

Okeanos Explorer ROV Dive Summary

Dive Information			
Dive Map			
Site Name	"Utu" seamount, ROV on bottom at ~3043 m		
ROV Lead(s)	Karl McLetchie		
Expedition Coordinator(s)/ Mapping Lead	Kelley Elliott / Meme Lobecker		
Science Team Lead(s)	Santiago Herrera (Biology) and Matt Jackson (Geology)		
General Area Descriptor	North Samoan region, Near southern margin of Manihiki Plateau		
ROV Dive Name			
Cruise	EX1702		
Leg			
Dive Number	06		
Equipment Deployed			
ROV	Deep Discoverer (D2)		
Camera Platform	Seirios		
ROV Measurements	<input checked="" type="checkbox"/> 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"/> Low Res Cam 1	<input checked="" type="checkbox"/> Low Res Cam 2
	<input checked="" type="checkbox"/> Low Res Cam 3	<input checked="" type="checkbox"/> Low Res Cam 4	<input checked="" type="checkbox"/> Low Res Cam 5
	<input checked="" type="checkbox"/> LSS	<input checked="" type="checkbox"/> ORP	
Equipment Malfunctions	Port manipulator not onboard		
ROV Dive Summary (from processed ROV data)	In Water:	2017-02-21T19:32:29.998000 12°, 16.851' S ; 168°, 19.504' W	
	Out Water:	2017-02-22T03:35:36.691000 12°, 16.191' S ; 168°, 18.803' W	
	Off Bottom:	2017-02-22T01:55:24.911000 12°, 16.876' S ; 168°, 19.058' W	
	On Bottom:	2017-02-21T21:16:35.321000 12°, 16.902' S ; 168°, 19.268' W	
	Dive duration:	8:3:6	
	Bottom Time:	4:38:49	
	Max. depth:	3037.0 m	
Special Notes			
Scientists Involved (please provide name, location, affiliation, email)	Asako Matsumoto, PERC, Chiba Institute of Technology, Japan Bruce Mundy, NOAA PIFSC Chris Mah, NMNH Smithsonian Institution Christopher Kelley, University of Hawaii Deborah Glickson, National Academies of Sciences, Engineering, and Medicine Diva Amon, University of Hawaii at manoa Les Watling, University of Hawaii at Manoa Matthew Jackson, UC Santa Barbara Santiago Herrera, Lehigh University Steve Auscavitch, Temple University Timothy Shank, Woods Hole Oceanographic Institution Tina Molodtsova, P.P. Shirshov Institute of Oceanology RAS		
Purpose of the Dive	<p>The goal of this dive was to generate baseline information on geology and geochemistry of this unexplored (and largely unmapped) seamount. There is also significant interest in understanding the deep sea habitats and biological communities on the seamount to better understand their diversity and distribution.</p> <p>Maps of the seamount were generated the night before. From a geological standpoint, this seamount may be an older seamount linked to the Society hotspot, not Samoa. Samples from this seamount are key in defining the Society hotspot tracks back in time, and as such an age on a volcanic rock is needed from this seamount. Without an age, it is not possible to truly define plate motion for</p>		



	<p>the time frame represented by this volcano.</p> <p>From the biological perspective this dive has the potential to provide new depth records for several species as well the discovery of new species. Very little work has been done in the Central Pacific at these depths on seamounts. We aimed to collect information that will inform the biogeographic identity of the communities at abyssal depths in this region.</p>
<p>Description of the Dive</p>	<p>The new seamount explored in this dive, tentatively called “Utu” seamount, lies in the northern region of the American Samoa EEZ. The seamount had been partially mapped before, but required additional mapping at higher resolution for dive site selection. Thus, the night before diving, we mapped much of the volcano. The seamount appears to be comprised of two distinct structures: The base of the seamount is composed a “lumpy” or “blocky” structures, perhaps consistent with pillow or pillow mounds; the basal portion of the volcano is similar in morphology to “pancake” seamounts. Constructed on top of this basal pancake structure is a volcanic structure that has both steeper and smoother sides than the basal pancake portion of the volcano. These two morphologically different structures of the volcano (i.e., the pancake basal portion and the steeper sided upper section) are consistent with two stages of volcanic activity on this seamount. It is notable that the summit of the seamount is nearly flat-topped, and is host to a nicely developed volcanic crater: the center of the crater hosts a volcanic cone, and the crater walls exhibit at least two different “step-like” features, consistent with partial crater collapse like that which is observed in calderas at basaltic shield volcanoes at oceanic hotspots. The dive track was designed to start at the base of the volcanic cone in the crater, transit toward the crater wall, and then climb up the steep sides of the crater wall and crest the rim of the crater wall.</p> <p>The following geological description provides a chronological summary of the major geological features, or changes in the geology of the ocean floor, over the course of the dive:</p> <p><i>21:15:11.</i> The first view of the ocean floor revealed sediment covered bottom with ripple features in sediment. <1% of the bottom is covered with dark pebbles. Increased to 5% dark pebbles ~5 meters further along.</p> <p><i>21:37:42.</i> Some small (1 to 2 meters, including the largest boulder observed thus far) “islands” of outcropping rock in the sand. There are loose cobbles associated with both outcrops. One ferromanganese encrusted cobble (~20 cm in diameter) was taken as the first geological sample: 02_DIVE06_SPEC01GEO (placed in starboard rockbox of ROV). This rock is close to the central cone of the crater, so is likely to have been derived from the central cone in the volcano’s crater.</p> <p><i>21:55:14.</i> More outcrops, perhaps 10 m in length, composed of discontinuous exposures of ferromanganese encrusted rock. Light colored sediment continues to dominate the view (>50%).</p> <p><i>21:58:32.</i> Moving out of the outcrop area, but ferromanganese encrusted rocks and smaller outcrops continue to persist in the field of view, representing 10 to 30% of the surface cover.</p> <p><i>22:01:00.</i> A boulder equal in size the prior boulder, perhaps 2 m in diameter, representing the 2nd large boulder seen thus far. Like the first boulder, this boulder is also covered with larger fauna. These larger boulders seem to serve as “islands” for the seafloor fauna.</p> <p><i>22:06:22.</i> We have moved 80 meters since arriving on bottom. We are seeing significant basaltic flow structures, covering perhaps 30% of the field of view, and</p>



the flow structures are covered with significant sediment deposits.

22:17:23. Just over 1 hour on the bottom and the geology has been quite similar throughout the dive: ferromanganese encrusted lavas, as well as loose pebbles, cobbles and boulders, are interspersed with a light colored sediment.

22:27:19. The field of view is dominated by cobbles and boulders with abundant sediment. Probably the highest concentration of loose rock material observed thus far in the dive, and this might be a product of the fact that we are moving closer to the crater wall. A 20 cm cobble was selected as the second geological sample of this dive. However, we are close to the central cone at this point, so this rock may also have come from the central cone in the crater.

The rock was placed in the port rockbox: D2_DIVE06_SPEC02GEO. (This is such a large rock sample that the lid on the PORT box won't close).

22:39:18: Moving out of the boulder field the ROV encounters a relatively flat, sediment-dominated landscape very similar to the first view from the "on bottom" site; the abundance of ferromanganese encrusted pebbles and cobbles representing a higher percentage (perhaps 10% of the total surface cover) of the field of view.

22:48:34. Large boulder in field of view, perhaps 10 meters in diameter. This is the largest boulder yet on the dive. It may have broken off the crater wall and rolled down the steep wall of the crater.

23:09:02. Moving beyond the large block noted in the previous observation, the ROV shows numerous large blocks (>5 meters in diameter) with boulders and cobbles interspersed between the boulders; light-colored sediment is interspersed between the blocks, covering >50% of the surface. These large blocks are not attached to the substrate and likely represent portions of the steep crater wall that broke loose and rolled downhill.

23:43:05. The landscape continues to be dominated by large blocks and boulders (all ferromanganese encrusted) with light-colored sediment infilling the regions between the blocks and cobbles. The slope is approximately 15 to 20 degrees, and the high density of blocks and cobbles is likely due to basaltic rocks detaching from the steep walls of the crater and rolling down hill.

00:10:55. Large ferromanganese encrusted blocks (up to 1 meter or more) continue to dominate the field of view. Light colored sediment infills spaces between boulders.

00:39:00. The ROV moved just beyond the field of large blocks and into a field dominated by smaller ferromanganese encrusted boulders (<0.5 meters wide), and the field of view has 50 to 60% sediment cover. One of the smaller boulders (perhaps 15 cm wide) was selected as the third geology specimen and was placed in the starboard rock box with the first rock specimen: D2_DIVE06_SPEC05GEO. This cobble almost certainly detached from the walls of the crater above and rolled down hill.

00:50:27. The field of view is now dominated by both large ferromanganese encrusted boulders (1-2 meters) and smaller cobbles, with light colored sediment infilling the spaces between the rocks.

01:21:59. The ROV is on a 10 to 15-degree slope, moving upslope. The field of view is dominated by ferromanganese encrusted cobbles and medium-sized (<1 m) boulders, with ~40% of the field of view showing sediment cover that is concentrated between the spaces between the rocks.

01:24:16. The ROV is on a 20-degree slope, and all rocks are smaller (<30 cm), and the same light-colored sediment covers only 20 to 30% of the field of view.

01:41:02. A number of large boulders (>2 m) are coming into view and are complemented by smaller boulders and cobbles. Again, light-colored sediment

fills the spaces between the rocks, covering perhaps 10 to 15% of the field of view. Like previous observation made of the geology of the crater wall, the blocks, boulders and cobbles have the appearance of talus resulting from volcanic material that has broken off the craters of the wall and rolled down hill.

02:00:00. The ROV came quite close to achieving the summit of the crater wall, but the ROV had to surface before we could reach the summit.

The biological perspective is as follows:

Landed at 3043 m at 21:15, flat bottom with rippled sediment, small pebbles of manganese nodules. Not obvious large megafauna, some small sponges/xenophyophores? As we move upslope on the southern face of the feature in the center of the crater we encounter larger cobbles, boulders and outcrops, no apparent ripples on sediment. Collected rock D2_DIVE06_SPEC01GEO at 21:40, 3033m.

Observed, stalked glass sponge (*Bolosoma*) with hydroid associate, brisingid brittle star, a whip primnoid coral with small amphipod associate, carnivorous tunicate. Found another outcrop with barnacle as well as carnivorous tunicate and a glass sponge. Also observed two halosaur fish *Aldrovandia* (one sitting on sediment, one drifting with currents). As we move along upslope we observe an increase of outcrops intermixed with rippled sediment, larger cobbles and pebbles.

Observed a beautiful specimen of a holothurian with sail *Psychropotes* (22:20, 3024 m). Moved over similar terrain until reaching the transition zone between central cone feature and the inner eastern wall of the crater. Collected rock D2_DIVE06_SPEC02GEO at 22:32, 3024m. Transition zone covered in sediment and small pebbles likely manganese nodules. Observed another halosaur fish *Aldrovandia*.

At 22:55 encountered large outcrop, likely the base of the eastern crater wall. Observed one chrysogorgiid octocoral with sparse branching, several carnivorous tunicates (*Megalodicopia*), whip primnoid and a branching primnoid, another branching chrysogorgiid with more branching (3033m). Two cusk eels of different size (different sex or different species?) at 23:17 3032 m. Larger outcrops and steeper slope. Observed a couple of whip primnoid and *Pleurogorgia*-like chrysogorgiids with anemone associates (likely depth record for anemone associates). Collected the later 23:52 D2_DIVE05_SPEC03BIO, 3012m.

Loose boulders with sediment pockets in between. Collected dead sponge stalk with 4 crinoids and 2 hydroids attached to it D2_DIVE06_SPEC04BIO 00:28 2985 m. Continue observing a mix of large boulders, sediment pockets and slides, cobbles of different sizes. Outcropping large boulders had several colonies of *Pleurogorgia*-like chrysogorgiids and 'whip' primnoid octocoral. After several close observations determined that the 'whip' primnoid is likely a juvenile stage of the same species that we later observed branching in long V patterns. Collected rock D2_DIVE06_SPEC05GEO at 00:45 2981 m.

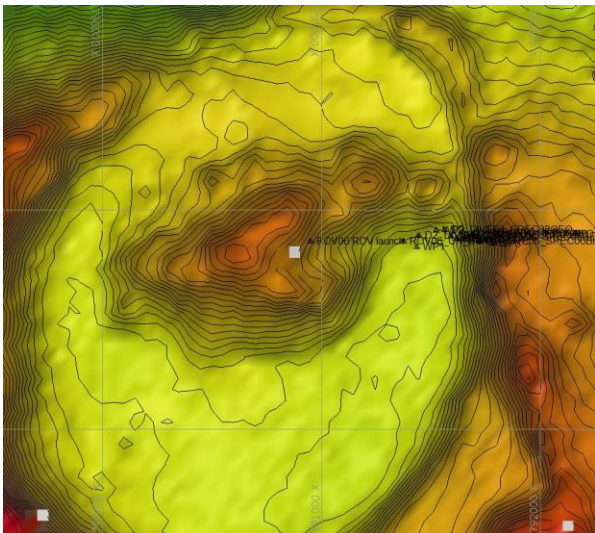
Further upslope crossed an area of sediments and cobbles into another area of large boulders. Observed more of the V primnoids, stalked sponges, and an unusual association of a branching chrysogorgiid (different morphology from



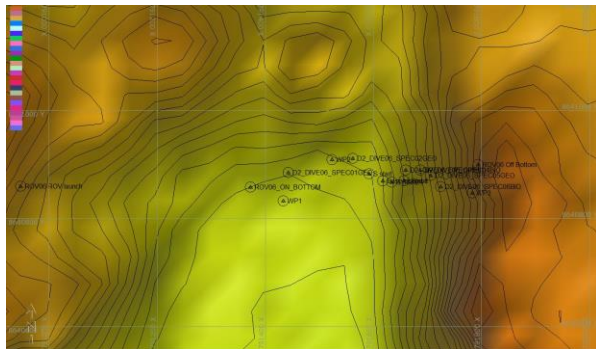
Pleurogorgia with an ophiuroid (*Ophiacantha*?) associate on bare skeleton. Very unusual as ophiuroids are usually associated with healthy coral tissue. Made collection of this association D2_DIVE06_SPEC05GEO at 01:13, 2967 m. Observed the first bamboo coral of the dive at 01:19, 2953 m, now morph for the cruise (intermodal branching, no needle sclerites in polyps).

At 01:34, 2947 m, observed a *Iridogorgia* with a predatory sea star (crinoid on top of predatory sea star). Very large outcrop boulders with many sponges *Bolosoma* 2923 m. At the end of the dive we reached the summit of the wall 2871 m. Observed very large outcrops with very large abundance of *Bolosoma* sponges (>1.5 m tall), as well as very large "barrel"? glass sponges (>1m tall, >0.5 wide). Also several large octocoral fans (likely bamboos or primnoids), *Iridogorgia*, large bamboo whips (>1.5 meters tall), spectacular end of dive, wish we had more time here.

Overall Map of the ROV Dive Area



Close-up Map of Main Dive Site



Representative Photos of the Dive



EX1702_IMG_20170221T213250Z_ROVHD.jpg



EX1702_IMG_20170222T013254Z_ROVHD.jpg


"Islands" of outcropping rock in the sand with

Field of view dominated by ferromanganese encrusted


stalked sponges and other sessile invertebrates	cobbles and medium-sized (<1 m) boulders, with sediment concentrated between the spaces between the rocks. <i>Iridogorgia</i> octocoral with predatory seastar on the right.
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Samples Collected

Sample

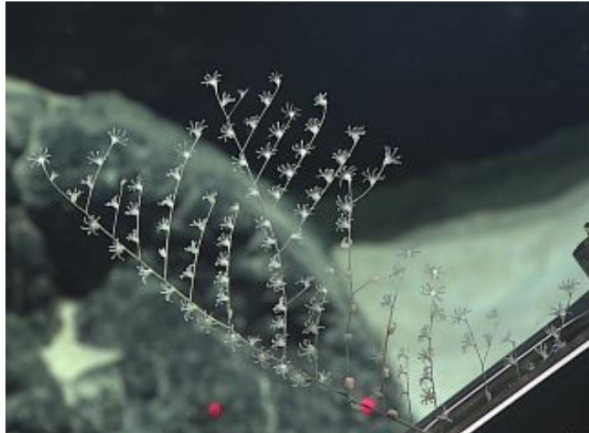
Sample ID	D2_DIVE06_SPEC01GEO	
Date (UTC)	20170221	
Time (UTC)	21:15	
Depth (m)	3043	
Temperature (°C)	1.68527	
Field ID(s)	Rock	EX1702_IMG_20170221T213919Z_ROVHD.jpg
Comments		

Sample


Sample ID	D2_DIVE06_SPEC02GEO	
Date (UTC)	20170221	
Time (UTC)	22:32	
Depth (m)	3024	
Temperature (°C)	1.68709	
Field ID(s)	Rock	EX1702_IMG_20170221T223115Z_ROVHD.jpg

Comments	
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Sample

Sample ID	D2_DIVE05_SPEC03BIO	
Date (UTC)	20170221	
Time (UTC)	23:52	
Depth (m)	3012	
Temperature (°C)	1.70586	
Field ID(s)	<i>Pleurogorgia</i> -like chrysogorgiids with anemone associates	
Comments		EX1702_IMG_20170221T235242Z_D2_DIVE06_SPEC03...



Sample

Sample ID	D2_DIVE06_SPEC04BIO	
Date (UTC)	20170221	
Time (UTC)	00:28	
Depth (m)	2985	
Temperature (°C)	1.71504	
Field ID(s)	Dead sponge stalk with 4 crinoids and 2 hydroids	
Comments		EX1702_IMG_20170222T002735Z_PTMAN_SAMPLE.jpg

Sample

Sample ID	D2_DIVE06_SPEC05GEO
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Date (UTC)	20170222	
Time (UTC)	00:45	
Depth (m)	2981	
Temperature (°C)	1.79082	
Field ID(s)		
Comments	Black coral	EX1702_IMG_20170222T004346Z_D2_DIVE06_SPEC05...
Sample		
Sample ID	D2_DIVE06_SPEC06BIO	
Date (UTC)	20170222	
Time (UTC)	01:13	
Depth (m)	2967	
Temperature (°C)	1.70238	
Field ID(s)	Chrysogorgiid (different morphology from <i>Pleurogorgia</i>) with an ophiuroid (<i>Ophiacantha</i> ?)	EX1702_IMG_20170222T010807Z_ROVHD.jpg
Comments		

Please direct inquiries to:

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

