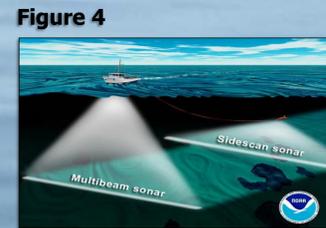
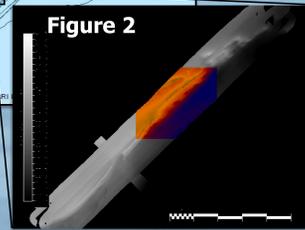
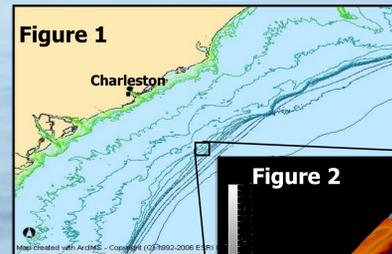


TRIPLE LEDGES: SONAR CHARACTERIZATION OF ROCKY CONTINENTAL SHELF-EDGE EXPOSURES OFF CHARLESTON, SOUTH CAROLINA

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Multibeam sonar surveys were conducted on the continental shelf off Charleston, SC from aboard the NOAA Ship *Nancy Foster* in November 2006. Triple Ledges is a rocky hardground that is a segment of a larger shelf-edge feature referred to as Doc's Rocks, located in water depths of 50-60 m. Triple Ledges has three distinct outcrops of strata aligned roughly parallel to shore, beyond which water depths descend rapidly to more than 100 m. The site is characterized using multibeam sonar bathymetry, side scan sonar, ROV video data, and surface sediment samples. Data collected are compared to other similar shelf-edge sites and essential fish habitats are preliminarily assessed.



Multibeam sonar and sidescan sonar have different swath angles. Both are used to analyze seafloor features.

METHODS

- NOAA ship *Nancy Foster* used to collect Multibeam sonar data.
- Sediments collected with a sediment grab sampler and analyzed using sieve techniques.
- Bathymetric maps of the Triple Ledges site were made using CARIS HIPS/SIPS software
- Video was captured using a Phantom 300 ROV during previous Transect cruise.
- Sidescan sonar was gathered at 100 kilohertz during Transect cruise.

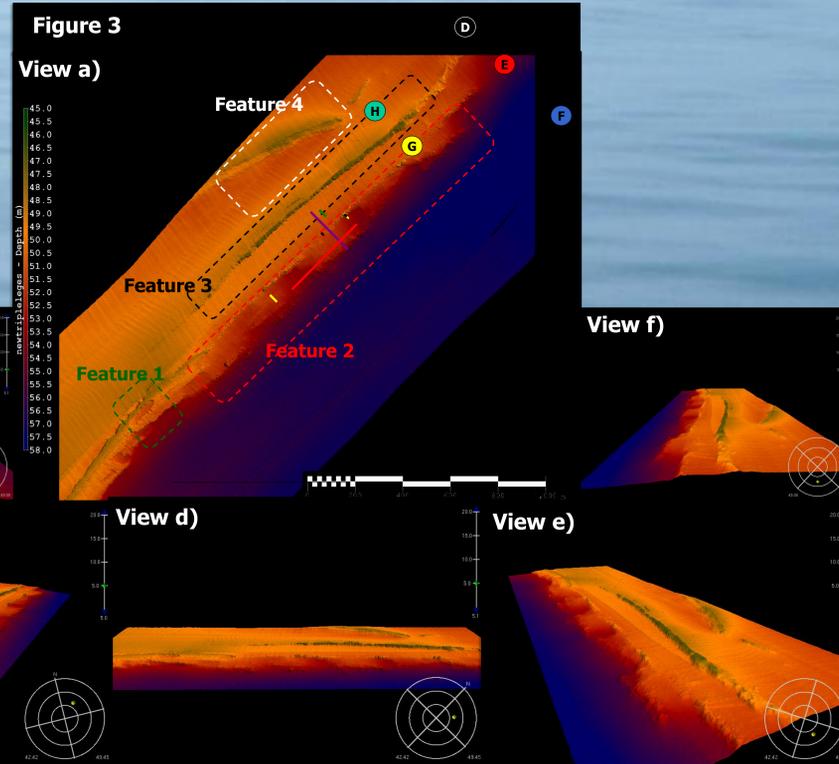


Figure 3 shows the area of study, Triple Ledges, and different 3D views of it. (a) is an overview of the Triple Ledges area (b) a view looking from the bottom left of the overview (c) same image as 'b' but tilted to the right (d) view looking at straight at Triple Ledges (e) view looking from the tip right, but tilted to the left (f) right side view looking down Triple Ledges. Letters D-H represent locations of sediment samples in figure 5. Letters D and F were located in poster to the right.

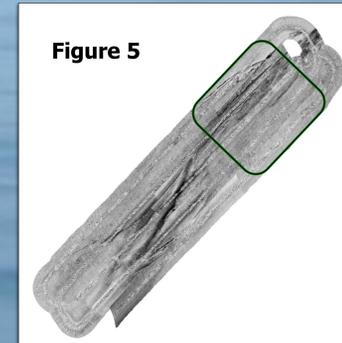
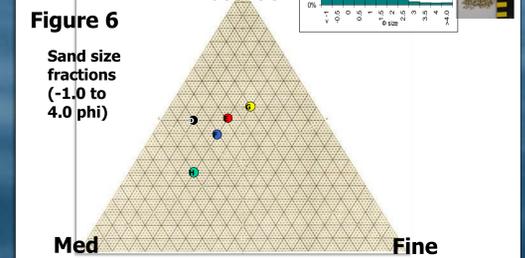
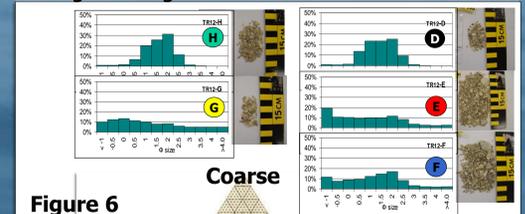
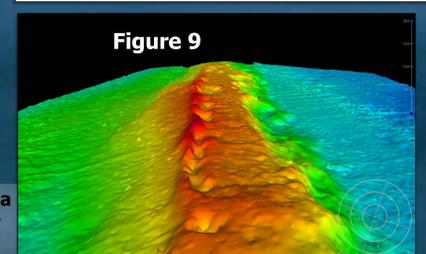


Figure 5. Sidescan mosaic created during a Transects cruise in 2002 along Doc's Rocks. This sidescan image is what prompted us to go over the same area with Multibeam sonar

Figure 6. Grain size analysis of sediment samples shows similarities for similar seafloor morphologies. Samples H and D which are both further back on the shelf edge (towards shore) with a high concentration of medium sand. G was irregular in that it is strongly skewed in the coarse direction (more negative phi). Both E and F have high input of gravel (<-1.0 phi) and are poorly sorted within the medium and coarse sand size fractions. D,E,F were all collected from a depression that cut through the ridge.



ROV video captured during the 2002 leg of Transects near the right side of feature 4. Fish in the circle is a Lionfish.



The Foster ridge is a feature further north that has a similar shelf beak structure, that may be a member as Doc's Rocks.

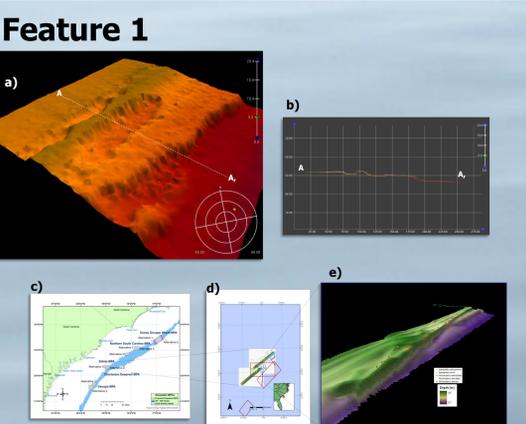
Discussion

Triple Ledges and the two adjacent areas of Doc's Rocks (Crescent Ridge and Thumbprint) all have the same linear ridges running through them. This shelf-edge ridge feature also occurs farther north (Figure 9) and farther south (Feature 1e). In the Triple Ledges system we see what looks like several sedimentary beds that are being exposed on edge, parallel to each other. Each ridge has a smooth side on the landward side, and a rough, jagged side on the seaward portion.

This linear ridge system is probably the result of tilted sedimentary strata outcropping along the edge of the continental shelf, as water depths increase dramatically. This region is heavily impacted by erosive forces of the Gulf Stream.

It is quite possible that the Gulf Stream and semi-diurnal tides have played a role in the sediment distribution. The sediment samples that were taken in the area showed that the currents were having an sedimentary distribution effect in the area, but there was not enough sediment samples taken to show which currents were effecting the sedimentary movement the most.

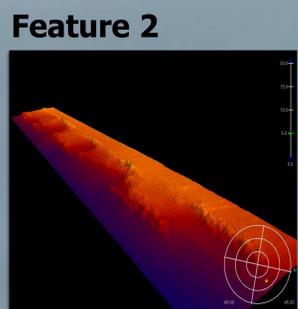
The hard bottom features along the shelf edge are utilized by many different fish species. This was seen in the ROV videos. The current of the gulf stream next to the shelf edge allows many different species of fish to spawn next to the current so that the Charleston gyre will take the eggs away from the invertebrates and other fish species that live on the reef, and then bring them back around 30 days later. By 30 day mark most of the eggs have metamorphosed into fish larva which have a higher chance of escaping predators. Shelf ridge areas such as Triple Ledges should be turned into marine sanctuary because of the importance of having great fish habitat and spawning areas



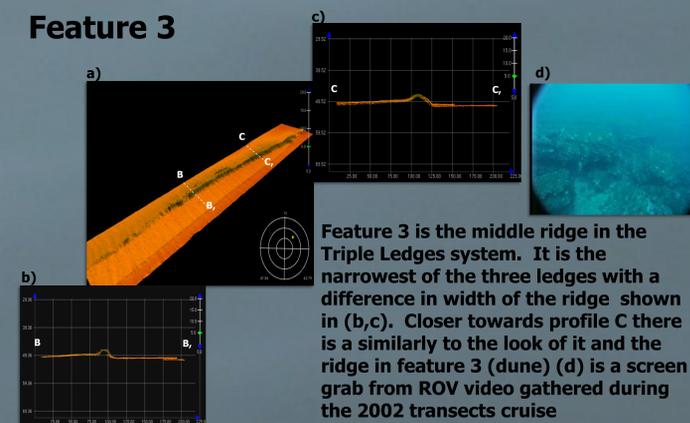
Feature 1 (a) shows a deviation in the hard ground which appears as a hole. There are no similar features in the immediate area. The profile (b) shows that the hole is only about 2-3 m deep and about 25 m wide. It has been documented by Dr. Sedberry that fish create holes in hard bottom surfaces. In similar areas to the north of Triple Ledges (c,d,e) it has been document that fish will spawn and do live along the shelf edge.

RESULTS

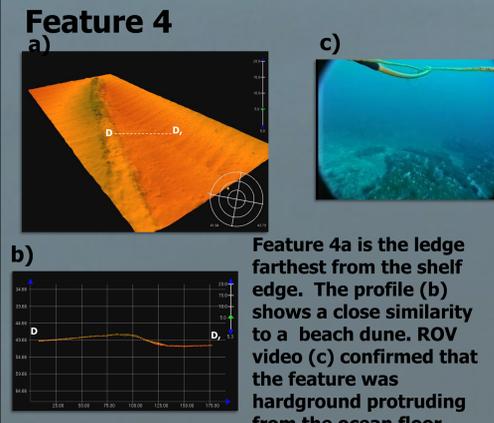
- An analysis if the multibeam data (using CARIS software) shows long linear features along the Triple Ledges area.
- Underwater video of the features shows the region to have rocky hard ground covered with invertebrates with soft sediment around it.
- The sedimentary data show that sediment samples D and H were similar, showing a relationship with that terrain and the type of sediment that would be found there.
- The edge of each ledge that faced seaward is more jagged than the opposing side
- Along the hard rock outcrops there were many different species of fish. A lionfish was seen near to Feature 4 a (Figure 8).



Feature 2 is the front ledge of the Triple Ledges area which has holes and divots all aligned with each other. These holes are thought to be caused by strong currents moving away from shore into deeper water eroding the hardground creating "pot holes."



Feature 3 is the middle ridge in the Triple Ledges system. It is the narrowest of the three ledges with a difference in width of the ridge shown in (b,c). Closer towards profile C there is a similarity to the look of it and the ridge in feature 3 (dune) (d) is a screen grab from ROV video gathered during the 2002 transects cruise



Feature 4a is the ledge farthest from the shelf edge. The profile (b) shows a close similarity to a beach dune. ROV video (c) confirmed that the feature was hardground protruding from the ocean floor.

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