Pacific Islands 2015 Quick Look Report for DSC-RTP

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The U.S. Pacific Islands Region encompasses more than 50 oceanic islands, including the Hawaiian Archipelago, the Commonwealth of the Northern Mariana Islands (CNMI), the territories of Guam and American Samoa, Rose Atoll and the Pacific Remote Islands (Kingman Reef, Palmyra Atoll, Jarvis Island, Howland and Baker Islands, Johnston Atoll, and Wake Island). Also in this region are the Pacific Island States in free association with the U.S. – the Republic of Palau, the Federated States of Micronesia, and the Republic of the Marshall Islands (Figure 1).

Deep-sea corals and sponges are patchily distributed in the waters surrounding these islands. Many species are unique to this region and found nowhere else in the world. The Deep Sea Coral Research and Technology Program is funding a fieldwork initiative in the Pacific Islands Region from 2015 to 2017 to locate and characterize the deep-sea coral habitats, investigate the environmental factors that influence their distribution, and study their life history.

The first year of activities under the initiative focused on the Hawaiian Archipelago and Johnston Atoll. From July through September four separate cruise legs took place on board the NOAA Ship Okeanos Explorer (cruise EX1504) in the waters around the Hawaiian Archipelago, including the Main Hawaiian Islands, Papahanaumokuakea Marine National Monument (PMNM) in the Northwestern Hawaiian Islands, and the Johnston Atoll region of the Pacific Remote Islands Marine National Monument (PRIMNM). The 69-days of exploration in the region, given the moniker *Hohonu Moana* (meaning "deep ocean" in the Hawaiian language), mapped 79,333 square kilometers of seafloor and conducted 37 ROV dives ranging from 323 to 4,829 meters deep. The ROV collected rock samples so scientists can learn about the origin and age of the geologic features, such as seamounts, in the region. Seventy biological samples were also collected, all of which are potentially new species or new records for the Hawaii region. Sixty-eight rock samples were obtained during the dives, all of which are still at the University of Hawaii. The contract between NOAA Office of Exploration and Research (OER) and the Oregon State University repository has still not been finalized. Once it has, the rocks, weighing a total of 370 lbs, will be crated and shipped to OSU where preliminary cuts and distribution of subsamples will take place.

Seventy biological samples were collected during the cruise, which include 46 cnidarians and 20 sponges. Selected specimens were split, with a small piece remaining in Hawaii at the Bishop Museum. The bulk of the split specimens along with those that were not split have already been sent off to the Smithsonian National Museum of Natural History. Until these specimens are thoroughly examined, it is difficult to say how many represent new species; however, it is certain that there will at least be a substantial number of new records for the Central Pacific from this first year of collections.

While the majority of the operations from the expedition took place in deep water, some near-shore sites were also visited in support of other ongoing research projects in the region. The expedition retrieved instruments that had been deployed to the seafloor in and near coral areas in previous years by the Pacific

Islands Fisheries Science Center (PIFSC) to record the velocity of currents and the amount of organic particles they carried. Analysis of these records will help scientists determine the environmental factors that support coral growth. These instruments were in various states of disrepair after their long resident times on the seafloor, but it is hoped that current and temperature readings will be retrieved from at least a few of the instruments in the coming months. In addition, marked colonies of gold coral (Kulamanamana haumaea, Family Parazoanthidae) located near the instruments were imaged with lasers in order to obtain data on their rates of growth since being marked. This analysis is ongoing.

Another part of the expedition surveyed areas near Hawaii Island that were covered by lava flows at different times in history and examined how coral communities differ in these places. This will tell provide information on how corals colonize a fresh lava field and the rate at which the populations recover after being destroyed by lava or other disturbance. The dive on the western branch of the 1968 lava flow was designed to be comparable to surveys conducted in 2011 by the Hawaii Underwater Research Laboratory (HURL) Pisces V submersible. Data are currently being analyzed to determine species richness, diversity, abundance, maximum size of species, and size class frequency of Coralliidae (pink coral). In addition, the benthic terrain characteristics, such as substrate hardness, slope and curvature, will be examined along the survey track to determine if there was an association between high coral abundance and specific characteristics of the seafloor terrain. Rock samples are being analyzed to confirm the age of the substrate as originating from the 1868 lava flow. Prior testing at this site indicated that the submarine substrate was of a younger age than the samples collected from the sub-aerial 1868 lava flow. These new samples will help us understand why previously collected submarine samples did not reflect the age of the sub-aerial flow.

In addition to the Hohonu Moana expedition, scientists working on this 3-year initiative made progress on several other projects:

- **Documented the locations and characteristics of deep-sea corals and sponges** by reviewing seafloor images taken from research cruises in previous years. The video annotation process of both archival collections and the more recent OER collections has only just begun and will continue through Spring 2016. From the 37 ROV dives conducted during EX1504, it's safe to say that there will be thousands of records of deep sea corals and sponges that will be extracted from the video. Almost 800 cnidarians and 247 sponges were listed as being seen in the dive summary reports for each dive.
- **Examined the population structure, and determined the species and colony densities in black coral beds off Maui**. Data previously collected in 2004, 2008 and 2010 were reviewed in order to select sites for new surveys and plan for upcoming field work activities. New field work activities are currently planned for the period between May-August 2016. Field work will include resurveying five areas that were surveyed between 2004-2010, as well as surveying several additional sites in order to measure species abundances across a wide bathymetric gradient.
- **Surveyed black corals between 50 and 90 meters deep off American Samoa to determine their distribution and species**. A literature review of the scientific literature was conducted to determine what species have been reported from American Samoa (N=60 scientific articles). Based on this review, only two black corals are known from American Samoa and these are only known to genus level (Antipathes and Cirrhipathes). In April 2015, four dives were conducted to maximum depths of 91 m using mixed-gas technical diving off Tutuila Island in American

Samoa. During these dives, a total of 18 black coral specimens were collected. These specimens are currently being processed using scanning electron microscopy in order to identify them taxonomically. In March 2016, additional field work is planned in American Samoa, during which a total of 10 sites will be surveyed at depths between 50-91 m using mixed-gas technical diving.

- **Conducted multibeam mapping of the seafloor shallower than 500 meters** around American Samoa, the Pacific Remote Islands, and the Northwestern Hawaiian Islands. Multibeam mapping was conducted using the NOAA ship Hii Alakai around the remote U.S. Pacific Islands of Howland, Baker, Jarvis, Palmyra and Kingman. These multibeam data are still being processed and should be available to the public in 2016.
- **Developed a model intended to guide the ROV deployment**. The hypothesis that high density communities can be found on ridge topography was supported by the dives, however, not on every ridge. Communities were found where stable substrate such as bedrock or large boulders were present and were absent from debris slopes and other unconsolidated sediments . Depth also appears to be important since no high density communities were observed below 2700 m. Next year, additional dives will be conducted to examine the role of ridge orientation which may be a factor as well.

In the next two years of the Pacific Islands fieldwork initiative, scientists plan to extend ROV surveys to CNMI, Guam, Wake Island, and American Samoa, and continue other studies.

Much of the deep-water environment in the Pacific Islands Region has not yet been explored. Although several national marine sanctuaries and marine national monuments have been established to protect the region's unparalleled pristine ecosystems, scientific knowledge is limited in the marine species and habitats that lie in the depths of these protected areas. The Program's comprehensive effort to study the deep-sea communities will help fill an important data gap for the managers and users of these sites.

Additional details of the 10 projects under the 3-year Pacific Islands fieldwork initiative are online: https://deepseacoraldata.noaa.gov/fieldwork-studies/pi-fieldwork-fy15-17.

Summary Narrative of Cruise Results

Multibeam Mapping Results

Mapping operations were conducted during all 4 legs of EX1504 using the deep-water mapping systems available on the Okeanos Explorer (Kongsberg EM302 multibeam sonar, EK60 split-beam fisheries sonar, and knudsen 3260 chirp sub-bottom profiler). Leg 1 was a dedicated mapping cruise focused on the Johnston Atoll region of the PRIMNM. The other 3 legs included a combination of mapping operations and ROV dives (Figures 2-6). Preliminary observations from the mapping data revealed the complex and fascinating details of the abyssal plains, seamounts and guyots that characterize the central Pacific's seafloor. There are many flat-topped seamounts (guyots) which were likely above sea level at some point in time, and a subset of those are dotted with what appear to be volcanic domes that likely formed during a different period. Over the course of the 65 days at sea, the multibeam system was used to map a total of nearly 80,000 square kilometers of seafloor, including three seamounts in PMNM and numerous other features that were not previously mapped using multibeam sonar.

Remotely Operated Vehicle *Deep Discoverer* Results

During legs 2-4 of EX1504, a total of 37 ROV dives were conducted with maximum dive depths ranging from 368 to 4831 meters and a total bottom time of 199 hours (Figures 2-6; Table 1). Leg 2 of EX1504 focused on conducting ROV surveys on priority areas identified from 2014 R/V Falkor mapping data in the Papahānaumokuākea Marine National Monument (PMNM). Although considerable previous work had been conducted down to 2,000 meters with submersibles, the majority of habitat in PMNM is below 2,000 meters and as a result had never been surveyed before. ROV dives were conducted from West Nihoa to Salmon Bank and focused on conducting seafloor surveys of rift zone ridges and other types of abrupt topography likely to host high-density communities of deep-water corals and sponges. A total of 18 dives were conducted from 1,096 meters to 4,829 meters, including the deepest dives ever conducted in PMNM. Two ROV dives extended the depth range of known high-density communities of coral and sponges, and six discovered new ones. Two dives included mid-water transects to document animals living in the little known water column from 450 meters to 1,200 meters. Overall, 334 different types of animals were identified from visual surveys of the seafloor and water column, including cnidarians, sponges, echinoderms, arthropods, mollusks, tunicates, bryozoans, ctenophores, siphonophores, fishes, and a squid (Figure 7-10).

Leg 3 was a short cruise during which 6 dives were conducted over seven days, with operations taking place in the Main Hawaiian Islands and the Geologists Seamounts located southeast of Hawaii Island. Two dives were focused on the retrieval of instruments deployed in previous years by PIFSC (Figure 11). One of these instrument recovery dives visited the hull of the World War I-era submarine, S-19 (Figure 12). Another dive on this cruise was conducted to support a study on disturbance and recovery of precious corals near South Point, Hawai'i, being conducted by researchers at Hawai'i Pacific University. Three dives were conducted within the Geologists Seamounts group. High-density coral communities were found at Ellis and Swordfish seamounts, while a low density of corals were observed on the McCall Seamount dive. During the six dives conducted on this cruise, the science team observed at least 189 types of animals, including 16 that are potential new species or records for the region.

During Leg 4 eleven ROV dives were conducted at the Johnston and Karin seamount chains, including the first seafloor visual surveys of the Cretaceous guyots within the Monument and the deep-water volcanic cones on the Johnston Seamounts. Also on Leg 4, two ROV dives were conducted to support other NOAA interests in the Main Hawaiian Islands during transit to and from the Monument, including a dive in an area under consideration for inclusion in the Hawaiian Islands Humpback Whale National Marine Sanctuary and a dive to recover instruments previously deployed by PIFSC. Several highly diverse and abundant coral and sponge gardens were discovered at depths greater than 1,800 meters during the Johnston dives, and potentially 180 different types of animals were observed, including 30 that are thought to be potential new species or records for the region.

ROV sampling results

This expedition marked the first time Okeanos Explorer collected physical samples using the ROV Deep Discoverer (Figures 13-14). Biological sampling was limited only to potential new species or new animal records for the Hawaii region. A total of 70 biological samples were collected for analysis. Sampled specimens are being delivered to the Smithsonian National Museum of Natural History for species identification and further analysis. Table 2 below provides a summary of collected biological samples.

Geological sampling was carried out to provide more information about the origin and age of the seamounts, lava flows and other geologic features of the region. A total of 68 samples were collected during legs 2-4. Table 3 below provides a summary of collected samples, which are being delivered to Oregon State University for further analysis.

Public Engagement and Outreach

For EX1504, in partnership with the University of Hawaii at Manoa and NOAA's Inouye Regional Center, NOAA's Office of Ocean Exploration set up two new Exploration Command Centers, enabling more than 75 scientists and students from 14 U.S. states and four countries to participate in the expedition. In addition, online coverage of the expedition, including live video feeds, were streamed throughout, allowing thousands of the public to monitor the dives and virtually explore the ocean in real time.

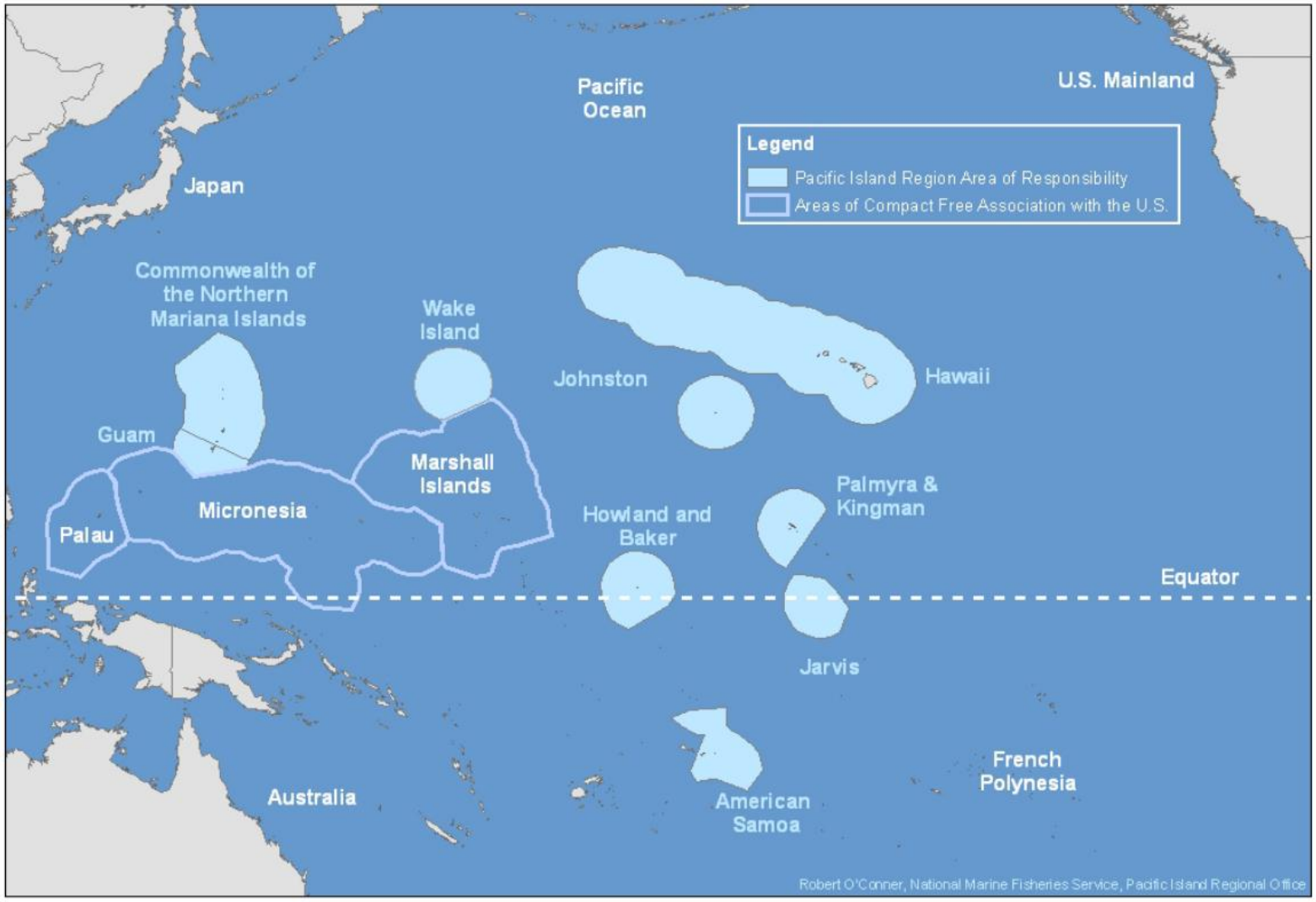

Figure 1 -The U.S. Pacific Islands Region encompasses more than 50 oceanic islands, including the Hawaiian Archipelago; the Commonwealth of the Northern Mariana Islands (CNMI); the territories of Guam and American Samoa; Rose Atoll; and the Pacific Remote Islands (Kingman Reef; Palmyra Atoll; Jarvis Island; Howland and Baker Islands; Johnston Atoll; and Wake Island). Also in this region are the Pacific Island States in free association with the U.S. – the Republic of Palau, the Federated States of Micronesia, and the Republic of the Marshall Islands. Image from NMFS, Pacific Island Regional Office

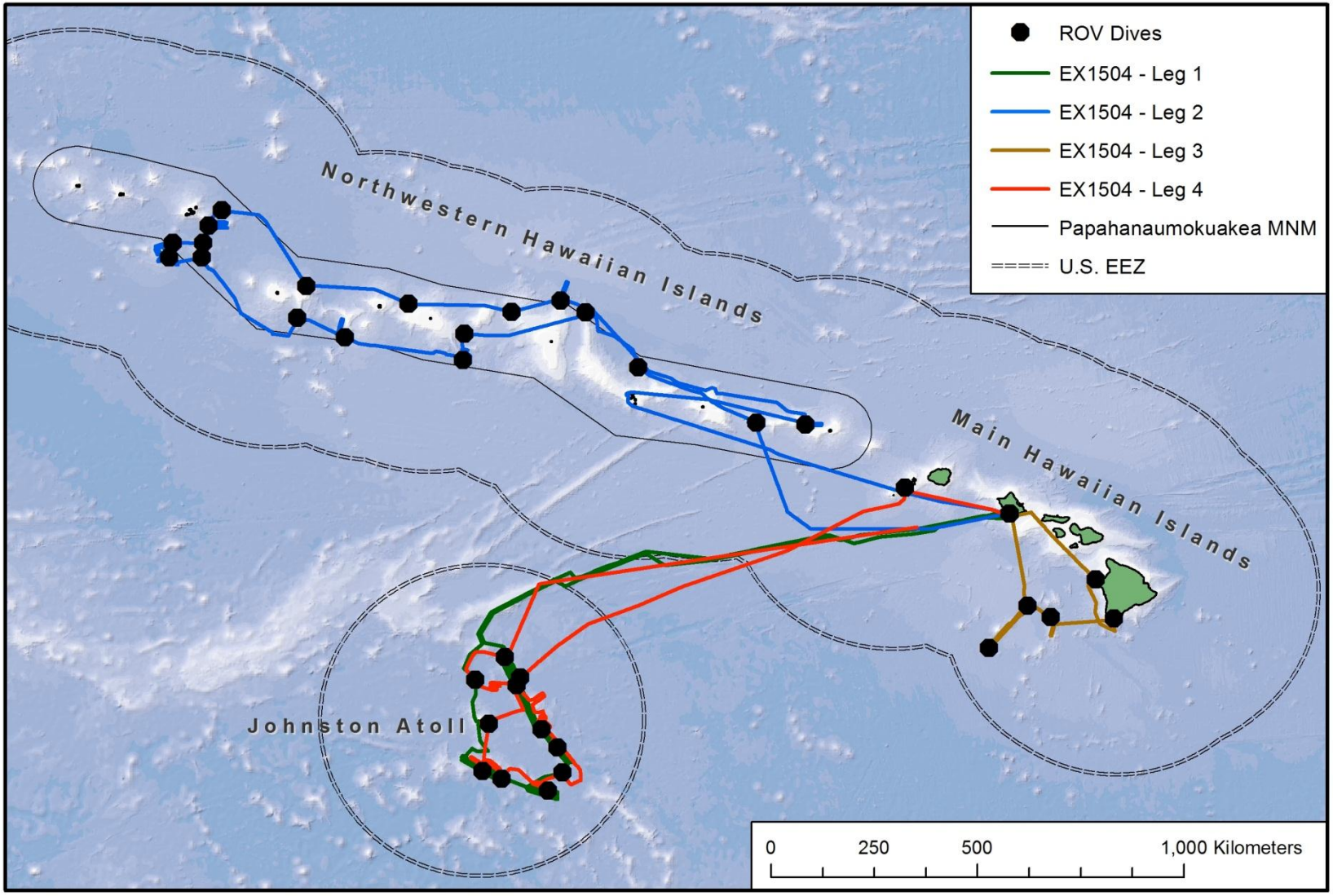

Figure 2 - Overview map showing the operating area for EX1504. Leg 1 was solely a mapping cruise focused on the region around Johnston Atoll. All dives were conducted on legs 2-4, but additional mapping data was collected during transits between dive sites.

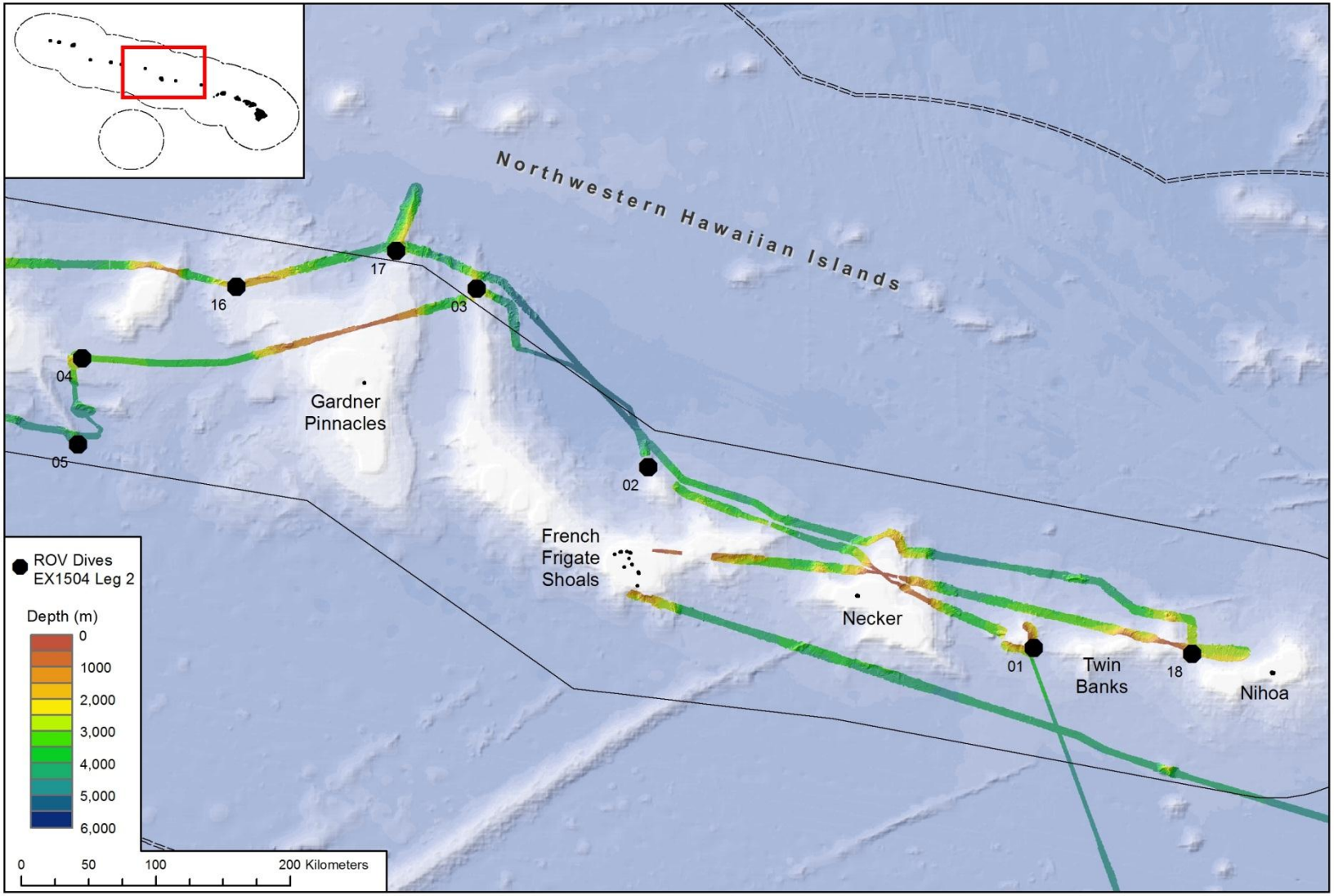

Figure 3 – Leg 2 of EX1504 took place in the Northwestern Hawaiian Islands. The above figure shows the dive sites and multibeam data collection from the southeastern end of the Papahanaumokuakea National Marine Sanctuary.

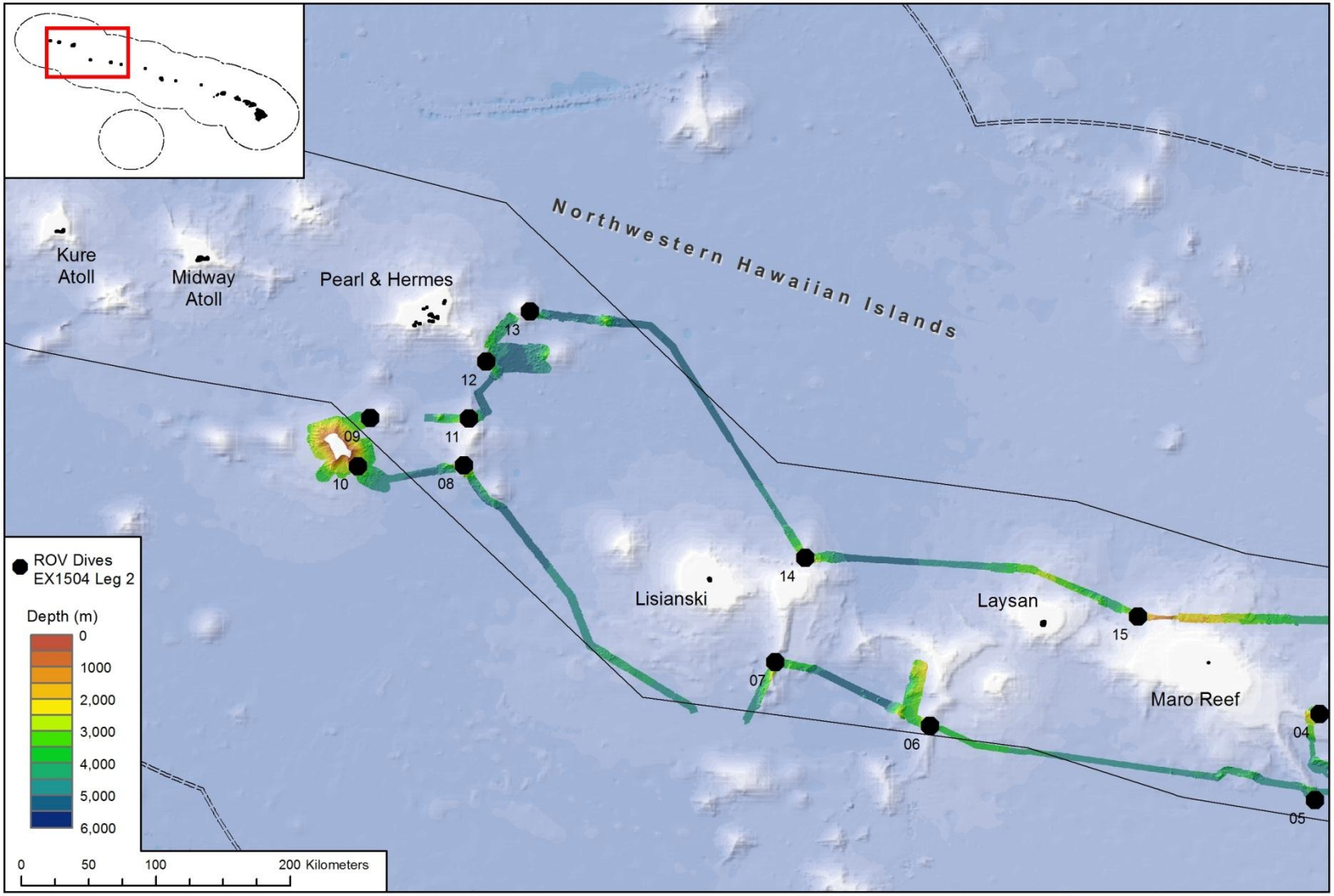

Figure 4 - Leg 2 of EX1504 took place in the Northwestern Hawaiian Islands. The above figure shows the dive sites and multibeam data collection from the northwestern end of the Papahanaumokuakea National Marine Sanctuary.

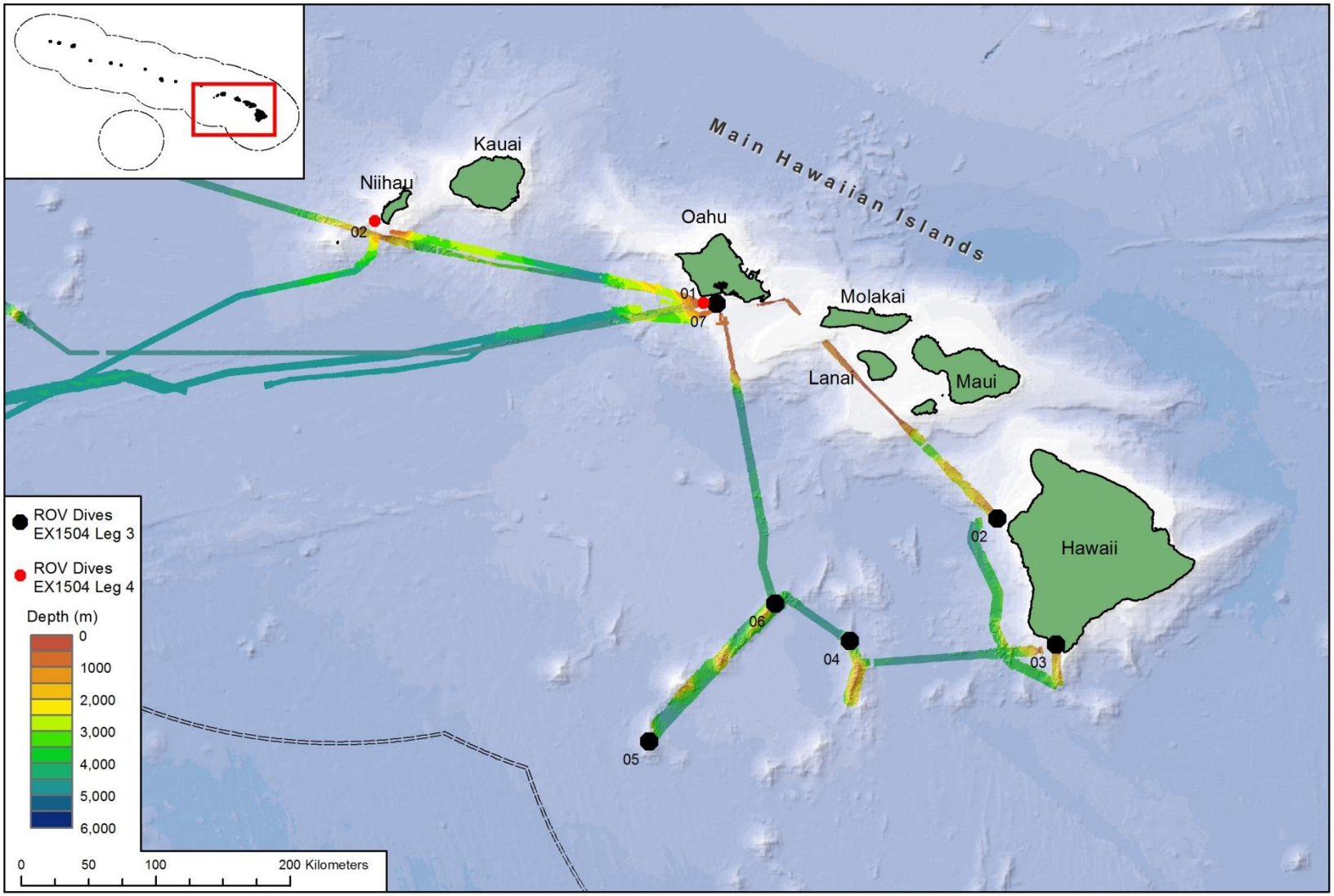

Figure 5 - Leg 3 of EX1504 took place in the Main Hawaiian Islands. The above figure shows the Leg 3 dive sites and multibeam data collection for the region, as well as two dives conducted at the beginning of Leg 4 .

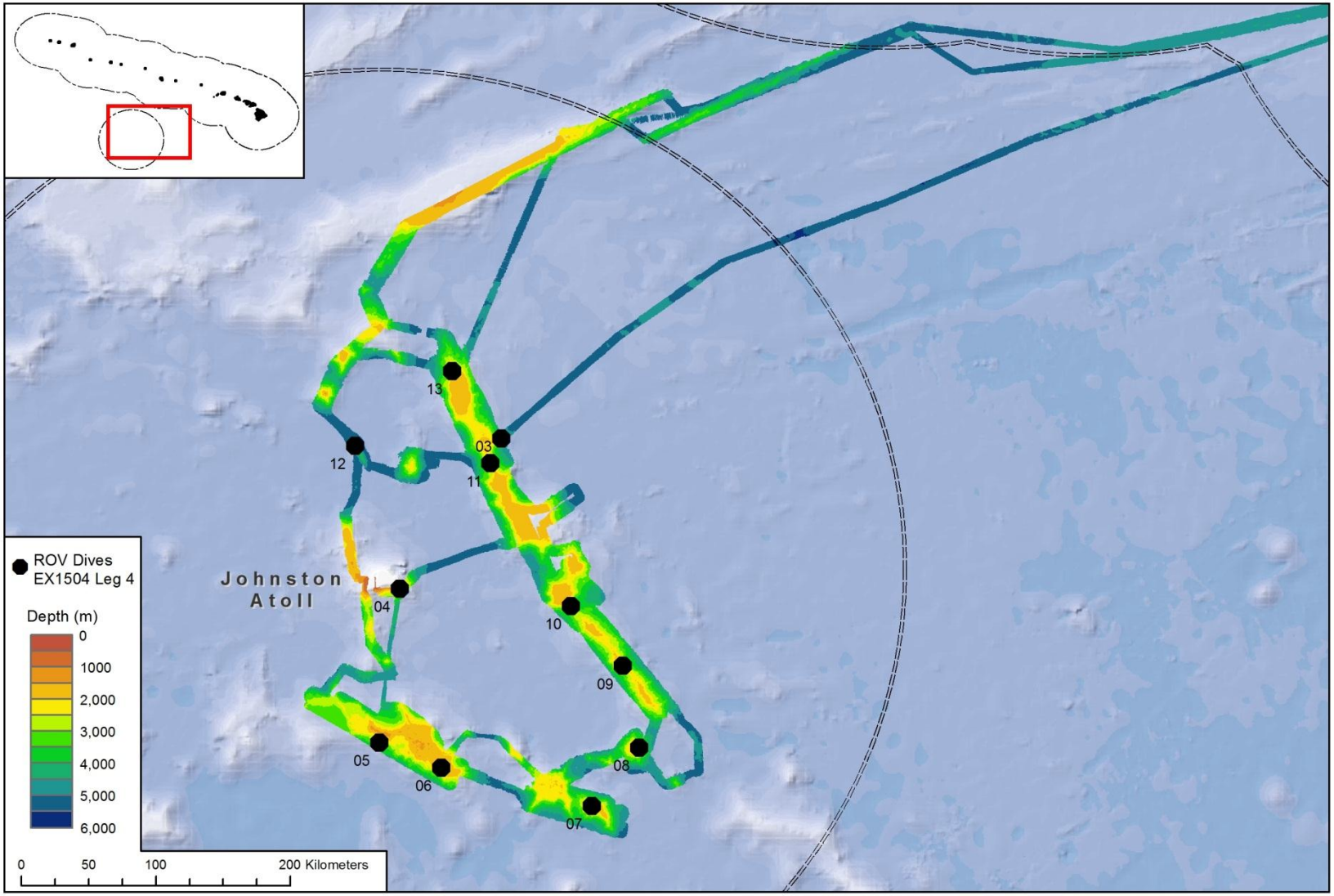

Figure 6 – Leg 1 of EX1504 was a mapping cruise that focused around Johnston Atoll in the Pacific Remote Islands Marine National Monument. On Leg 4, the Okeanos Explorer returned to the region to collect additional multibeam data, and also conducted a total of 12 dives (2 Leg 4 dives were done in the Main Hawaiian Islands; see Figure 5).

Figure 7 - Specimen of Corallium species collected during leg 2 from a large high-density deep-sea coral and sponge community encountered on the ridge crest of Pioneer Bank. A remotely operated vehicel dive here during the cruise revealed that a known high-density community further upslope extended at least six kilometers down the ridge to where the dive was conducted.

Figure 8 - This distinctive-looking, spiny squat lobster, seen here perched on a black coral, Umbellapathes, at 1,493 meters depth in the Johnston Atoll Unit of the Pacific Remote Islands Marine National Monument, is likely a new (undescribed) species in the anomuran family Chirostylidae.

Figure 9 - The cusk eel, Leucicorus lusciosus (Garman, 1899). This fish is rarely encountered – the whole genus is known from a collection of fewer than 20 individuals. This species was previously known only from the eastern tropical Pacific. Although the eye is large, we don't think they can actually see images, as the eye does not have a fully formed lens.

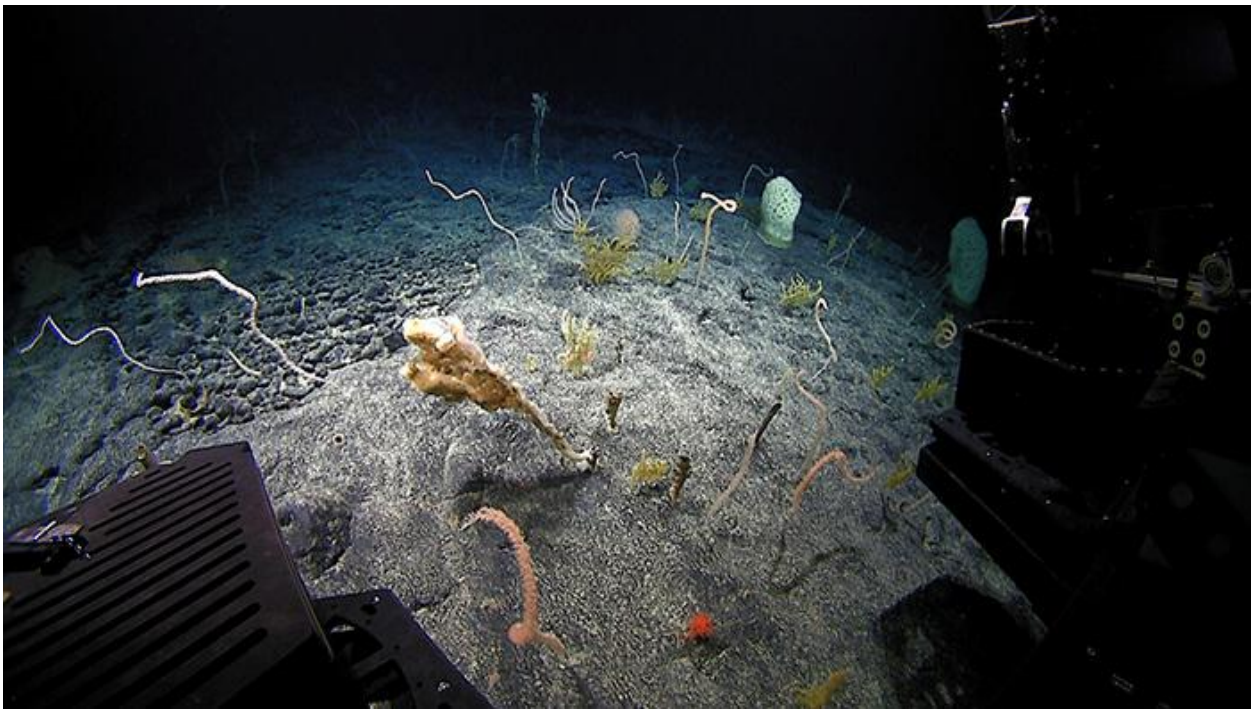

Figure 10 - View from Deep Discoverer of a deep coral and sponge community along the Northampton Seamount Ridge, seen during the 2015 expedition.

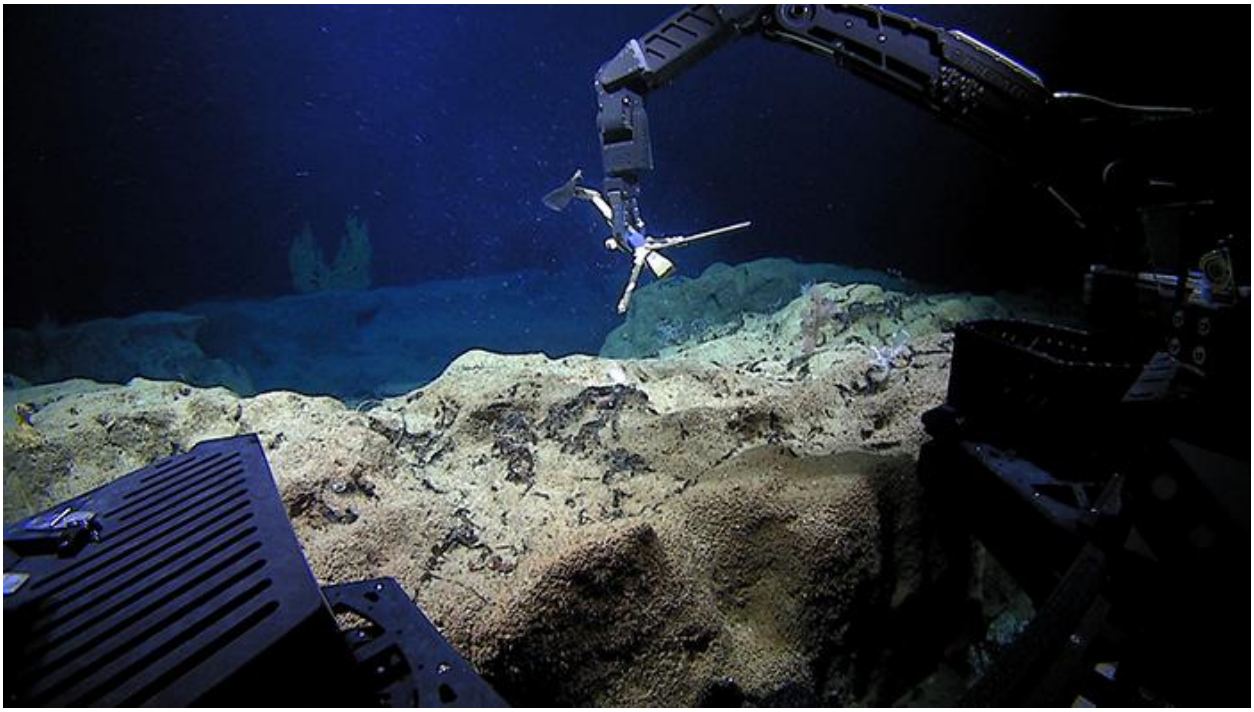

Figure 11 - Remotely operated vehicle Deep Discoverer recovers a current meter at a dive site just south of Oahu.

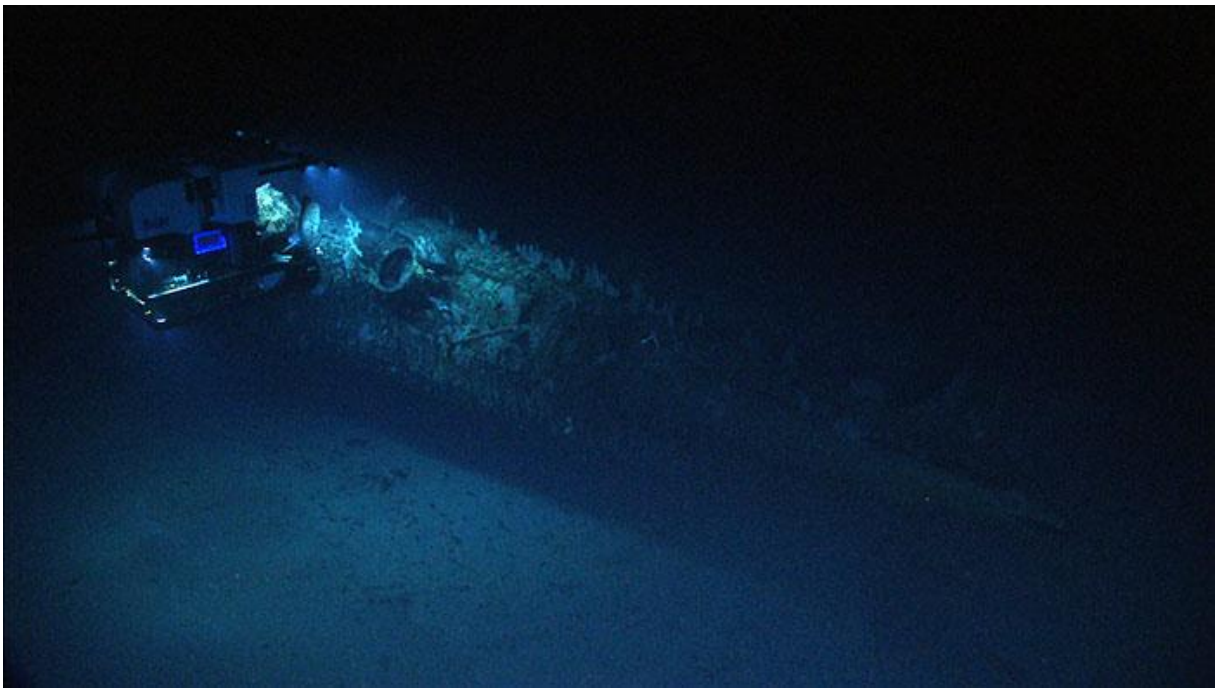

Figure 12 - A dive during Leg 3 of the expedition visited the S-19 submarine to assess the state of the submarine and survey the settlement of a pioneer coral community covering the sub.

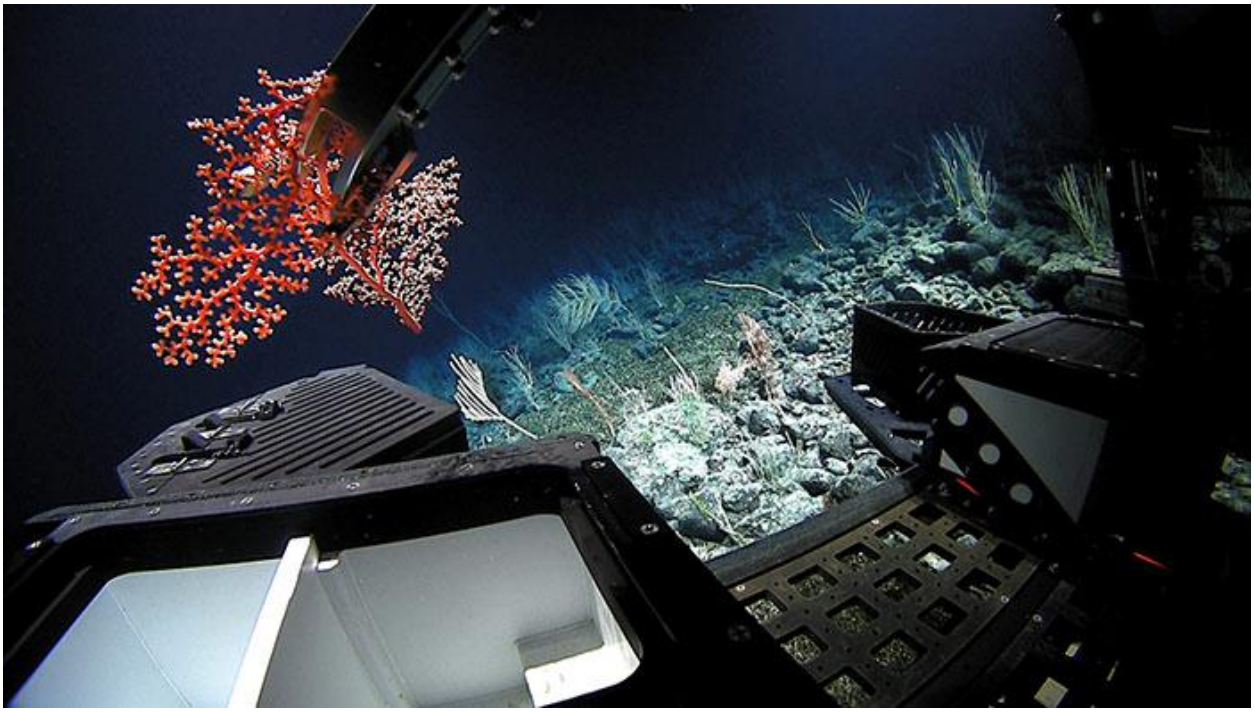

Figure 13 - Remotely operated vehicle (ROV) Deep Discoverer places a piece of an unknown Corallium species collected at 2,078 meters depth in one of the bio boxes on the ROV.

Figure 14 - This is a photo of the Deep Discoverer's manipulator arm grabbing a sample from pillow lavas on the seafloor.

Table 1. Summary of ROV Dives conducted during research expedition EX1504 cruises in the central Pacific.

Locality	DiveID	On Bottom (UTC)	On Bottom Longitude	On Bottom Latitude	Off Bottom (UTC)	Off Bottom Longitude	Off Bottom Latitude	Dive Duration	Bottom Time	Max Depth Meters
EX1504 - Leg 2 ROV Dives										
East Necker Seamount	DIVE01	20:09	-163.51767	23.22172	1:23	-163.51913	23.22835	7:59	5:14	2222
North French Frigate Shoals Seamount	DIVE02	21:42	-166.09500	24.43523	2:55	-166.09140	24.42889	8:03	5:12	2485
St. Rogatien Rift Zone Ridge	DIVE03	19:33	-167.23920	25.62637	1:19	-167.24265	25.62653	8:07	5:46	2156
Maro Crater	DIVE04	20:08	-169.88370	25.16005	2:23	-169.87562	25.16430	9:26	6:14	3036
Southeast Maro Ridge	DIVE05	20:53	-169.91235	24.58382	23:50	-169.91483	24.58513	8:07	2:56	4831
West Northampton Seamount Ridge	DIVE06	21:18	-172.48902	25.08162	2:52	-172.49015	25.08752	7:45	5:34	1997
Pioneer Bank Ridge	DIVE07	19:27	-173.52197	25.50747	23:28	-173.52178	25.51072	6:18	4:01	2118
Bank 9 South	DIVE08	20:44	-175.60660	26.82195	3:35	-175.60743	26.83047	8:20	6:51	1382
East Salmon Bank	DIVE09	19:26	-176.23273	27.14040	1:15	-176.22623	27.14323	8:14	5:48	2285
Salmon Bank Southeast Ridge	DIVE10	19:32	-176.31405	26.81615	1:10	-176.31655	26.81915	8:05	5:38	2053
Bank 9 North	DIVE11	19:34	-175.57085	27.13303	1:13	-175.57070	27.12832	8:01	5:39	2158
Southeast Pearl & Hermes Ridge	DIVE12	19:46	-175.45938	27.51688	1:33	-175.46215	27.51932	10:06	5:46	2800
Unnamed Seamount E of Pearl & Hermes	DIVE13	19:38	-175.16292	27.85332	23:29	-175.17000	27.85488	6:28	3:50	2306
North Pioneer Ridge	DIVE14	19:26	-173.32420	26.20113	1:30	-173.32572	26.19688	7:56	6:03	1645
North Maro Ridge	DIVE15	19:18	-171.09770	25.81188	1:37	-171.08965	25.81413	8:11	6:19	1752
Gardner Terrace	DIVE16	19:08	-168.84980	25.63785	1:41	-168.84427	25.64543	8:11	6:33	1564
East North Gardner	DIVE17	19:27	-167.78128	25.88042	1:56	-167.78062	25.88745	10:21	6:28	2086
West Nihoa	DIVE18	19:11	-162.45700	23.18413	23:35	-162.45215	23.18080	6:35	4:23	1599
EX1504 - Leg 3 ROV Dives										
Kona Precious Coral Bed	DIVE02	19:24	-156.12578	19.80498	2:11	-156.12600	19.80157	7:19	6:46	394
South Kona transect of 1868 lava flow	DIVE03	19:17	-155.73168	18.95892	2:11	-155.71340	18.94568	7:27	6:54	455
McCall Seamount	DIVE04	20:03	-157.11175	18.98305	0:58	-157.11085	18.97693	7:45	4:54	2715
Swordfish Seamount	DIVE05	18:59	-158.45553	18.31257	1:50	-158.45452	18.30585	8:04	6:50	1077
Ellis Seamount	DIVE06	19:39	-157.61187	19.23148	0:10	-157.61593	19.22737	7:03	4:30	2153
S19 Submarine Site	DIVE07	19:19	-158.00303	21.24015	22:11	-158.00308	21.23963	3:33	2:51	403

EX1504 - Leg 4 ROV Dives										
Barbers Point Pinnacles	DIVE01	22:43	-158.01542	21.24042	2:00	-158.01963	21.23918	4:07	3:16	369
Ni'ihau	DIVE02	19:17	-160.28822	21.80878	2:12	-160.28413	21.80293	7:44	6:55	574
Karin Ridge East	DIVE03	20:27	-168.67257	17.66427	0:45	-168.67847	17.66280	7:47	4:17	3187
Deep Twin Ridge	DIVE04	0:05	-169.34977	16.65995	3:35	-169.35042	16.66410	5:05	3:30	1414
Johnston Atoll South East	DIVE05	19:58	-169.48855	15.63425	1:11	-169.48795	15.64133	7:53	5:13	2434
Twin Cones	DIVE06	19:30	-169.07070	15.46568	1:36	-169.07870	15.46467	8:06	6:06	1698
Southernmost Cone	DIVE07	19:29	-168.06277	15.20922	1:31	-168.05845	15.20485	8:09	6:01	1951
Lone Cone	DIVE08	19:26	-167.74478	15.59545	1:32	-167.74823	15.58745	8:11	6:05	2116
Southern Karin Ridge	DIVE09	19:27	-167.85613	16.14335	1:22	-167.85055	16.13860	9:37	5:55	1980
Mid Karin Guyot	DIVE10	19:55	-168.20788	16.53930	1:16	-168.21423	16.54090	8:04	5:21	2327
Karin Ridge Top	DIVE11	19:29	-168.74080	17.49888	1:21	-168.74443	17.50493	8:17	5:52	2173
Abyssal Ridge	DIVE12	20:28	-169.64485	17.61472	1:42	-169.64023	17.60950	9:50	5:14	4243
Guyot Ridge	DIVE13	20:38	-169.00230	18.11700	0:26	-169.00073	18.11658	7:36	3:48	2134

Table 2. Biological Sample log for all legs of EX1504.

SampleID	ObsDate	ObsTime	DepthM	Temp	Salinity	Oxygen	FieldID
EX1504 – LEG 2 – BIOLOGICAL SAMPLES							
20150803T220700_D2_DIVE02_SPEC01BIO	8/3/2015	22:07	2452	1.71246	34.65046	3.35526	Chrysogorgia pinnata
20150803T225100_D2_DIVE02_SPEC02BIO	8/3/2015	22:51	2464	1.72883	34.64855	3.28626	Parantipathes sp.
20150804T203300_D2_DIVE03_SPEC01BIO	8/4/2015	20:33	2153	1.83044	34.63902	3.11054	Cladorhizidae
20150804T220400_D2_DIVE03_SPEC02BIO	8/4/2015	22:04	2128	3.04564	34.63354	3.04564	Heteropathes pacifica
20150804T232800_D2_DIVE03_SPEC04BIO	8/4/2015	23:28	1981	2.00956	34.62038	2.78827	Jasonisis sp
20150806T004000_D2_DIVE04_SPEC03BIO	8/6/2015	0:40	2654	1.63944	34.66097	3.53591	Chrysogorgiidae
20150806T014300_D2_DIVE04_SPEC04BIO	8/6/2015	1:43	2676	1.65211	34.64958	3.55772	Isididae unbranched
20150806T232300_D2_DIVE05_SPEC02BIO	8/6/2015	23:23	4691	1.47986	34.69992	4.61365	Rhabdopectella sp.
20150807T231100_D2_DIVE06_SPEC02BIO	8/7/2015	23:11	1896	1.89789	34.62823	2.9612	Iridogorgia sp.
20150808T220400_D2_DIVE07_SPEC02BIO	8/8/2015	22:04	2078	1.8834	34.63092	2.98181	Corallium sp.
20150808T225400_D2_DIVE07_SPEC03BIO	8/8/2015	22:54	2002	1.89704	34.62885	2.97449	Corallium sp.
20150809T233700_D2_DIVE08_SPEC01BIO	8/9/2015	23:37	1229	2.98077	34.4878	1.27736	Antipatharia
20150810T030800_D2_DIVE08_SPEC04BIO	8/10/2015	3:08	1103	3.32554	34.42613	1.03895	Comatulida
20150810T223000_D2_DIVE09_SPEC03BIO	8/10/2015	22:30	2247	1.73356	34.6433	3.10438	Bathydorus sp.
20150811T005800_D2_DIVE09_SPEC05BIO	8/11/2015	0:58	2104	1.78398	34.63519	2.99952	Hexactinellida
20150811T223900_D2_DIVE10_SPEC02BIO	8/11/2015	22:39	1939	2.01989	34.61132	2.55936	Chrysogorgia averta
20150811T235000_D2_DIVE10_SPEC03BIO	8/11/2015	23:50	1880	2.03611	34.61053	2.56827	Euretinae
20150812T010700_D2_DIVE10_SPEC04BIO	8/11/2015	1:07	1848	1.983	34.6161	2.65266	Plexauridae
20150812T223300_D2_DIVE11_SPEC03BIO	8/12/2015	22:33	2116	1.794	34.63451	2.9719	Stylasteridae
20150813T002000_D2_DIVE11_SPEC04BIO	8/13/2015	0:20	2112	1.80351	34.63468	2.9826	Euretinae
20150813T210900_D2_DIVE12_SPEC01BIO	8/13/2015	21:09	2794	1.5	34.67	3.79	Hexactinellida
20150813T221200_D2_DIVE12_SPEC03BIO	8/13/2015	22:12	2775	1.53	34.67	3.75	Keratoisis sp.
20150814T013500_D2_DIVE12_SPEC05BIO	8/14/2015	1:35	0	0	0	0	Sponge
20150814T215700_D2_DIVE13_SPEC02BIO	8/14/2015	21:57	2149	1.87	34.63	2.88	Keratoisis sp.
20150814T223800_D2_DIVE13_SPEC04BIO	8/14/2015	22:38	2160	1.766	34.64	2.98	Pythonaster sp.
20150815T210600_D2_DIVE14_SPEC02BIO	8/15/2015	21:06	1587	2.3376	34.5794	2.22604	Narella unbranched

20150815T232100_D2_DIVE14_SPEC03BIO	8/15/2015	23:21	1535	2.33354	34.58081	2.24042	Parantipathes sp.
20150816T202100_D2_DIVE15_SPEC02BIO	8/16/2015	20:21	1720	2.29	34.6	2.48	Plexauridae
20150817T012800_D2_DIVE15_SPEC04BIO	8/17/2015	1:28	1554	2.46	34.57	2.2	Acanthogorgia sp.
20150817T210100_D2_DIVE16_SPEC01BIO	8/17/2015	21:01	1464	2.65	34.56	2.14	Semperella sp.
20150818T013700_D2_DIVE16_SPEC02BIO	8/18/2015	1:37	1412	2.77	34.55	2.05	Eknomisis sp.
20150818T194200_D2_DIVE17_SPEC02BIO	8/18/2015	19:42	2082	1.89	34.63	3	Euretidae
20150819T003400_D2_DIVE17_SPEC04BIO	8/19/2015	0:34	2022	1.88	34.63	2.95	Hemicorallium sp.
20150819T013700_D2_DIVE17_SPEC05BIO	8/19/2015	1:37	1980	1.92	34.63	2.91	Stelodoryx sp.
20150819T014500_D2_DIVE17_SPEC06BIO	8/19/2015	1:45	1980	1.93	34.63	2.85	Pseudoanthomastus sp.
20150819T020000_D2_DIVE17_SPEC07BIO	8/19/2015	2:00	1980	1.93	34.63	2.85	Keratoisis sp.
EX1504 – LEG 3 – BIOLOGICAL SAMPLES							
20150830T005000_D2_DIVE02_SPEC01BIO	8/30/2015	0:50	389	8.10801	34.23323	2.48669	Chrysopathes sp.
20150830T014300_D2_DIVE02_SPEC02BIO	8/30/2015	1:43	393	8.11389	34.21656	2.48247	Keratoisis sp.
20150831T234000_D2_DIVE04_SPEC02BIO	8/31/2015	23:40	2647	1.58	34.67	3.72	Stauropathes sp.
20150901T004700_D2_DIVE04_SPEC05BIO	9/1/2015	0:47	2638	1.58	34.67	3.71	Primnoidae
20150901T005700_D2_DIVE04_SPEC06BIO	9/1/2015	0:57	2638	3.68	34.67	1.57	Schizopathidae
20150901T204300_D2_DIVE05_SPEC02BIO	9/1/2015	20:43	1013	3.92735	34.52844	1.68523	Anthomastus sp.
20150901T223400_D2_DIVE05_SPEC03BIO	9/1/2015	22:34	970	0	0	0	Madrepora sp.
20150901T234400_D2_DIVE05_SPEC05BIO	9/1/2015	23:44	953	4.33652	34.44431	1.54881	Rossellidae
EX1504 – LEG 4 – BIOLOGICAL SAMPLES							
20150913T001140_D2_DIVE01_SPEC01BIO	9/12/2011	0:11	359	8.49651	34.14202	3.53905	Telopathes
20150913T225945_D2_DIVE02_SPEC02BIO	9/12/2011	22:59	419	7.2343	34.1557	2.22663	Rock Pen - Anthoptilum
20150914T000302_D2_DIVE02_SPEC03BIO	9/13/2011	0:03	371	8.34847	34.12087	2.68336	Antipatharian fan
20150916T232107_D2_DIVE03_SPEC03BIO	9/15/2011	23:21	3106	1.55553	34.67364	3.81207	SPONGE 'Foxtail'
20150918T213300_D2_DIVE05_SPEC04BIO	9/17/2011	21:33	2378	1.88829	34.65257	3.32298	Sponge
20150919T014646_D2_DIVE04_SPEC01BIO	9/17/2011	1:46	1317	3.42915	34.55937	1.63841	Walteria sp.
20150919T223721_D2_DIVE06_SPEC03BIO	9/18/2011	22:37	1529	3.02842	34.58844	2.24912	Umbellapathes
20150920T204336_D2_DIVE07_SPEC01BIO	9/19/2011	20:43	1894	2.31541	34.62562	2.77284	Stalked crinoid
20150920T235711_D2_DIVE07_SPEC04BIO	9/19/2011	23:57	1745	2.59522	34.60967	2.50761	Lepidisis
20150921T202731_D2_DIVE08_SPEC01BIO	9/20/2011	20:27	2084	2.20214	34.62481	2.91541	Stalked Crinoid (Naumachocrinus)

20150921T225230_D2_DIVE08_SPEC03BIO	9/20/2011	22:52	1923	2.30881	34.62653	2.74366	Bolosominae
20150922T231725_D2_DIVE09_SPEC02BIO	9/21/2011	23:17	1944	2.08334	34.636	3.00658	Unbranched Primnoid
20150922T234004_D2_DIVE09_SPEC03BIO	9/21/2011	23:40	1939	2.09462	34.64958	3.02089	Branching Sponge
20150922T235210_D2_DIVE09_SPEC04BIO	9/21/2011	23:52	1932	2.25055	34.63017	2.82765	Narella
20150923T223400_D2_DIVE10_SPEC02BIO	9/22/2011	22:34	2255	2.09711	34.631	3.0133	Orstomisis
20150924T003615_D2_DIVE10_SPEC03BIO	9/23/2011	0:36	2153	1.92125	34.64235	3.22673	Branched Isidid w/bumps
20150924T222851_D2_DIVE11_SPEC03BIO	9/23/2011	22:28	2084	2.0483	34.63717	3.01727	Hexactinellida
20150925T010032_D2_DIVE11_SPEC04BIO	9/24/2011	1:00	2064	1.98158	34.64194	3.10163	Lepidisis sp.
20150925T012012_D2_DIVE11_SPEC05BIO	9/24/2011	1:20	2062	1.94932	34.64376	3.1627	Eknomisis
20150925T205505_D2_DIVE12_SPEC02BIO	9/24/2011	20:55	4238	1.44986	34.69209	4.46932	Candelabrid hydroid
20150925T213430_D2_DIVE12_SPEC03BIO	9/24/2011	21:34	4233	1.44706	34.69183	4.54064	Hexactinellid
20150927T002243_D2_DIVE13_SPEC03BIO	9/26/2011	0:22	1882	2.07898	34.63083	2.91371	Chrysogorgia

Table 3. Geological Sample log for all legs of EX1504.

SampleID	ObsDate	ObsTime	DepthM	Temp	Salinity	Oxygen	FieldID
EX1504 – LEG 2 – GEOLOGICAL SAMPLES							
20150802T223100_D2_DIVE01_SPEC01GEO	8/2/2015	22:31	2147	1.806	34.644	3.16	Mn-crusted basalt
20150803T011500_D2_DIVE01_SPEC02GEO	8/3/2015	1:15	1836	2.14	3461	2.617	Mn-crusted basalt
20150804T001600_D2_DIVE02_SPEC03GEO	8/4/2015	0:16	2407	1.69045	34.65021	3.33598	Mn-crusted basalt
20150804T022800_D2_DIVE02_SPEC04GEO	8/4/2015	2:28	2243	1.9046	34.63508	2.91523	Mn-crusted basalt
20150804T223900_D2_DIVE03_SPEC03GEO	8/4/2015	22:39	2050	1.88453	34.63064	2.96857	Mn-crusted basalt
20150805T202400_D2_DIVE04_SPEC01GEO	8/5/2015	20:24	3032	1.66267	34.65649	3.65745	Mn-crusted basalt
20150806T000100_D2_DIVE04_SPEC02GEO	8/6/2015	0:01	6273	1.64852	34.65968	3.50145	Mn-crusted basalt
20150806T230800_D2_DIVE05_SPEC01GEO	8/6/2015	23:08	4698	1.47608	34.6958	4.65431	Mn-crusted pillow
20150807T220700_D2_DIVE06_SPEC01GEO	8/7/2015	22:07	1965	1.91273	34.62703	3.00205	Mn-crusted basalt
20150807T232000_D2_DIVE06_SPEC03GEO	8/7/2015	23:20	1896	1.89926	34.62718	3.00932	Mn-crusted basalt
20150808T210400_D2_DIVE07_SPEC01GEO	8/8/2015	21:04	2083	1.93961	34.62585	2.92061	Mn-crusted basalt
20150808T231600_D2_DIVE07_SPEC04GEO	8/8/2015	23:16	2001	1.9932	34.62813	2.9212	Mn-crusted basalt
20150810T002400_D2_DIVE08_SPEC02GEO	8/10/2015	0:24	1164	3.09288	34.46875	1.21906	Mn-crusted basalt
20150810T012900_D2_DIVE08_SPEC03GEO	8/10/2015	1:29	1169	3.20205	34.45951	1.10915	Mn-crusted basalt
20150810T194000_D2_DIVE09_SPEC01GEO	8/10/2015	19:40	2278	1.73783	34.64068	3.18724	Mn-crusted basalt
20150810T220800_D2_DIVE09_SPEC02GEO	8/10/2015	22:08	2251	1.7404	34.64091	3.18724	Mn-crusted basalt
20150810T233600_D2_DIVE09_SPEC04GEO	8/10/2015	23:36	2170	1.80602	34.63054	2.98121	Mn-crusted basalt
20150811T215800_D2_DIVE10_SPEC01GEO	8/11/2015	21:58	1955	2.01206	34.61571	2.59678	Mn-crusted basalt
20150812T205000_D2_DIVE11_SPEC01GEO	8/12/2015	20:50	2144	1.72837	34.64216	3.15195	Mn-crusted basalt
20150812T221200_D2_DIVE11_SPEC02GEO	8/12/2015	22:12	2120	1.75726	34.639	3.05488	Mn-crusted basalt
20150813T211200_D2_DIVE12_SPEC02GEO	8/13/2015	21:12	2794	1.51	34.67	3.86	Mn-crusted basalt
20150814T004400_D2_DIVE12_SPEC04GEO	8/14/2015	0:44	2780	1.58	34.67	3.64	Mn-crusted basalt
20150814T202100_D2_DIVE13_SPEC01GEO	8/14/2015	20:21	2286	1.81	34.64	3	Mn-crusted basalt
20150814T220800_D2_DIVE13_SPEC03GEO	8/14/2015	22:08	2161	1.89	34.63	2.87	Mn-crusted basalt
20150815T205000_D2_DIVE14_SPEC01GEO	8/15/2015	20:50	1587	2.3354	34.58217	2.26041	Mn-crusted basalt
20150816T002100_D2_DIVE14_SPEC04GEO	8/16/2015	0:21	1528	2.2246	34.59106	2.34934	Mn-crusted basalt

20150816T193400_D2_DIVE15_SPEC01GEO	8/16/2015	19:34	1741	2.2	34.6	2.52	Mn-crusted basalt
20150816T230400_D2_DIVE15_SPEC03GEO	8/16/2015	23:04	1645	2.25	34.6	2.46	Mn-crusted basalt
20150818T193800_D2_DIVE17_SPEC01GEO	8/18/2015	19:38	2082	1.9	34.63	3.01	Mn-crusted basalt
20150818T234500_D2_DIVE17_SPEC03GEO	8/18/2015	23:45	2041	1.87	34.63	3	Mn-crusted basalt
20150820T213700_D2_DIVE18_SPEC01GEO	8/20/2015	21:37	1515	3.01	34.55	2.08	Mn-crusted basalt
EX1504 – LEG 3 – GEOLOGICAL SAMPLES							
20150830T015700_D2_DIVE02_SPEC03GEO	8/30/2015	1:57	388	8.17932	34.212	2.55	Dead Coral
20150830T200800_D2_DIVE03_SPEC01GEO	8/30/2015	20:08	452	7.40131	34.22578	1.89563	Basalt
20150830T223300_D2_DIVE03_SPEC02GEO	8/30/2015	22:33	450	6.80495	34.2484	1.59734	Basalt
20150831T202700_D2_DIVE04_SPEC01GEO	8/31/2015	20:27	2699	1.67	34.64	3.63	Mn-crusted basalt
20150901T000500_D2_DIVE04_SPEC03GEO	9/1/2015	0:05	2643	1.57	34.67	3.76	Mn-crusted basalt
20150901T002300_D2_DIVE04_SPEC04GEO	9/1/2015	0:23	2634	1.57	34.67	3.74	Mn-crusted basalt
20150901T191700_D2_DIVE05_SPEC01GEO	9/1/2015	19:17	1071	3.68546	34.54378	1.79924	Basalt
20150901T224500_D2_DIVE05_SPEC04GEO	9/1/2015	22:45	969	4.0135	34.41251	1.62899	Carbonate
20150902T001800_D2_DIVE05_SPEC06GEO	9/2/2015	0:18	973	4.33078	34.44357	1.52962	Basalt
20150902T200800_D2_DIVE06_SPEC01GEO	9/2/2015	20:08	2135	1.98	34.64	3.05	Mn-crusted basalt
20150902T222100_D2_DIVE06_SPEC02GEO	9/2/2015	22:21	2125	1.98	34.64	3	Mn-crusted basalt
EX1504 – LEG 4 – GEOLOGICAL SAMPLES							
20150913T195328_D2_DIVE02_SPEC01GEO	9/12/2011	19:53	567	6.13178	34.22295	1.70049	Basalt
20150916T204822_D2_DIVE03_SPEC01GEO	9/15/2011	20:48	3184	1.55576	34.70158	3.86278	Rock
20150916T220116_D2_DIVE03_SPEC02GEO	9/15/2011	22:01	3162	1.57119	34.67429	3.82286	Rock
20150917T004328_D2_DIVE03_SPEC04GEO	9/16/2011	0:43	3049	1.54255	34.67485	3.83577	Rock
20150918T200955_D2_DIVE05_SPEC01GEO	9/17/2011	20:09	2429	1.81308	34.66284	3.47744	Mn-encrusted basalt
20150918T220456_D2_DIVE05_SPEC03GEO	9/17/2011	22:04	2357	1.89909	34.65242	3.30072	Mn encrusted basalt
20150919T021614_D2_DIVE04_SPEC02GEO	9/17/2011	2:16	1270	3.53897	34.56481	1.6177	Carbonate Rock
20150919T200939_D2_DIVE06_SPEC01GEO	9/18/2011	20:09	1672	2.67046	34.6008	2.53929	Mn-encrusted Basalt
20150919T221151_D2_DIVE06_SPEC02GEO	9/18/2011	22:11	1530	3.00781	34.5858	2.28848	Mn-encrusted basalt
20150920T005409_D2_DIVE06_SPEC04GEO	9/19/2011	0:54	1508	2.73505	34.60307	2.44387	Mn-encrusted basalt
20150920T210406_D2_DIVE07_SPEC02GEO	9/19/2011	21:04	1894	2.31491	34.62594	2.78583	Mn-encrusted basalt
20150920T221401_D2_DIVE07_SPEC03GEO	9/19/2011	22:14	1843	2.34251	34.62278	2.75862	Mn-encrusted basalt

20150921T010732_D2_DIVE07_SPEC05GEO	9/20/2011	1:07	1747	2.52547	34.61472	2.55113	Mn-encrusted basalt
20150921T204528_D2_DIVE08_SPEC02GEO	9/20/2011	20:45	2074	2.17923	34.63227	2.92074	Mn-encrusted basalt
20150921T234946_D2_DIVE08_SPEC04GEO	9/20/2011	23:49	1833	2.37355	34.62114	2.6795	Mn-encrusted basalt
20150922T203849_D2_DIVE09_SPEC01GEO	9/21/2011	20:38	1969	2.07456	34.63723	3.04152	Mn-encrusted basalt
20150923T003720_D2_DIVE09_SPEC05GEO	9/22/2011	0:37	1929	2.26502	34.62727	2.79611	Mn-encrusted basalt
20150923T203538_D2_DIVE10_SPEC01GEO	9/22/2011	20:35	2324	2.02658	34.6405	3.11369	Pillow fragment
20150924T194238_D2_DIVE11_SPEC01GEO	9/23/2011	19:42	2168	1.87646	34.64922	3.31978	Mn-encrusted basalt
20150924T214653_D2_DIVE11_SPEC02GEO	9/23/2011	21:46	2106	2.11026	34.63481	2.97404	Basalt
20150925T205256_D2_DIVE12_SPEC01GEO	9/24/2011	20:52	4238	1.45536	34.69379	4.48522	Mn-encrusted basalt
20150925T235114_D2_DIVE12_SPEC04GEO	9/24/2011	23:51	4097	1.45719	34.69432	4.36507	Basalt
20150926T011422_D2_DIVE12_SPEC05BIO	9/25/2011	1:14	4060	1.44957	34.69831	4.34294	Hyalonematidae
20150926T014011_D2_DIVE12_SPEC06GEO	9/25/2011	1:40	4062	1.4719	34.6862	4.26773	Mn-encrusted basalt
20150926T211815_D2_DIVE13_SPEC01GEO	9/25/2011	21:18	2104	1.85991	34.64742	3.27927	Mn-encrusted basalt
20150926T231823_D2_DIVE13_SPEC02GEO	9/25/2011	23:18	1972	2.14272	34.62644	2.88722	Mn-encruted basalt