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Purpose of the Dive

- i) To carry out five 10 minute horizontal traverse mid water transects every 1000m from 800-1200m to observe mid-water biology.
- ii) To document hard substrate megabenthos and other benthic communities along the canyon wall and to compare the communities to those found at similar depths on the west wall of Mona Canyon.
- iii) To observe lithology and structure along a transect from 4000m to 3300m to compare with observations of the west wall of Mona Canyon, including looking for evidence of faults on the east wall of the canyon.
- iv) To look for, and examine, the late Cretaceous to Middle Eocene arc rocks which lie immediately below the Middle Oligocene to Pliocene platform carbonate sequence.
- v) To identify features that could be related to failure of the canyon wall.

Description of the Dive:

This deep dive was located on a >40° dipping slope on the east wall of Mona Canyon. The dive began at 12:47 UTC. D2 descended to 800m at 13:47 UTC and began to carry out the mid water transects. The transects were complete at 15:11 UTC and D2 headed down towards 4000m. Because the start of the dive was on a relatively steep slope, D2 stopped descending at 4005m (16:46) and then proceeded to move towards the slope reaching the slope at 4019m (16:56 UTC). D2 then headed up a sediment covered talus slope with occasional exposed talus blocks, until, at 3909m (18:56 UTC), lightly sediment covered outcrop was reached. D2 then continued up the outcrop, which in places consisted of near vertical rock faces until the end of the dive at 3730m (20:27 UTC). Weak currents were encountered throughout the dive.

Geology

The dive began on a steep muddy/clayey slope at 4019m (16:54 UTC). Immediately the D2 encountered, a large (5 metre dia.), sediment covered block of Fe-Mn coated rock. This occurrence set the tone for the first part of the dive which traversed 110 vertical meters of dominantly sediment covered talus. The sediment appeared to be thick in places, completely covering the talus, but in other places, collections of often very large (a few meters dia.), Fe-Mn coated, angular blocks were present. Sediment draping was variable, which together with the blocks sitting on the surface of the mud suggests that some of the blocks were relatively recent rock fall. The blocks were noticeably bigger, had more

extensive Fe-Mn coatings and were more angular than those encountered on the west wall, although there were a few accumulations of smaller blocks (30 cm dia), often trapped on the slope behind larger blocks (e.g. 3989m, 17:56 UTC). The relative absence of smaller clasts suggests that there was significant transport of material downslope. In places the mud was rippled (e.g. at 4002m, 17:38 UTC and 3948m, 18:29 UTC), indicating current activity. Sediment chutes and debris aprons were observed at 3949 m (18:36 UTC) and 3925m (18:47 UTC). Although the Fe-Mn coating was extensive, a few clasts/blocks were found to have non coated faces providing a glimpse into the true lithology of the rocks. At 3981 m(18:08) a possible volcanic breccia with 2-5mm dia clasts was observed and elsewhere green colored rocks with white veins were seen (3976, 18:11 UTC and 3949-2930, 18:31-18:45 UTC). These rocks may be greenschist facies metavolcanics with quartz or carbonate veins.

Outcrop, encountered at 3909m (18:56 UTC), continued upwards until and (beyond) the end of the dive at 3730m (20:27 UTC). This outcrop was clearly the source of the blocks seen below. The lower part of the outcrop consisted of steep, fractured, sometimes rubbly, Fe-Mn encrusted exposures. Planar, sub-vertical exposures were seen in several places, but at 3885m (19:06 UTC) possible vertical striations were observed on a slope parallel vertical face. This could be a fault surface or possibly a joint surface with some vertical slip. The rocks at this height also were similar in color to the greenschist blocks recognized downslope and consequently this part of the exposure may consist of greenschist facies volcanic rocks. Downslope sediment trails were observed at 3856m (19:28 UTC). At 3855m (19:29 UTC), the outcrop became more massive and joints with variable orientations were clearly visible. At 3771m (219:59 UTC) red colouration was observed on a broken face. Very tentatively, because of their massive character, we suggest that these rocks may be plutonic rocks, perhaps of granodioritic composition. At 3751m (20:07 UTC), the slope became more gentle with areas of debris accumulation and the character of the outcrop changed and became less massive. Another broken rock face was seen to be red in color at 3739m (20:13 UTC). These exposures might be volcanic rocks. At the top of the dive (3731m, 2018 UTC) massive exposures with steeply dipping joints, created re-entrants in the cliff face. Speculating wildly, these rocks could have been dikes.

The dive clearly traversed the Late Cretaceous to Middle Eocene meta-volcanic/plutonic basement that forms the core of Puerto Rico and sits below the Late Oligocene to Pliocene platform carbonate sequence and consequently traversed a very different sequence of rocks than seen at similar depths on the west wall. Here on the east wall, the top of the platform carbonates is interpreted to be in a down-dropped fault block at ~2600m and using seismic evidence that suggests the platform carbonate sequence is 750m thick at this locality (Mondziel et al, 2010), leads to the prediction that the base of the carbonate unconformity occurs at ~3350m. Hence the end of today's dive at 3730m was approximately 400m below that unconformity.

Biology

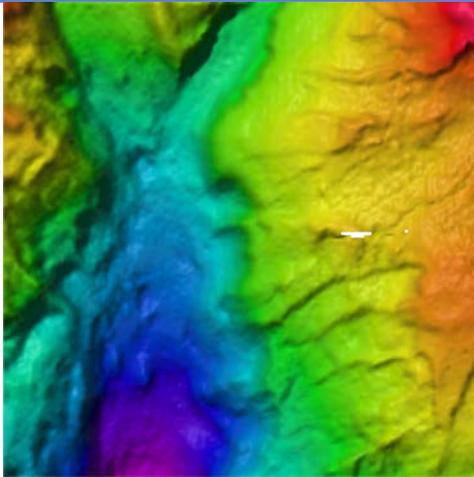
The dive began with five mid-water transects conducted from 800-1200 m depth. Prior to starting the first transect at 800 m (13:41 UTC), amazing imagery was captured of a squid, *Asperoteuthis acanthoderma*, swimming away from D2. Mid-water organisms appeared to be more abundant during the first two transects conducted from 800-1000 m. During all transects, jellyfish, lobate ctenophores, siphonophores, larvacean houses, barracudinas (Paralepididae), and arrowworms (Chaetognatha) were common. A fair amount of particulate matter was noticed near the bottom at 16:49 UTC, 4000 m depth.

Sponges (Phoronematidae, Euretidae, Cladorhizidae), branching ? bryozoans, and crinoids were observed attached to the clean rock faces. Numerous aborescent foraminiferans were also seen colonizing the rock faces. Several anemones with very wide bases and short tentacles were observed as well as a cerianthid tube anemone. The same species of black coral with two morphotypes was observed throughout the dive: the whip-like morphotype at 17:28 UTC (4007 m) and the whip-branched-at-tip morphotype at 17:44 UTC (3995 m), 17:54 UTC (3984 m), and 19:08 UTC (3883 m). White color morphs of an alcyoniidae octocoral, (the mushroom coral) were prevalent throughout the course of the dive.

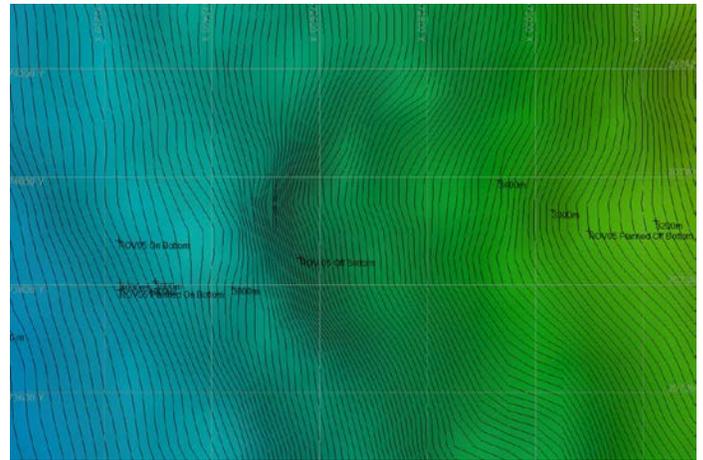
Further up slope (3726 m) near the end of the dive, 4-5 colonies of a bamboo coral (Isididae) were observed. Overall, it was noted that sessile colonization was not very dense throughout the entire dive track. However, more sessile species appeared to colonize the Mn-Fe coated rock faces of the large, angular rock slabs at the deepest depths and shallowest depths surveyed. In contrast, no to little colonization was evident on the massive outcrops that occurred between these two layers.

Decapod crustaceans were fairly common; several *Munidopsis* sp. squat lobsters were observed as well as *Aristaeopsis edwardsiana*. As for fishes, only two individuals of *Bassozetus* sp. were observed. Several brisingids, comatulid crinoids and sea lilies were common throughout the dive. Two species of swimming holothurians were observed, including *Eynpniastes* sp. and ?*Peniagone/Amperima* sp. A sea cucumber (Elaasiopod) unfamiliar to ship and shoreside participating scientists was observed at 19:48 UTC (3796 m) and 20:05 UTC (3763 m). Additionally, an unidentified animal (urchin? or Porifera?) was seen at 18:20 UTC (3962 m). Notably, a 6-armed seastar, *Laetmaster spectabilis*, was observed on hard substrate at 18:53 UTC (3916 m). This is the first record of this species since the description of the holotype, which was collected off Cuba, in 1878.

Overall Map of ROV Dive Area



Close-up Map of Main Dive Site



Representative Photos of the Dive





Please direct inquiries to:

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