


Okeanos Explorer ROV Dive Summary

Site Name	Arecibo Amphitheater (Guajataca Canyon)			
ROV Lead/Expedition Coordinator	Brian Bingham/ Brian Kennedy			
Science Team Leads	Andrea Quattrini and Mike Cheadle			
General Area Descriptor	Puerto Rico and US Virgin Islands			
ROV Dive Name	Cruise Season	Leg	Dive Number	
	EX1502	3	DIVE01	
Equipment Deployed	ROV:	Deep Discoverer		
	Camera Platform:	Seirios		
ROV Measurements	<input checked="" type="checkbox"/> D2 CTD	<input checked="" type="checkbox"/> Depth	<input checked="" type="checkbox"/> Altitude	
	<input checked="" type="checkbox"/> Scanning Sonar	<input checked="" type="checkbox"/> USBL Position	<input checked="" type="checkbox"/> Heading	
	<input checked="" type="checkbox"/> Pitch	<input checked="" type="checkbox"/> Roll	<input checked="" type="checkbox"/> HD Camera 1	
	<input checked="" type="checkbox"/> HD Camera 2	<input checked="" type="checkbox"/> ROV HD 2	Seirios CTD	
	<input checked="" type="checkbox"/> Temperature Probe	<input checked="" type="checkbox"/> D2 DO Sensor	<input type="checkbox"/> Seirios DO Sensor	
Equipment Malfunctions	The Seirios CTD is not configured for this dive. The main HD camera on D2 could not be color balanced properly. Operating with a secondary DO sensor that was last calibrated in 2013.			
ROV Dive Summary (From processed ROV data)	Dive Summary: EX1502L3_DIVE01			
	In Water at:	2015-04-10T12:21:48.062000 18°, 51.716' N ; 066°, 48.878' W		
	Out Water at:	2015-04-10T23:29:25.062000 18°, 51.666' N ; 066°, 48.185' W		
	Off Bottom at:	2015-04-10T21:22:02.656000 18°, 51.530' N ; 066°, 49.174' W		
	On Bottom at:	2015-04-10T14:31:05.312000 18°, 51.604' N ; 066°, 48.625' W		
	Dive duration:	11:7:36		
	Bottom Time:	6:50:57		
Max. depth:	4062.8 m			
Special Notes				
Scientists Involved <i>(please provide name / location / affiliation / email)</i>	Bernard Ball	Duke University Marine Lab	bernie.ball@duke.edu	
	Jason Chaytor	USGS	jchaytor@usgs.gov	
	Mike Cheadle	University of Wyoming	cheadle@uwyo.edu	
	Erik Cordes	Temple University	ecordes@temple.edu	
	Amanda Demopoulos	USGS	ademopoulos@usgs.gov	
	Mike Ford	NOAA Fisheries	michael.ford@noaa.gov	

	Graciela Garcia-Moliner	Caribbean Fishery Management Council	graciela.garcia-moliner@noaa.gov
	Christopher Kelley	University of Hawaii	ckelley@hawaii.edu
	Cheryl Morrison	USGS	cmorrison@usgs.gov
	Andrea Quanttrini	USGS	aquattrini@usgs.gov
	Herrera Santiago	Woods Hole Oceanographic Institution	tiagohe@gmail.com
	Susan Schnur	Oregon State University Woods Hole Oceanographic Institution	sschnur@coas.oregonstate.edu
	Timothy Shank	Woods Hole Oceanographic Institution	tshank@whoi.edu
	Liz Shea	Delaware Museum of Natural History	eshea@delmnh.org
	Uri ten brink	USGS	utenbrink@usgs.gov
	Michael Vecchione	NMFS National Systematics Lab	vecchiom@si.edu
	Denise Brietburg	Smithsonian	breitburgd@si.edu

Purpose of the Dive

- i) To investigate the lithology of the exposed rocks along the escarpment,
- ii) To identify features that could be related to failure of the escarpment/platform. And in particular to look for recent features that might be related to the January 2014 recent Magnitude 6 Earthquake.
- iii) To look for evidence of sediment flows emanating from the canyons.
- iv) To explore for fresh water seeps along the marginal escarpment.
- v) To document the biology living on and around the escarpment from 3000-4000m.

Description of the Dive:

This dive was situated at the mouth of Guajatacea Canyon, on the marginal escarpment of the carbonate platform, in the Arecibo Amphitheatre, very close to the epicenter of the January 2014, Magnitude 6.5 earthquake. The dive began at 12:18 UTC and D2 descended to 4060m and landed on a gently sloping surface of fine biogenic carbonate mud at the base of a canyon wall with a mean slope of 32°. The dive ended at 3452 m after traversing a sequence of massive to rubbly weathering carbonates with intercalated clastic sediments, with D2 leaving the slope at 20:23 UTC.

Geology:

The dive traversed a thick sequence of Late Oligocene to Early Pliocene carbonate rocks with intercalated clastic rocks. Exposures consisted of up to 10's of meters high cliff sections separated by gently dipping slopes or ledges covered by biogenic mud/sediment. Most outcrops were vertically jointed and a thin Fe-Mn crust of variable thickness covered most rock surfaces. Overall 30-40% of the traverse was over rock outcrop.

The first outcrop, reached at 4060m (14:48 UTC), was small (50cm high by 12 m across) and sediment draped and of ambiguous lithology due to extensive Fe-Mn coating. It was heavily fractured but exhibited a weak, sub-horizontal, bedding/foliation, and a light coloration beneath the Fe-Mn coating suggests that it might be carbonate. Gestel et al (1988) report that the Late Oligocene to Early Pliocene platform sequence is 1.5km thick in this location (from seismic data). Given that this outcrop was only ~1000m below the top of the platform (~ 3050m), it's likely that this outcrop is within the platform sequence. The next outcrop encountered at 4058m (1505 UTC) was more substantial, consisting of highly fractured carbonate rocks lying above a shale/marl layer at the base (see photo below). The presence of shales/marls could indicate that this is an outcrop of the Early Miocene Cibao Formation, which contains marls and mudstones. In one part of the outcrop (4058m; 15:11 UTC), an approximately 2m section of the Fe-Mn encrusted face of the layer had spalled off revealing the white fractured carbonate rocks. This was the best example of very recent "slope failure" seen during the dive. The close-up photo (15:09 UTC) of the fresh rock face hints that these rocks might be in the damage zone of a fault. Immediately, above this locality, the outcrops were relatively massive carbonates, commonly with obvious sub-horizontal bedding (see photo below; 15:14 UTC). The presence of Fe-Mn coating on only some faces of this outcrop, suggests episodic uncovering of the outcrop or the possibility of recent slope failure. D2 then traversed a relatively steep slope consisting of commonly Fe-Mn encrusted, and/or mud dusted, carbonate outcrops separated by areas of sediment.

The top of this relatively continuous sequence of exposures was reached at 3750m (~18:10 UTC) and this sequence could correspond to the Middle Miocene Los Puertos Formation. Occasional, small talus piles were crossed e.g. at 4025m, (15:48 UTC), and at ~4011m (15:55 UTC) D2 passed over a sediment dusted talus slope of rounded boulders, perched on a ledge above a large, steep faced outcrop. Vertical joints were noted at 3785m (17:45 UTC).

The rest of the traverse crossed, commonly sediment draped, rubbly weathering, carbonate rock exposures of varying height and slope separated by gently dipping sediment covered slopes. A small downslope chute of coarse grained gravel was observed at 3625m (18:46 UTC), and sediment trails were seen on several of the rock faces (e.g. 3625m, 18:46 UTC). Other sediment chutes, at for example 3967m (16:27 UTC) and 3515m (19:35 UTC), indicate some downslope movement of sediment into the trench. A large, steep rock face with vertical joints was encountered at 3586m (18:49 UTC) and Fe-Mn encrusted outcrops at 3546m (19:23 UTC) had a rubbly appearance suggestive of conglomerate. Clear sub-horizontal bedding was seen at 3489m (19:52 UTC). An overall picture emerged of relative stability of the escarpment; there were no significant recent slope failures and downslope movement of sediment was not extensive. Both of these observations are consistent with the escarpment eroding in piecemeal fashion, rather than by catastrophic failure. No freshwater seeps were found during the dive.

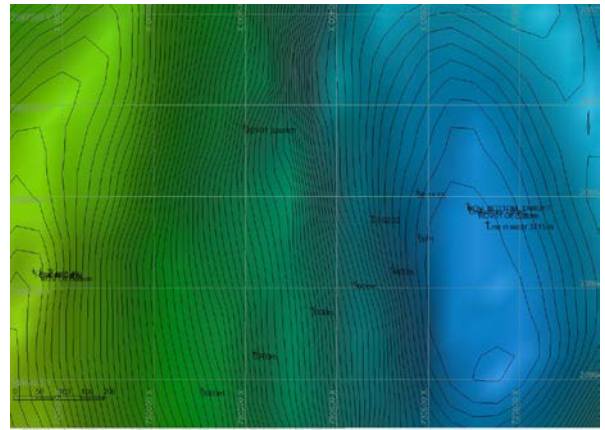
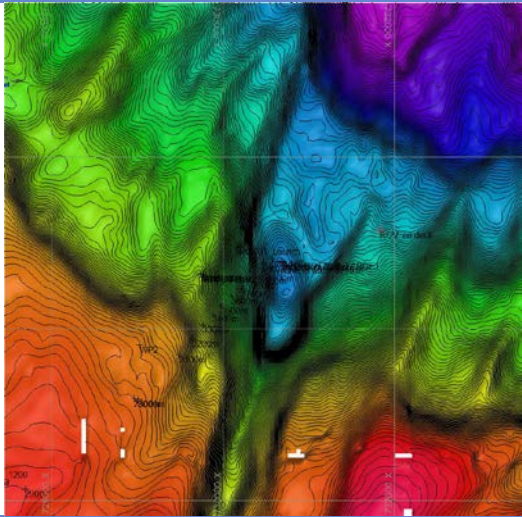
Biology:

Two fish, one siphonophore, and eight jellyfish were observed during descent with the majority observed in the upper 2000 m of the descent. Fishes were rarely observed in the lower part of the dive, but rattail fishes (*Coryphaenoides ?armatus*, *Nezumia* sp.) were observed from 3700 m upwards, with spectacular examples at 3694 m (18:24 UTC), 3000 m (~ 18:45 UTC) and 3567 m (19:11 UTC). Several of the fish hosted ectoparasites. Two individuals of ophidiid cusk eels (*Bassozetus* sp.) were also observed during the dive. At least five species of isolated stalked and non-stalked glass sponges were observed. Sponges were the most common sessile species observed throughout the dive. However, they were patchily distributed on vertical rock faces, with some areas being more heavily colonized than others. Occasionally, amphipods were associated with the sponges. Spectacular examples of swimming ctenophores were observed at 3913 m (16:59 UTC) and 3787 m (17:39 UTC) and a jellyfish (Nacromedusae) was observed at 3765 m (17:58 UTC). Five observations of midwater shrimp were also observed. Purple Holothurians (*Benthoodytes* sp.) became increasing common as the dive progressed upwards including a spectacular, defecating example at 3464m (20:05 UTC). Their tracks in the sediment were observed at three localities. Eight, up to 10cm diameter, squat lobsters were seen, together with one crab at 2910 m and a spectacular gastropod at 3576m (19:04 UTC). Bamboo octocorals were observed regularly from 4002m (16:09 UTC) until the end of the dive. Actinaria anemones, stalked crinoids and spectacular brisingid sea stars were relatively common. Other identifications included pteropod shell tests on the seafloor.

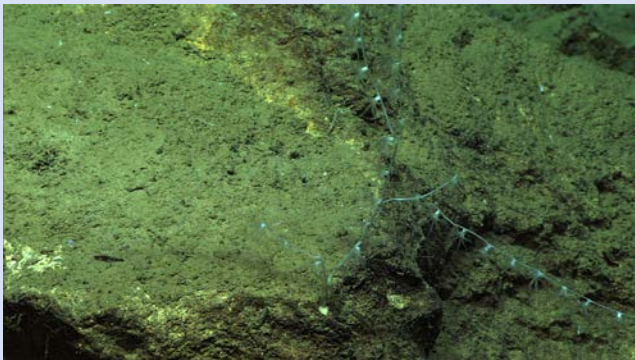
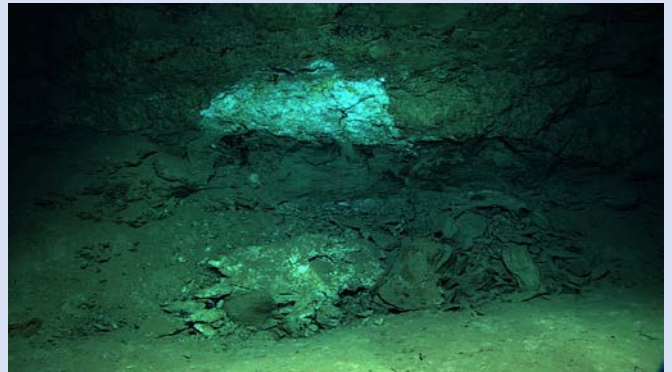
As the vehicles left the bottom, Seirios became entangled in a submarine cable running adjacent to the dive site. Vehicles were successfully untangled and returned to the surface with little damage.

Overall Map of ROV Dive Area

Close-up Map of Main Dive Site



Representative Photos of the Dive



Please direct inquiries to:

NOAA Office of Ocean Exploration & Research
1315 East-West Highway (SSMC3 10th Floor)
Silver Spring, MD 20910
(301) 734-1014