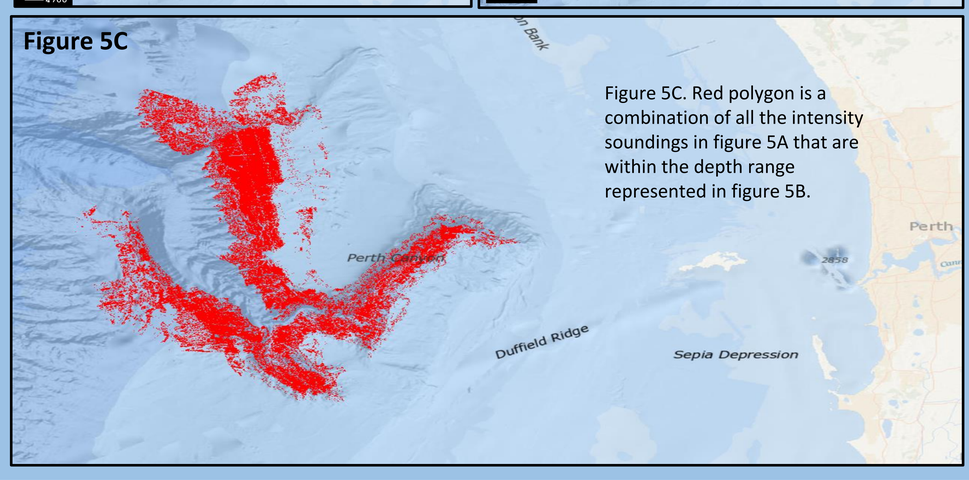
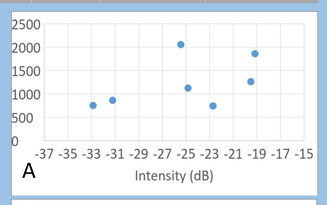


Figure 5C. Red polygon is a combination of all the intensity soundings in figure 5A that are within the depth range represented in figure 5B.

Table 1. Depth, Intensity and Slope associated with the six coral locations, labeled A-, in Figure 1A.

Sites	Depth (m)	Intensity (dB)	Slope (Degrees)	Latitude (Deg/ Dec-Min)	Longitude (Deg/ Dec-Min)
A	862.7	-31.20	14.21	31-55.223 S	115-04.716 E
B	752.9	-32.86	18.61	31-54.727 S	115-04.805 E
C	1124.3	-24.82	1.28	31-58.500 S	115-05.250 E
D	1860.9	-19.15	61.21	32-05.687 S	114-51.823 E
E	1261.8	-19.50	21.41	32-09.982 S	114-50.580 E
F	2055.4	-25.43	38.63	31-46.500 S	114-42.200 E
G	742.9	-22.71	8.70	31-42.045 S	114-50.640 E



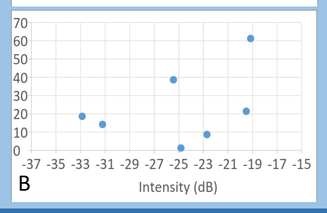
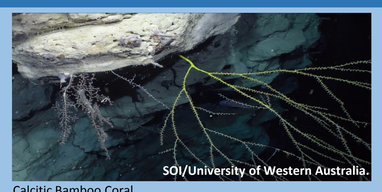


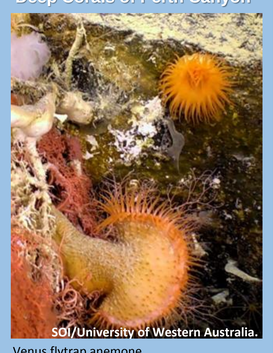
Figure 6.
A) Depth vs. Intensity for each of the seven deep coral sites A-G (Table 1).
B) Slope vs. Intensity for each of the seven deep sea coal sites A-G (Table 1).



Calcitic Bamboo Coral

Aragonitic coral *Desmophyllum*

Deep Corals of Perth Canyon



Venus flytrap anemone

DISCUSSION

The original hypothesis of this study was that deep coral locations found by UWA scientists would be associated with locations of most intense backscatter return, however this hypothesis was not supported by the sonar data. Locations that had the most intense return were found to be in the deepest parts of the canyon's thalweg (Figure 4). The slope data were not found to be helpful. Coral was found at an extremely broad range of slope, between ~1 and 60 degrees. This range nearly covered the entire region except for the canyon walls. However all known coral sites, with a slope of 15 degrees or less, are found within about 100 meters of a location with a slope value of ~30 degrees or greater.
Latitude and longitude locations of known coral sites may be slightly inaccurate which could explain the vast range of slope. The coral's range of backscatter intensity was found at many depths throughout the canyon (Figure 5B). The red polygon shows a general trend of points near the top edge of canyon where Ekman drainage is likely to occur (Figure 5C). This red polygon, which could be used for future deep sea coral expeditions, displays the hypothesized locations where deep sea coral may possibly be located.

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