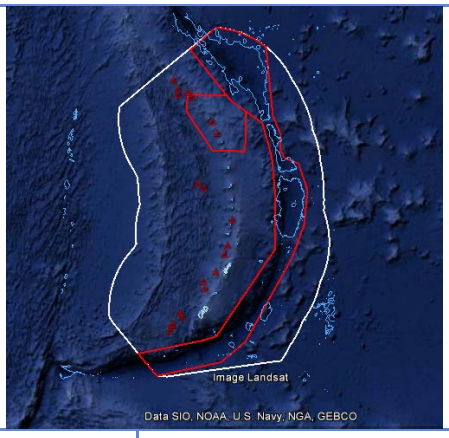
OKEANOS EXPLORER ROV DIVE SUMMARY

Site Name	Explorer Ridge - Deep	
ROV Lead/Expedition Coordinators	Jim Newman/ Kasey Cantwell	
Science Team Leads	Shirley Pomponi (HBOI-FAU, CIOERT) Patty Fryer (UH)	
General Area Descriptor	Areas in and around the Marianas Trench Marine National Monument	

ROV Dive Name	Cruise	Leg	Dive Number
	EX1605	3	DIVE14
Equipment Deployed	ROV:	Deep Discoverer	
	Camera Platform:	Seirios	
ROV Measurements	☒ CTD	☒ Depth	☒ Altitude
	☒ Scanning Sonar	☒ USBL Position	☒ Heading
	☒ Pitch	☒ Roll	☒ HD Camera 1
	☒ HD Camera 2	☒ Low Res Cam 1	☒ Low Res Cam 2
	☒ Low Res Cam 3	☒ Low Res Cam 4	☒ Low Res Cam 2
Equipment Malfunctions			

ROV Dive Summary (From processed ROV data)

Dive Summary: EX1605L3_DIVE14

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In Water:	2016-06-30T20:33:16.271000 20°, 40.779' N ; 145°, 05.211' E
Out Water:	2016-07-01T04:32:44.395000 20°, 40.970' N ; 145°, 05.022' E
Off Bottom:	2016-07-01T03:12:09.936000 20°, 41.036' N ; 145°, 05.130' E
On Bottom:	2016-06-30T22:03:18.325000 20°, 40.787' N ; 145°, 05.282' E
Dive duration:	7:59:28
Bottom Time:	5:8:51
Max. depth:	2594.2 m

Special Notes

Scientists Involved

Name	Institution	Email

(please provide name / location / affiliation / email)			
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Purpose of the Dive

This dive focused on an unstudied complex structural high east of the volcanoes in the MTMNM Islands Unit. This ridge is in an analogous tectonic setting to the better developed high that stretches from Guam in the south through the uplifted islands of Rota, Tinian, and Saipan to Farallon de Medinilla, although it is more poorly developed and appears to broken up by E-W faults. Much of this region was mapped during Leg 2; two dives are

planned on the largest (and shallowest) such highs, which we informally named “Okeanos Ridge—Deep and Shallow”. The objective is to study the geology and biology of this region. This dive investigated one of the deep (~2500 m) terraces of this feature. Dive 15 will explore a shallower terrace along this same feature

Description of the Dive:

The dive was planned to ascend a steep wall (undoubtedly fault-controlled), 646 m high. ROV *Deep Discoverer* (D2) made it about 336 m of the way up on this dive. D1 settled to the sea floor at 2,598 m on a smooth surface, with a pale-brown sediment and numerous tiny foraminiferal tests (shells). We immediately saw a series of small (a couple of cm high) darker mounds aligned in a sharp V-shape with a second line segment crossing the apex of the "V" (making and elongate "A" - see 22:11:42 Z). A zoom on the mounds also showed a radiating pattern of dark streaks at the base of and centered on the mounds. We had no consensus from our shore-based scientists as to exactly what these mounds represent. Most of the beginning of the dive was on what appeared to be a talus slope covered by sediment. The general slope at the beginning of the dive was 45°, which is the normal average "angle of repose" assumed by piles of debris. The talus pile had occasional chutes (large or small furrows), likely caused by debris moving down-slope and thus eroding the surface of the talus fan. Some of these chutes contained rocks, varying in size from pebbles to boulders.

As D2 ascended the talus slope it became steeper, eventually reaching ~ 55°. We collected a rock sample from upslope of a large block of rock. We think the sample came from the large block. The block looks like it has detached intact from the slope further up so it's a pretty good chance that the rock represents the bulk of that large boulder. The sample we recovered is a well-indurated siltstone. It had sediment adhering to it when it got back onto the ship, and a quick look showed that that the sediment contained many fragments of foraminiferal tests, a green olivine grain, cleavage fragments of plagioclase and pyroxene, and a lot of black volcanic glass fragments, all enclosed in fine clay-sized particles. We scooped the mud off and put it into a jar and labeled it as a GEO sample for this dive. The general color of the sediment is medium brown, and the rock, where not coated with MnO crust, is the same color.

Higher up the slope at about 2,430 m, we began to see low (~ 20-30 cm high) outcrops of the sediment that makes up the talus pile. These are apparently exposed when part of the talus pile sloughs off downslope. The small outcrop appears finely layered and is pale tan or buff in the lights from the ROV, but so was the sediment adhering to the rock sample. So, likely, the sediment is actually darker.

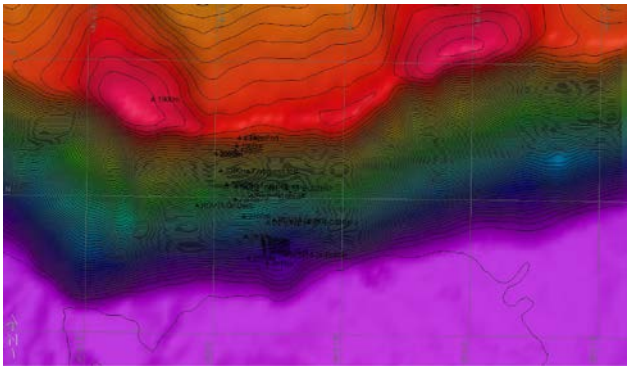
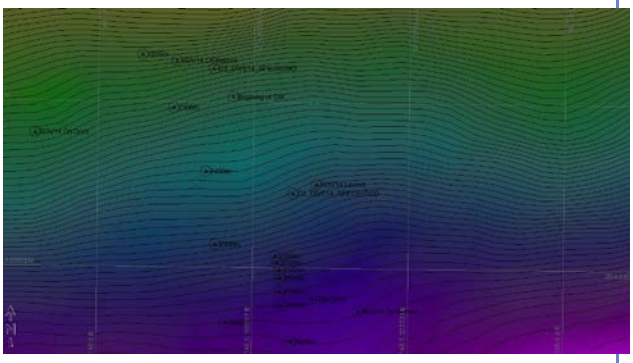
At about 2,405 m, we encountered a chute (depression) in the sediment with a large boulder in it (erosional channel in the talus slope?). At 2370 m we saw an outcropping(?) of rock that appeared to have columnar jointing, but only about 1 m of the rock extended above the sediment. There were many areas where rocks were partly covered (from above) with sediment. About 10 m above this depth we began to see talus comprised of numerous angular blocks. The slope maintained about a 45° slope throughout this area. Near 2,365 m we saw a large rock on the slope with cobbles surrounding it, all nestled in soft sediment. Passing about 2,350 m, we again saw a smooth sedimented surface and a locally lower slope. The character of the slope was changing considerably as we passed 2,337 m or so, and there were chutes in the slope, some of which contained large boulders. There was a pile of rocks on right side of the local ridge of the talus slope at about 2330 m and some in the channels on each side of the ridge. The rocks had rough surfaces (rubbly) and were dusted with fine sediment. We took a poke at some cobbles in a small slump scar, but they were all cemented to the seafloor, apparently by MnO crust. At 2,318 m, D2 crossed onto a hard surface, very lightly dusted with sediment that had linear scratch marks running down slope. The ROV bumped into the surface and left only scratch marks, not the gouges that it made when settling in the sift sediment lower on the talus pile. At 2311 m we saw some layers of sediment containing rock rubble overlying this hard surface to the right of the ROV. To its left, the entire slope was covered with the same sediment and rubble.

The guess is that this material had slid off the hard surface, exposing it only in the area we had just traversed. Just above 2,295 m, we saw a groove in hard surface with broken blocks (cobble sized) at the apex of the groove, but they were too cemented to the layer to collect. Again at 2,270 m, we saw another wider groove with loose-looking rubble (again in the apex of the groove). These grooves are sharp-edged and this one is also deeper (maybe 30 cm?). Still, no luck getting a rock. At 2,253 m we saw definite outcropping of blocky rocks with columnar jointing (fractures) that was exposed in cross-section, so that the joints were diving into the face of the wall. This jointed and blocky rock outcropping extended upward until about 2,229 m where we encountered a smooth, nearly vertical wall with a massive smooth surface. This nearly featureless wall lasted until we left the bottom at 2110 m.

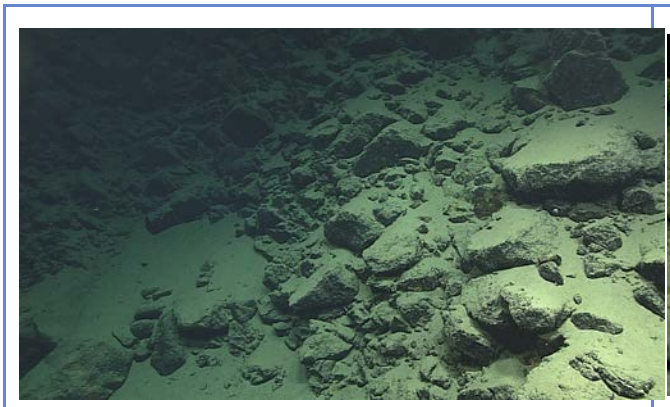
Without a doubt, the most awesome biological discovery today was the aphyonid fish, about 10 cm long, with transparent skin and highly reduced eyes. According to the experts, this is the first time that a fish in the family Aphyonidae has ever been seen alive! These eel-like fishes are found between 2,000 and 6,000 m in tropical and subtropical waters worldwide. They've developed an unusual reproductive strategy to adapt to the difficulty of finding a mate that's sexually mature: the male bundles its sperm, which it can store until it mates with a female (often immature), and the female can store the sperm inside her ovaries until the eggs are fully developed. We spent quite a bit of time photographing the never-before-seen-alive fish!

Other unusual findings were a benthic-sweeper black coral (Schizopathes sp.) was found on its side, making circles in the sediment - It was noted by Ken Sulak (USGS) that it can have a commensal fish (Bassozetus) that is typically found underneath, where it can remain for extended periods of time (this association was observed during the SERPENT project, and is the subject of a paper currently in press); tiny polynoid polychaetes that ride on elasipod holothurians; mounds of possibly echiuran feeding traces—all in alignment; a pattern of holes—known as Paleodictyon nodosum - these have been usually interpreted to be burrows, and they appear in the geologic record beginning in the Cambrian, but they might also be sponges or a Xenophyophoran; a tripod fish, *Ipnops* sp., with the top of its head modified to be light sensitive; a voracious predator, it lunges upward to catch crustaceans and small fish.

None of these deeper dives in the Marianas would be complete without seeing some carnivorous sponges, and this dive was no exception (including one "lollipop"-type sponge, pinkish from some crustacean it was in the process of "digesting"). The hexactinellid sponges were more diverse than on previous dives, but a few did seem to show some signs of aging!

Overall Map of ROV Dive Area	**Close-up Map of Main Dive Site**
	

Representative Photos of the Dive



Much of this dive traversed sedimented slopes, but some outcrops like this one exposed sedimentary rocks that were heavily fractured, but in place (in situ) on the steeper places on the dive track, as on the left of the view above. The boulders on the right in this view are thick slabs of the same sedimentary rock as exposed on the left, but they have broken free of the outcrop.

Never before seen alive, this aphyonid fish has adapted to life in the deep sea with its reduced eyes, cartilaginous skeleton, and scaleless, translucent skin.

Samples Collected

Sample ID	SPEC01GEO
Date (UTC)	20160701
Time (UTC)	003658
Depth (m)	2442.71
Temperature (°C)	1.84
Field ID(s)	ROCK
Comments	21x22x7cm Collected from the base of a large boulder on a talus slope.

Sample ID	SPEC02BIO
Date (UTC)	20160701
Time (UTC)	025713
Depth (m)	2250.22
Temperature (°C)	1.92
Field ID(s)	HEXACTINELLIDA
Comments	Appeared to have shrimp inside, but none found. Inward spicule fringe, modification of a sieve plate.

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