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Purpose of the Dive

- i) To determine the lithology, structure and origin of two recently discovered ~100-200m diameter mounds/pinnacles sitting on the top of the gently sloping carbonate platform to the SE of St. Croix.
- ii) To document benthic communities living on and around these two mounds/pinnacles from 870m to 818m depth for the first mound/pinnacle and from 933m to 920m for the second smaller mound/pinnacle.

Description of the Dive:

This dive was located on a probable Middle Miocene to Lower Pliocene platform carbonate sequence to the south east of St Croix and designed to explore two mounds/pinnacles that were recently discovered in March during surveying by the RV Nancy Foster (NOAA NOS, Tim Battista et al.). The ROV landed on a muddy seafloor at 866m (13:23 UTC) and traversed SW, reaching the base of the mound at 868m (13:58 UTC). It then climbed the mound reaching, and traversing across, the top until 817m (16:11 UTC). At this point the ROV “flew” to the west to the seafloor on the western side of the mound, landing at 865m (17:32 UTC). The ROV then traversed due east along a gully up the western side of the mound. At 827m (18:02), the ROV reached a gentle muddy slope and the decision was taken to “fly” the ROV to the second mound to the SE. Bottom was reached at 928m (19:10 UTC). The ROV then proceeded up this second mound and reached the top at 920m (19:59 UTC), at which point the dive was completed and the ROV returned to the surface. The current came from the NE throughout the dive and was measured at 13 cm/s at the start of the dive.

Geology:

The dive on the first mound started with D2 landing on a gently dipping, bioturbated sediment covered surface at 866m (13:23 UTC). The sediment was very fine grained (muddy), and contained lots of shell debris, notably pteropod shells. Traversing to the SW, the sea floor deepened to 871m (13:55 UTC) as D2 crossed a moat around the base of the mound. A single rounded, 20cm diameter, rock was observed at 870m (13:57 UTC) and loose rubble fringing the mound was reached at 868m (13:58 UTC). All rocks throughout the dive were Fe-Mn encrusted and no interior surfaces were observed. However, the recognition of i) pitted, honey-combed, surfaces (e.g. 851m, 15:05 UTC), ii) rare burrowed surfaces, together with iii) occasional indications of bedding surfaces (e.g. 849m, 16:04 UTC), iv) the presence of thin crusts on some exposures similar to those seen in dives 3 & 6 in the Mona Passage area (e.g. 855m, 14:45 UTC; 823m, 16:31

UTC) and v) proto-karstic weathering on the top of the mound (818m, 16:42 UTC) suggests this mound is made of platform carbonate.

Overall, the mound appeared to be a relatively solid mass, with outcrop at the surface (e.g. 867m, 14:05 UTC) or lightly dusted with sediment (e.g. 857m, 14:23 UTC; 835m, 16:15 UTC). However, rounded rock debris of variable size was present in some locations and thicker mud deposits were present in depressions and areas of more shallow slope (e.g. 855m, 14:53 UTC). The top of the mound was sub-planar and approximately sub-horizontal. It was mud covered, but a sea-poke test showed the unconsolidated mud was only 2cm thick (817m, 16:57 UTC).

At 16:50 UTC, D2 flew to the west side of the mound and landed on soft sediment at 865m (17:32 UTC). The western base of the mound was marked by a few pieces of 30cm-1m diameter talus sitting on an *in-situ* carbonate crust (864m, 17:34m). The traverse upslope, to the east, followed a 30m wide gully. Initially D2 traversed over sediment dusted outcrop (e.g. 846m, 17:56 UTC), until a steep, vertically jointed, rounded, outcrop with boulder debris was reached at 837m (18:01 UTC) at which point D2 had to rise more steeply. Possible gently dipping bedding was visible at 827m (18:14 UTC). The slope quickly became more gentle as the mud covered top of the western side of the mound was reached at 826m (18:15 UTC). At this point the dive on this mound was halted and D2 flew to the mound to the SSE landing on a muddy sea floor at 928m (19:10 UTC).

The second mound was reached at 929m (19:29 UTC) and was very quickly examined as we were short of time. It mostly consisted of Fe-Mn encrusted one meter diameter boulders and smaller debris (e.g. 929m, 19:29 UTC), but clear bedding was recognized at 928m (19:30 UTC) in a loose boulder and, dipping, in a possible outcrop at 924m (19:47 UTC). Probable outcrop, with partially sediment filled proto-karstic weathering was found at the top of the mound (923m, 19:55 UTC). This mound is also thought to be composed of carbonate.

The dive clearly confirmed the mounds were made of carbonate, but their origin is still unclear. There are two possibilities. Firstly, the mounds could be *in-situ* and represent a relict surface protruding above the present day planar surface that dips to the south from St Croix. Alternatively, the mounds are large 200m wide, 50m high blocks that detached from the relatively steep shelf-slope break 5km to the north. This interpretation is supported by the angular 5 sided margin to the first mound (see bathymetry) which could be explained if the shape of the detached block was controlled by jointing in the outcrop and by the observation that bedding may be dipping and therefore not *in-situ*. This explanation requires *in-situ* weathering and breakdown to produce the rock debris sitting on the mound today. The prevalence of the Fe-Mn coating and the amount of biological colonization suggest that if this is indeed a slide block, the transport of the block was not recent. Whilst this second interpretation requires a rather dramatic event (a 200m relatively coherent block sliding 5km), it seems to be the best way to satisfy the observations.

Biology

The dive began off the feature on a muddy bottom at a depth of 866 m. Several fishes were observed here, including at least two species of rattail fishes (*Nezumia ?aequalis* and *?Hymenocephalus* sp.) and a halosaur (*?Aldrovandia* sp.). Several nematocrinid shrimps were evident in the area as well. Also of note, several dead sponge stalks colonized by zoanths were anchored in the soft sediment. One *?Acanella* bamboo coral was observed at 13:46 UTC.

D2 reached the base of the feature at 14:00 UTC and worked its way up the eastern flank of the mound to the top (depth of 820 m). Then, the D2 came off the feature to the western side and then transited up the western flank of the mound. Numerous species of corals were observed on both sides of this mound. Diversity appeared to be similar, however, it appeared that corals were less abundant on this western slope transit compared to the transit on the eastern slope. The most abundant coral included an unknown morphotype of an antipatharian black coral (each with at least one *Gastroptychus* sp. squat lobster), and this was most abundant just below the top of the mound. At least four additional black coral species were observed (e.g., *Stichopathes* sp., *?Bathypathes* sp., and 2 unknown species) as well as five species of scleractinian corals (*Madrepora* sp., *Javania* sp., *Enallopsammia* sp., *?Lophelia pertusa*, and another unidentified cup coral). Octocorals were also common, and included at least eight species of plexaurids, primnoids, anthothelids, corallids, and chrysogorgiids. Of note, two *Iridogorgia ?magnispiralis* colonies were observed and one *?Dendrobranchia* sp. was observed.

After surveying the western and eastern flanks of this mound, the D2 picked up off the seafloor (at ~18:22 UTC) and

transited to another mound 1.2 km to the southeast. Upon arriving on the seafloor (~19:10 UTC), more sponge stalks colonized with zoanthids were noted. However, these sponges were not all dead; there were several live sponges in the area as well. The D2 surveyed this mound feature at a depth of 928 m to 920 m. Corals were common during the survey (NW to SE transit), and noted to be diverse. There were several coral species present (e.g., *Enallopsammia* sp., *Corallium* sp., *Chrysogorgia* sp.) on this mound that were also observed on the shallower mound; however, there were several species not encountered on the shallower mound. These species included: *Paramuricea* sp., *?Narella* sp., *Anthothela* sp., *Jasonisis* sp., *Lepidisis* sp., and a stoloniferan octocoral.

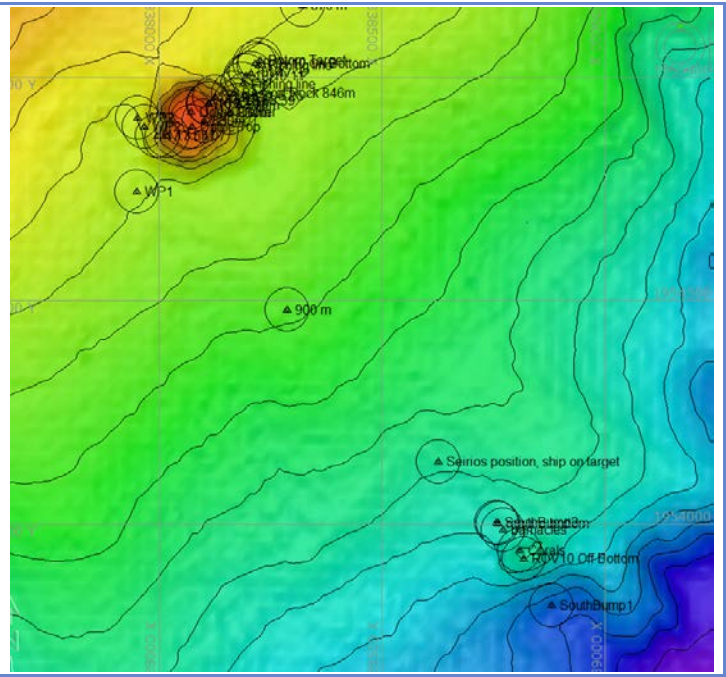
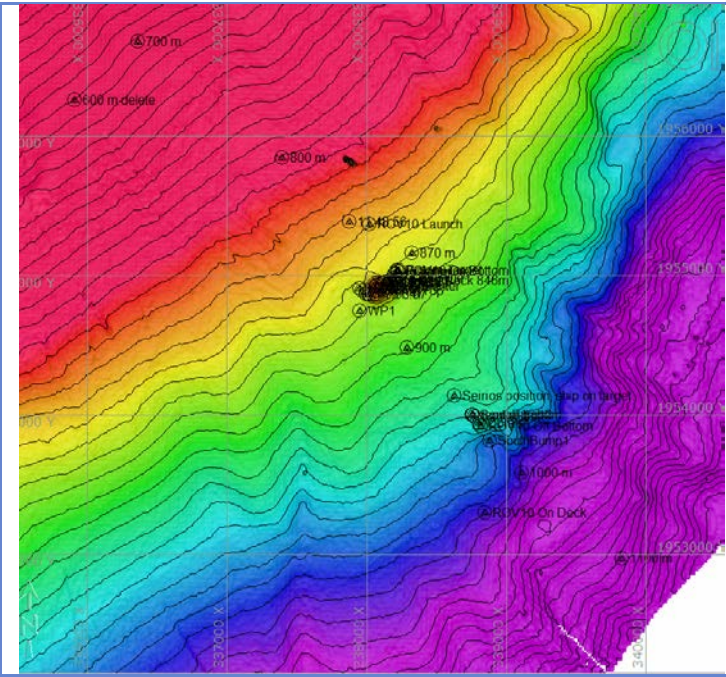
At least 10 species of fish were observed during this dive, including: *?Aldrovandia* sp., *?Benthocometes robustus*, *Cyclothone* sp., *?Hymenocephalus* sp., *Nezumia ?aequalis*, *Synagrops bellus*, an unknown Macrouridae, an unknown Ophidiidae, *Nemichthys ?curvirostris*, and *Neoscopelus ?macrochir*. Crustaceans were abundant throughout the dive, including several observations of pagurid hermit crabs both inhabiting coral colonies and the surrounding substrate. Galatheoid squat lobsters were both common and diverse during this dive. *Gastroptychus* sp. was abundant, and observed colonizing almost every black coral colony (of the same morphotype) encountered. Several *Munidopsis* spp. and *Munida* spp. were observed inhabiting corals and the surrounding substrates, respectively. Two unknown squat lobsters were observed hiding within two *Chrysogorgia* colonies. Shrimps (Pandalidae) were very large (up to and greater than 10 cm in total length). Ophiuroid brittle stars were common. *Ophomusium* -like morphotypes were observed on soft substrates whereas *Asteroschema* sp. were commonly observed wrapped tightly around octocoral colonies. Asteroid sea stars were rare during this dive, but included one observation of *Tremaster mirabilis*, *?Mediaster bairdii* and an additional asteroid sea stars. Other coral associates included gooseneck barnacles, amphipods, mysids, and polychaete worms.

Notable Observations:

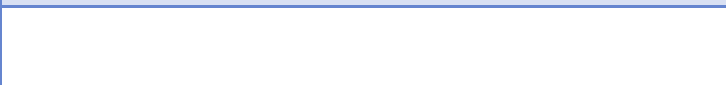
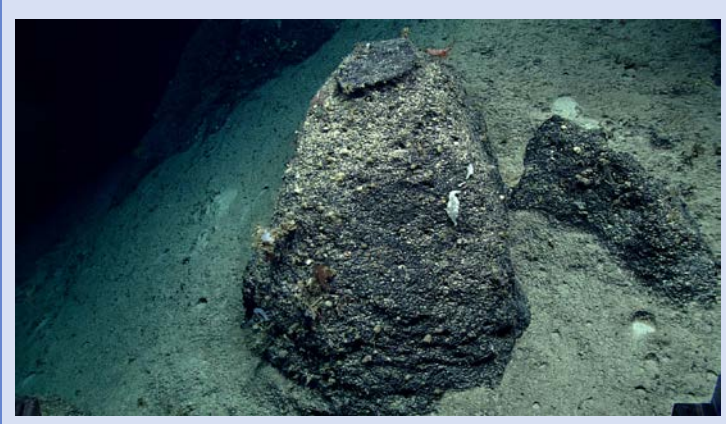
Trash was observed on the soft sediment surrounding the feature, including plastic trash bags, derelict fishing gear (or a hydrophone and cable), and a possible fishing line. At 14:43 UTC, a shrimp “grooming” itself with its chela was imaged at a depth of ~ 857 m. At 15:09 UTC, an *Enallopsammia* coral colony was observed that may have been parasitized, as large, bulbous portions of the skeleton were apparent. Two observations of gorgonocephalid basket stars were observed; both were perched on octocorals at 16:40 UTC (818 m) and 18:21 UTC (825 m). Several squat lobsters were observed on this dive, including some that had not yet been observed during this expedition. Of note, one galatheoid squat lobster inhabiting *Madrepora* was well camouflaged, with coloration matching the coral (16:27 UTC, 829 m). On this same *Madrepora* colony, one Eunicidae polychaete worm was observed, peaking its head between two coral branches. Coral diversity was high on this dive, including at least 26 species of corals. An unknown macrourid, with a very long chin barbel and black, filamentous fin rays was noted at 19:44 UTC (925 m). Also during this dive, we noted numerous dead coral skeletons, several of which were colonized by living scleractinians.

Overall Map of ROV Dive Area

Close-up Map of Main Dive Site



Representative Photos of the Dive



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