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Ocean Exploration and Research

Windows to the Deep 2019

EX1903 Leg 2 (EX1903L2) Cruise Report

Southeast and Mid-Atlantic U.S. Continental Margin

Port Canaveral, FL to Norfolk, VA
(June 20 - July 12, 2019)

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Abstract

The deepwater areas offshore Florida, Georgia, South Carolina, and North Carolina are some of the least explored areas along the U.S. East Coast. In 2019, NOAA and partners conducted a two-part expedition to map and characterize this area to support priorities put forward by the deep-ocean science and resource management communities. The primary objective of the expedition was to survey deepwater areas offshore of Florida, Georgia, South Carolina and North Carolina in order to provide baseline information to support management and science needs. This two-part expedition used the ship's deepwater mapping systems (Kongsberg EM302 multibeam sonar, Simrad EK60 and EK80 split-beam fisheries sonars, Knudsen 3260 chirp sub-bottom profiler sonar, and Teledyne Acoustic Doppler Current Profiler [ADCP]), NOAA's two-body deepwater remotely operated vehicle (ROV), and a high-bandwidth satellite connection for real-time ship to shore communications. This cruise report details activities associated with the second leg of the Windows to the Deep 2019 expedition (EX1903L2). 19 ROV dives were conducted, ranging in depth from 298 to 3,490 meters (978-11,450 feet) to improve knowledge of unexplored areas within the U.S. Exclusive Economic Zone (EEZ) to inform management needs for sensitive habitats, maritime heritage sites, and potential resources. EX1903L2 also mapped 14, 314 square kilometers of seafloor to extend bathymetric mapping coverage in the U.S. EEZ in support of Seabed 2030 and NOAA's goal to map and characterize the U.S. EEZ. Data from this expedition will help to improve our understanding of the deep-ocean habitats of the U.S. continental margin and of the connections between communities throughout the Atlantic Basin.

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1. Introduction

The NOAA Office of Ocean Exploration and Research (OER) is the only U.S. federal program solely dedicated to exploring our deep ocean, closing the prominent gap in our basic understanding of U.S. deep waters and seafloor, and delivering the ocean information needed to strengthen the economy, health, and security of our nation. Using the latest tools and technology, OER explores previously unknown areas of our deep ocean, making discoveries of scientific, economic, and cultural value. Through live video streams, online coverage, training opportunities, and real-time events, OER allows scientists, resource managers, students, members of the general public, and others to actively experience ocean exploration, expanding available expertise, cultivating the next generation of ocean explorers, and engaging the public in exploration activities. From this exploration, OER makes the collected data needed to understand our ocean publicly available, so we can maintain the health of our ocean, sustainably manage our marine resources, accelerate our national economy, and build a better appreciation of the value and importance of the ocean in our everyday lives.

NOAA Ship *Okeanos Explorer* is the only U.S. federal vessel dedicated to exploring our largely unknown ocean for the purpose of discovery and the advancement of knowledge. America's future depends on understanding the ocean. Exploration supports NOAA mission priorities and national objectives by providing a broad diversity of data and information about the deep ocean to anyone who needs it.

In close collaboration with government agencies, academic institutions, and other partners, OER conducts deep-sea exploration expeditions using advanced technologies on NOAA Ship *Okeanos Explorer*. From mapping and characterizing previously unseen seafloor to collecting and disseminating information about deep waters and seafloor—and the resources they hold—this work establishes a foundation of information and fills data gaps. Data collected on the ship adhere to federal open-access data standards and are publicly available shortly after an expedition ends. This ensures the delivery of reliable scientific data needed to identify, understand, and manage key elements of the ocean environment. As the only federal program dedicated to ocean exploration, OER is uniquely situated to lead partners in delivering critical deep-ocean information to managers, decision makers, scientists, and the public, leveraging federal investments to meet national priorities.

1.1 Expedition Overview

The Windows to the Deep 2019 (EX1903 Legs 1 and 2) was the sixth in a series of expeditions that contribute to NOAA's Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE) campaign, a major multi-year, multi-national collaborative field

program focused on raising collective knowledge and understanding of the North Atlantic. This campaign provides timely, actionable information to support decision making based on reliable and authoritative science. It also serves as an opportunity for the nation to highlight the uniqueness and importance of these deepwater environments. ASPIRE builds on the momentum of past U.S. campaigns and international initiatives to support ecosystem-based management of marine resources.

1.2 Rationale for Exploration

The deepwater areas offshore Florida, Georgia, South Carolina, and North Carolina are some of the least explored areas along the U.S. East Coast. Though this region is home to millions of Americans and is experiencing some of the highest population growth rates in the U.S (Conley et al., 2017), the offshore habitats are some of the least explored areas of the U.S. East Coast. The southeast U.S. continental margin has some of the largest gaps in high-resolution ocean mapping data on the East Coast and limited previous observations via submersibles. These data gaps also include much of the Stetson/Miami Terrace Deepwater Coral Habitat Area of Particular Concern (HAPC).

As part of the planning for this expedition, NOAA collaborated with the scientific and management community to assess the exploration needs and data gaps in unknown and poorly-known areas of the southeast U.S. continental margin. NOAA incorporated the 2018 Call for Input, results from the 2018 ASPIRE Workshop, and priorities from resource managers to define the operating area for this expedition. Data from this expedition helped improve our understanding of the deep-ocean habitats of the U.S. continental margin and of the connections between communities throughout the Atlantic Basin. Data and information from the expedition provided critical knowledge to inform deep-sea management plans for HAPCs, Marine Protected Areas (MPAs) and National Marine Sanctuaries; supported local scientists and managers seeking to understand and manage deep-sea resources; and supplied a foundation of information to stimulate subsequent exploration, research, and management activities.

This expedition also contributed to the ongoing NOAA collaboration with the Office of National Marine Sanctuaries Maritime Heritage Program, the Bureau of Ocean Energy Management (BOEM), the U.S. Geological Survey (USGS), and the National Marine Fisheries Deep-sea Coral Research and Technology Program's Southeast Deep-sea Coral Initiative (SEDCI).

This two-part expedition used the ship's deepwater mapping systems (Kongsberg EM302 multibeam sonar, Simrad EK60 and EK80 split-beam fisheries sonars, Knudsen 3260 chirp sub-bottom profiler sonar, and Teledyne Acoustic Doppler Current Profiler [ADCP]), NOAA's

two-body deepwater remotely operated vehicle (ROV), and a high-bandwidth satellite connection for real-time ship to shore communications. ROV dives included high-resolution visual surveys of water column and seafloor habitats as well as biologic and geologic sampling. Information about the first leg of this expedition (EX1903L1) of this expedition which conducted 16 days of mapping on the Blake Plateau, can be found in White et al. 2019.

2. Objectives

The expedition addressed science themes and priority areas put forward by NOAA scientists and resource managers, the South Atlantic Fishery Management Council (SAFMC), BOEM, the USGS, and the broad ocean science community. The primary objective of the expedition was to survey deepwater areas offshore Florida, Georgia, South Carolina and North Carolina in order to provide baseline information to support management and science needs. Weather and the position of the Gulf Stream during the last week of EX1903L2 necessitated moving the operating area north to include exploration in the Mid-Atlantic Canyons. Specifically, this expedition sought to:

- Acquire data on deepwater habitats in the southeast and mid-Atlantic U.S. continental margin to support priority science and management needs;
- Identify, map, and explore the diversity and distribution of benthic habitats, including fish habitats, deep-sea coral and sponge communities, chemosynthetic communities, and biological communities that colonize or aggregate around shipwrecks;
- Explore U.S. maritime heritage by identifying and investigating sonar anomalies as well as characterizing shipwrecks;
- Investigate biogeographic patterns of deep-sea ecosystems and connectivity across the southeast U.S. continental margin for use in broader comparisons of deepwater habitats throughout the Atlantic Basin;
- Map, survey, and sample geologic features within the southeast U.S. continental margin to better understand the geological context of the region and improve knowledge of past and potential future geohazards;
- Collect high-resolution bathymetry in areas with no (or lower quality) mapping data;
- Acquire a foundation of ROV, sonar, and oceanographic data to better understand the characteristics of the resident water column;
- Engage a broad spectrum of the scientific community and the public in telepresence-based exploration;
- Provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities.

3. List of Participants

The EX1903L2 expedition included mission personnel who participated in the expedition from on board NOAA Ship *Okeanos Explorer*, as well as shore-side science personnel who participated in the expedition remotely via telepresence technology. A list of participating personnel for Leg 1 and 2 of EX1903 can be found in Tables 1 and 2.

At-Sea Mission Personnel

Table 1. Names, roles and affiliation of the mission team on board the NOAA Ship *Okeanos Explorer* EX1903 Leg 2 expedition.

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Shore-based Science Team

Table 2. Name, affiliation, email of the shore-based science team who participated in Legs 1 and 2 of EX1903.

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4. Methodology

In order to accomplish its objectives, the expedition made use of:

(1) dual-bodied ROV system (ROVs *Deep Discoverer* and *Seirios*) to conduct daytime seafloor and water column surveys, as well as to collect a limited number of specimens to help further characterize the deepwater fauna and geology of the region;

(2) mapping systems (Kongsberg EM 302 multibeam sonar, Knudsen 3260 sub-bottom profiler, Kongsberg EK60 and EK80 split-beam sonars, and Teledyne ADCPs) to conduct mapping operations at night and when the ROV was on deck; and

(3) high-bandwidth satellite connection for real-time ship-to-shore communications.

4.1 ROV Surveys

ROV dive operations were conducted to support the expedition objectives, including characterizing deep-sea coral and sponge habitats, chemosynthetic communities at seeps, submarine canyons, and landslide or slump features. During each dive, the ROVs descended onto the seafloor and then moved from waypoint to waypoint, documenting the geology and biology of the area. Each ROV dive was approximately 8-10 hours, conditions and logistics permitting. During EX1903L2 , dives were primarily conducted during the day (operations described in detail by Quattrini et al., 2015 and Kennedy et al., 2019). Additional information about the general process of site selection, collaborative dive planning, scientific equipment on the ROVs, and the approach to benthic exploration can be found in Kennedy et al. (2019). Onboard and shore-based scientists identified each encountered organism to the lowest taxon possible based on data available during real-time assessment. Additionally, onboard and shore-based scientists provided geological interpretations of the observed substrate throughout each ROV seafloor survey. These observations were recorded using Ocean Networks Canada SeaTube version 2.0.

For water column exploration, a series of transects were performed during vehicle ascent following the completion of the benthic/seafloor exploration. Transects primarily targeted the deep scattering layer and the waters directly above and below. Specific transect depths were decided each day during ROV descent through an evaluation of the Simrad EK60 and EK80 data, ROV CTD data, and the acoustically determined position of the deep scattering layer. Additionally, when seafloor depth allowed, a standard set of deeper transects were also completed at 900 m, 700 m, and 500 m. Transect length varied between 20 minute to 50 minutes at each depth, depending on the specific objectives for water column exploration, conditions, and seafloor depth. Specific transect depths and times are noted in each dive summary (Appendix A).

4.2 Specimen Collections

A limited number of geological and biological samples were collected on the seafloor using ROV *Deep Discoverer*'s manipulator arms and biological and geological collection boxes. ROV *Deep Discoverer*'s five chamber suction sampler was used for both seafloor and midwater sample collections. The primary goal of sampling operations was to collect voucher specimens to be made publicly available to the science community so they could be used to characterize the site. For each collected specimen, the date, time, latitude, longitude, depth, salinity, temperature, and dissolved oxygen content were recorded at the time of collection. Geological samples were acquired for age dating and geochemical composition. Biological specimen collections targeted samples that represented potential new species, range extensions of animals not previously known to occur in the region, dominant species at the site, rare morphotypes, or specimens targeted to contribute to trans-Atlantic connectivity studies.

After vehicle recovery, specimens were examined for commensal organisms, labeled, photographed, and entered into a database containing all relevant metadata. Any commensal organisms found were separated from the primary specimen and processed separately as an "Associate" sample. Geological samples were air dried and placed in rock bags. At the conclusion of the 2019 expeditions, these samples were shipped to the Marine and Geology Repository at Oregon State University, where they are photographed and entered into an online database (http://osu-mgr.org). Thin- and polished-sections are made for each hard-rock sample and included in the database.

Biological samples were subsampled for inclusion in the Smithsonian Institution's Biorepository (https://naturalhistory.si.edu/research/biorepository) for future barcoding and DNA extraction. For this purpose, a small subsample, consisting of not more than 1 cm^2 of tissue, was removed from the original sample and placed in 95% analytical grade ethanol. All voucher specimens and subsamples from EX1903L2 have been delivered to the Smithsonian Institution National Museum of Natural History for long term archival and public access through https://collections.nmnh.si.edu/search/iz/. For most collected specimens, the remainder of the biological sample was preserved in 95% ethanol. Some of these specimens from seep sites were also frozen for isotope analysis. For select taxa, vouchers or subsamples were preserved in 10%, 5%, or 4% buffered formalin per recommendation from taxa experts and guidance provided by the Smithsonian Institution National Museum of Natural History. Full details of the preservation of each biological sample can be seen in the metadata record associated with each specimen.

4.3 Seafloor Mapping

Mapping operations included Kongsberg EM 302 multibeam, Kongsberg EK60 and EK80 split-beam, Knudsen sub-bottom profile, and Teledyne Acoustic Doppler Current Profiler (ADCP) data collection. The schedule of mapping operations included overnight transits and whenever the ROV was on deck. Lines were planned to maximize either edge matching of existing data or data gap filling in areas where bathymetry coverage did not exist. In regions with no existing data, exploration transit lines were planned to optimize potential discoveries. Targeted mapping operations were conducted in the vicinity of: (1) the Stetson Miami Terance Deep Coral Habitat Area of Particular Concern, (2) central Blake Plateau, (3) in the vicinity of the North Carolina canyons and Currituck Landslide in search of underwater cultural heritage (UCH) sites, and (4) the Mid-Atlantic Canyons in the Frank R. Lautenberg Deep Sea Coral Protection Area.

4.3.1 Multibeam Sonar (Kongsberg EM 302)

Multibeam seafloor mapping data were collected using the Kongsberg EM 302 sonar, which operates at a frequency of 30 kHz. Multibeam mapping operations were conducted during all overnight transits between ROV dive sites. When possible, transits were designed to maximize coverage over seafloor areas with no previous high-resolution mapping data. Overnight surveys were also completed in areas that were previously mapped with a lower resolution multibeam sonar system. Additionally, multibeam mapping operations were conducted directly over planned ROV dive locations in order to collect seafloor mapping data to help refine dive plans. Multibeam mapping operations collected data on seafloor depth (i.e., bathymetry), seafloor acoustic reflectivity (i.e., seafloor backscatter), and water column reflectivity (i.e., water column backscatter). Targeted UCH mapping surveys (Figure 2) were conducted at 4 - 8 knots (depth dependant; slower at deeper depths to increase sounding density and potential for shipwreck discovery) off the coast of North Carolina to search for potential shipwrecks associated with the Battle of the Atlantic/World War II.

4.3.2 Sub-Bottom Profiler (Knudsen Chirp 3260)

The primary purpose of the Knudsen Chirp 3260 (3.5 kHz) sonar is to image sediment layers underneath the seafloor to a maximum depth of about 80 meters below the seafloor, depending on the specific sound velocity of the substrate. The sub-bottom profiler was operated simultaneously with the multibeam sonar during mapping operations in order to provide supplemental information about the sedimentary features underlying the seafloor. Specific sub-bottom profile surveys at 4 - 5 knots were conducted overnight while operating in the Mid-Atlantic Canyons (Figure 3).

4.3.3 Split-beam Sonars (Simrad EK60 and EK80)

NOAA Ship *Okeanos Explorer* is equipped with three Simrad EK60 and one Simrad EK80 split-beam sonar transducers operated at frequencies of 18, 120, and 200 kHz for the EK60 and 70 kHz for the EK80. Though the *Okeanos Explorer* is equipped with a 38 kHz EK80; it was not functional during EX1903L2. This sonars were used continuously throughout the cruise during both overnight mapping operations and daytime ROV operations. The sonars provided calibrated target strength measurements of water column features such as dense biological layers or schools of fish. These sonars can also help detect the presence of gaseous seeps emanating from the seafloor. EK60 and EK80 data were used during midwater transects of ROV dives to detect the depth of the deep scattering layers due to aggregations of biological organisms in the water column.

4.3.4 Acoustic Doppler Current Profiler (Teledyne Workhorse Mariner ADCP)

NOAA Ship *Okeanos Explorer* is equipped with two ADCPs: a Teledyne Workhorse Mariner (300 kHz) and a Teledyne Ocean Surveyor (38 kHz). The ADCPs provide information on the speed and direction of currents underneath the ship. They were used throughout ROV dives to support safe deployment and recovery of the vehicles.

4.4 Sun Photometer Measurements

OER gathers limited at-sea sun photometer measurements onboard NOAA Ship *Okeanos Explorer* in order to support a NASA-led, long-term research effort that assesses marine aerosols. Onboard personnel collected georeferenced sun photometer measurements on sunny days during the expedition in order to collect data to support the Maritime Aerosol Network (MAN) component of the Aerosol Robotic Network (AERONET). AERONET is a network of sun photometers which measure atmospheric aerosol properties around the world. MAN compliments AERONET by conducting sun photometer measurements on ships of opportunity in order to monitor aerosol properties over the global ocean. Sun photometer measurements were conducted as time allowed on cloud-free days.

5. Clearances and Permits

Pursuant to the National Environmental Policy Act (NEPA), NOAA OER is required to include in its planning and decision-making processes appropriate and careful consideration of the potential environmental consequences of actions it proposes to fund, authorize and/or conduct. NOAA's Administrative Order (NAO) 216-6A Companion Manual describes the agency's specific procedures for NEPA compliance. Among these is the need to review all proposed NOAA-supported field projects for their environmental effects. An Environmental Review Memorandum was completed for this survey, in accordance with Section 4 of the Companion Manual (Appendix C). Based on this review, a categorical exclusion was determined to be the appropriate level of NEPA analysis for this expedition, as no

extraordinary circumstances existed that required the preparation of an environmental assessment or environmental impact statement.

Informal consultation was initiated under Section 7 of the Endangered Species Act (ESA), requesting NOAA Fisheries' Protected Resources Division concurrence with our biological evaluation determining that NOAA Ship *Okeanos Explorer* operations conducted as part of ASPIRE, may affect, but are not likely to adversely affect, ESA-listed marine species. The informal consultation was completed on August 8, 2018 when NOAA OER received a signed letter from the Regional Administrator of South East Regional Office, stating that NOAA National Marine Fisheries Service (NMFS) concurs with OER's determination that conducting proposed ASPIRE cruises are not likely to adversely affect ESA-listed marine species (Appendix D). OER has completed consultation with the NOAA Habitat Conservation Division on potential ASPIRE impacts of our operations to Essential Fish Habitat (EFH). They concurred that our operations would not adversely affect EFH provided adherence to our proposed procedures and their guidance stated in the letter (Appendix D).

Additionally, OER received a Letter of Acknowledgement (LOA) from NOAA NMFS for operations in the Southeast Deepwater MPAs and areas deemed as a Habitat Areas of Particular Concern (HAPCs). During the expedition as the Gulf Stream and weather pushed the expedition north into the Mid-Atlantic Canyons, OER requested and received a LOA from NOAA NMFS for operations in the Frank R. Lautenberg Deep Sea Coral Protection Area. The LOAs are attached in Appendix E.

6. Expedition Schedule

The second leg of EX1903 was planned for a total of 23 days at sea, from June 20, 2019 to July 12, 2019, departing from Port Canaveral, Fl to Norfolk, VA. There were 21 scheduled dives, with 19 dives achieved (Tables 3 and 4).

Table 3. Schedule of EX1903L2.

June - July						
SUN	**MON**	**TUES**	**WED**	**THURS**	**FRI**	**SAT**

16 *Okeanos Explorer* Change of Command Ceremony	**17**	**18**	**19**	**20** **Okeanos Departed** Transit + overnight mapping	**21** Dive 1: Canaveral Deep Overnight mapping	**22** Dive 2: Stetson Mesa South Mounds + Midwater Overnight mapping
23 Dive 3: Stetson Mesa South Scarp Overnight mapping	**24** Dive 4: Blake Plateau Knolls Overnight mapping	**25** Dive 5: Central Plateau Mounds Transit / overnight mapping	**26** Personnel transfer and transit mapping	**27** Dive 6: Stetson Mesa Seep + Midwater Overnight mapping	**28** Dive 7: "Shark Rock" Overnight mapping	**29** Dive 8: Central Plateau Scarp + Midwater AGU Instagram Takeover Overnight mapping
30 Dive 9: Blake Escarpment Mid + Midwater AGU Instagram Takeover Overnight mapping	**JULY 1** Dive 10: Richardson Jellyfish 0830-1630 860 m AGU Instagram Takeover Overnight mapping	**2** Transit AGU Instagram Takeover Live interaction with Santa Barbara Museum of Natural History Sea Center @ 13:00-13:30 Overnight mapping	**3** Dive 11: Deep "Dodge" Canyon Overnight mapping	**4** Dive 12: Deep Pamlico Overnight mapping	**5** Dive 13: Roanoke Minor Canyon Overnight mapping	**6** Dive 14: Bodie Seep + Midwater Overnight mapping
7 Dive 15: Currituck Base Overnight mapping	**8** Dive 16: Washington Canyon Overnight mapping	**9** Dive 17: Wilmington Canyon Live interaction with NC Aquarium @ 11:30 Overnight	**10** Dive 18: Baltimore Canyon 0830-1630 *Patriots Point Streaming event* Live interaction	**11** Dive 19: Norfolk Seep 0830-1630 Live interaction with the National Ocean Service Science Seminar @	**12** **Okeanos Docked in Norfolk, VA**	**13**

		mapping	with Santa Barbara Museum of Natural History Sea Center @ 14:00-14:30 Overnight mapping	12:00- 13:00 Overnight mapping		

7. Expedition Map

EX1903L2 began on June 20, 2019 in Port Canaveral, FL and ended on July 12, 2019 in Norfolk, VA. Figure 1 shows the locations of expeditions operations that included ROV exploration and seafloor mapping along the Blake Plateau, the Blake Escarpment, North Carolina Canyons, and the Mid-Atlantic Canyons. Though this expedition was initially planned to focus on the deepwater areas offshore the southeast U.S., the position of the Gulf Stream and weather offshore North Carolina pushed the cruise north into the Mid-Atlantic Canyons where dives were completed in Washington, Wilmington, and Baltimore Canyons and a seep site south of Norfolk Canyon during the last week of the expedition.

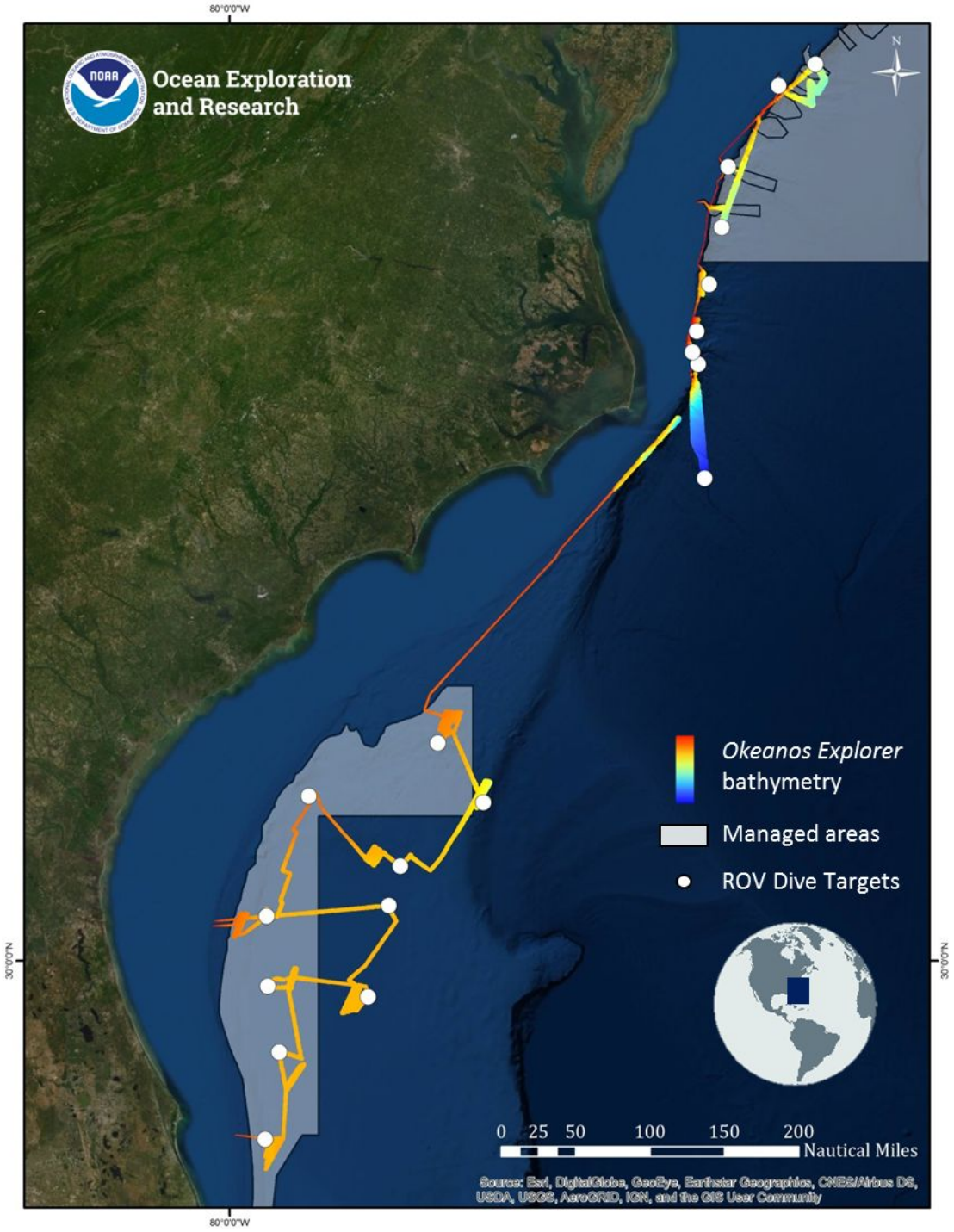

Figure 1. Map showing the locations of the 19 ROV dives and bathymetry data collected during EX1903L2. Figure created using ArcGIS.

8. Results

Depth ranges explored during ROV surveys were between 298 to 3,490 meters. During the 19 dives, the ROV spent a total of 110:29:33 hours on the bottom and 4:36:00 hours conducting water column exploration (Table 4).

Table 4. Summary information for the 19 ROV dives conducted during EX1903L2.

Date	Dive #	Site Name	On Bottom Latitude	On Bottom Longitude	Max Depth (m)	Dive Duration	Bottom Time	Water Column Exploration Time	High Diversity Community Present	Corals/ Sponges Present	Objective
6/21/19	1	Canaveral Deep	28°, 15.064' N	79°, 36.072' W	805.0 m	7:55:28	5:26:41	0:00:00	Yes	Yes	Corals + Geology
6/22/19	2	Stetson Mesa South Mounds	29°, 6.641' N	79°, 26.701' W	784.0 m	9:51:34	5:44:30	1:31:00	Yes	Yes	Corals + Geology + Midwater
6/23/19	3	Stetson Mesa South Scarp	29°, 45.247' N	79°, 34.262' W	893.0 m	8:19:56	5:18:22	0:00:00	Yes	Yes	Corals + Geology
6/24/19	4	Blake Plateau Knolls	29°, 39.147' N	78°, 26.988' W	827.0 m	8:09:35	6:53:08	0:00:00	Yes	Yes	Corals + Geology
6/25/19	5	Central Plateau Mounds	30°, 32.211' N	78°, 12.782' W	866.0 m	6:13:06	4:31:26	0:00:00	Yes	Yes	Corals + Geology
6/26/19		- Personnel transfer, no dive -									
6/27/19	6	Stetson Mesa Potential Seep	30°, 26.064' N	79°, 34.919' W	841.0 m	9:36:37	5:52:05	1:00:00	Yes	Yes	Water column anomaly ground-truth/ Corals +Geology
6/28/19	7	"Shark Rock" (no UCH confirmed)	31°, 35.422' N	79°, 6.597' W	461.0 m	8:31:15	7:04:50	0:00:00	Yes	Yes	UCH
6/29/19	8	Central Plateau Scarp	30°, 55.074' N	78°, 5.234' W	1008.0 m	8:00:31	5:19:04	0:30:00	No	Yes	Corals + Geology
6/30/19	9	Blake Escarpment Mid + Midwater	31°, 31.73' N	77°, 9.291' W	1426.0 m	10:01:16	6:26:49	0:45:00	No	Yes	Corals + Geology + Midwater
7/1/19	10	Richardson Jellyfish/Richardson	32°, 5.738' N	77°, 40.082' W	886.0 m	8:07:33	7:02:08	0:00:00	No	Yes	Corals + Geology
7/2/19		- Dive Canceled - Transit-									
7/3/19	11	Deep "Dodge" Canyon	35°, 37.477' N	74°, 44.914' W	1348.0 m	6:52:58	3:29:40	0:00:00	No	No	Canyon + Potential Seep

7/4/19	12	Deep Pamlico Canyon	34°, 34.709' N	74°, 40.617' W	3498.0 m	8:17:37	4:13:43	0:00:00	No	Yes	Canyon
7/5/19	13	Roanoke Minor Canyon	35°, 55.5' N	74°, 46.054' W	1056.0 m	8:15:51	6:34:53	0:00:00	No	Yes	Canyon + Corals
7/6/19	14	Bodie Seep + Midwater	35°, 44.109' N	74°, 48.735' W	446.0 m	10:01:07	7:44:55	0:50:00	Yes	Yes	Seep
7/7/19	15	Currituk Base	36°, 21.125' N	74°, 37.561' W	1645.0 m	6:36:17	4:13:31	0:00:00	No	Yes	Canyon + Corals
7/8/19	16	Washington Canyon	37°, 24.375' N	74°, 24.89' W	996.0 m	7:49:46	5:16:30	0:00:00	No	Yes	Canyon + Corals
7/9/19	17	Wilmington Canyon	38°, 18.95' N	73°, 26.065' W	1541.0 m	8:13:15	6:26:39	0:00:00	Yes	Yes	Canyon + Corals
7/10/19	18	Baltimore Canyon	38°, 7.577' N	73°, 50.873' W	770.0 m	8:19:07	6:52:07	0:00:00	Yes	Yes	Canyon + corals
7/11/19	19	Norfolk Seep	36°, 51.903' N	74°, 29.144' W	1623.0 m	7:57:10	5:58:32	0:00:00	No	Yes	Seep

8.1 Specimen Collections

A total of 166 samples were collected during the expedition, including 12 geological samples, 56 primary biological samples, and 98 associated samples. See Table 5 for geological sample details.

Table 5. *Inventory of geological samples collected during EX1903L2.*

Sample #	Sample ID	Preservation	Site	Date (YYYYMMDD)	UTC Time (HHMMSS)	Lat.	Long.	Depth (m)	Weight (Kg)
EX1903L2_D03_03G	Rock	washed and dried	Stetson Mesa South Scarp	20190623	185707	29.75	-79.5751	775.091	5.050
EX1903L2_D06_02G	Ferromanganese oxide encrusted rock (potentially)	washed and dried	Stetson Mesa Seep	20190627	153021	30.4362	-79.5818	821.844	0.150
EX1903L2_D07_01G	Rock	washed and dried	Shark Rock, Savannah Banks	20190628	180820	31.5948	-79.1036	455.077	0.100
EX1903L2_D07_02B_A01	Ferromanganese oxide encrusted rock	washed and dried	Shark Rock, Savannah Banks	20190628	181349	31.5948	-79.1036	454.94	0.830
EX1903L2_D07_04B_A01	Ferromanganese oxide encrusted rock	washed and dried	Shark Rock, Savannah Banks	20190628	185908	31.5947	-79.1039	456.571	0.050
EX1903L2_D08_01G	rock sample	washed and dried	Central Plateau Scarp	20190629	134951	30.9211	-78.084	1006.515	6.000

EX1903L2_D09_01G	Rock	washed and dried	Blake Escarpment Mid	20190630	142314	31.5265	-77.1616	1418.769	0.250
EX1903L2_D14_03G	Carbonate (authigenic)	washed and dried	Bodie Island Seep	20190706	164055	35.7335	-74.8152	401.66	3.010
EX1903L2_D15_03G	Rock	washed and dried	Currituck Base	20190707	191538	36.3555	-74.6257	1500.659	1.740
EX1903L2_D18_03G	Rock	washed and dried	Baltimore Canyon	20190710	195200	38.12378	-73.8476	507.112	1.850
EX1903L2_D19_01G	Authigenic carbonate	Rinsed and Dried	Norfolk Deep Seep	20190711	173004	36.8663	-74.4838	1579.814	3.080
EX1903L2_D19_02B_A03	Sediment	Rinsed and Dried	Norfolk Deep Seep	20190711	191904	36.8685	-74.4836	1523.331	Not weighed

There were 56 biological samples that were collected, as well as 98 samples that were incidentally collected as associated organisms. In total, these samples amounted to over 166 individuals. See Table 6 for biological sample details.

Table 6. *Inventory of biological samples collected during EX1903L2.*

Sample #	Sample ID	Preservative	Site	Date (YYYYMMDD)	UTC Time (HHMMSS)	Lat	Long	Depth (m)	Salinity (ppt)	Temp (C)	Oxygen (mg/L)
EX1903L2_D01_01B	Lophelia pertusa	EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174
EX1903L2_D01_01B_A01	Porifera	EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174
EX1903L2_D01_01B_A02	Hydrozoa	EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174
EX1903L2_D01_01B_A03	Crinoidea	70% EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174
EX1903L2_D01_01B_A04	Ophiuroidea	EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174
EX1903L2_D01_01B_A05	Polychaeta	EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174
EX1903L2_D01_01B_A06	Cirripedia	EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174
EX1903L2_D01_01B_A07	Actiniaria	EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174
EX1903L2_D01_01B_A08	Primnoidae	EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174
EX1903L2_D01_01B_A09	Nephtheidae	EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174
EX1903L2_D01_01B_A10	Porifera	EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174
EX1903L2_D01_01B_A11	Anthomastus	EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174

EX1903L2_D01_01B_A12	Clavularia	EtOH	Canaveral Deep	20190621	172847	28.2473	-79.5983	734.403	34.916	7.108	4.174
EX1903L2_D01_02B	Nephtheidae	EtOH	Canaveral Deep	20190621	183226	28.2467	-79.5977	726.699	34.917	7.119	4.163
EX1903L2_D01_02B_A01	Hexactinellida	EtOH	Canaveral Deep	20190621	183226	28.2467	-79.5977	726.699	34.917	7.119	4.163
EX1903L2_D01_02B_A02	Amphipoda	EtOH	Canaveral Deep	20190621	183226	28.2467	-79.5977	726.699	34.917	7.119	4.163
EX1903L2_D01_02B_A03	Lophelia skeleton	washed and dried	Canaveral Deep	20190621	183226	28.2467	-79.5977	726.699	34.917	7.119	4.163
EX1903L2_D01_02B_A04	Hydroidolina	EtOH	Canaveral Deep	20190621	183226	28.2467	-79.5977	726.699	34.917	7.119	4.163
EX1903L2_D01_02B_A05	Actiniaria	EtOH	Canaveral Deep	20190621	183226	28.2467	-79.5977	726.699	34.917	7.119	4.163
EX1903L2_D01_02B_A06	Porifera	EtOH	Canaveral Deep	20190621	183226	28.2467	-79.5977	726.699	34.917	7.119	4.163
EX1903L2_D01_03B	Isididae	EtOH	Canaveral Deep	20190621	192848	28.2468	-79.5967	726.894	34.917	7.131	4.162
EX1903L2_D01_03B_A01	Actiniaria	EtOH	Canaveral Deep	20190621	192848	28.2468	-79.5967	726.894	34.917	7.131	4.162
EX1903L2_D01_03B_A02	Hydroidolina	EtOH	Canaveral Deep	20190621	192848	28.2468	-79.5967	726.894	34.917	7.131	4.162
EX1903L2_D01_04B	Chirostyloidea	EtOH	Canaveral Deep	20190621	194927	28.2468	-79.5967	722.493	34.917	7.139	4.311
EX1903L2_D01_04B_A01	Isididae	EtOH	Canaveral Deep	20190621	194927	28.2468	-79.5967	722.493	34.917	7.139	4.311
EX1903L2_D02_01B	Crinoidea	70% EtOH	Stetson Mesa South Mounds	20190622	161741	29.112	-79.4456	748.962	35.144	8.267	4.881
EX1903L2_D02_02B	Plexauridae	EtOH	Stetson Mesa South Mounds	20190622	182609	29.1099	-79.4467	740.186	35.146	8.286	4.864
EX1903L2_D02_02B_A01	Ophiuroidea	EtOH	Stetson Mesa South Mounds	20190622	182609	29.1099	-79.4467	740.186	35.146	8.286	4.864
EX1903L2_D02_02B_A02	Cirripedia	EtOH	Stetson Mesa South Mounds	20190622	182609	29.1099	-79.4467	740.186	35.146	8.286	4.864
EX1903L2_D02_02B_A03	Lophelia pertusa il)	washed and dried	Stetson Mesa South Mounds	20190622	182609	29.1099	-79.4467	740.186	35.146	8.286	4.864
EX1903L2_D02_02B_A04	Madrepora oculata il)	washed and dried	Stetson Mesa South Mounds	20190622	182609	29.1099	-79.4467	740.186	35.146	8.286	4.864
EX1903L2_D02_03B	Haliscera sp	5% Formalin	Stetson Mesa South Mounds	20190622	195649	29.1105	-79.4475	699.172	35.243	9.944	4.173
EX1903L2_D02_04B	Arctapodema sp	5% Formalin	Stetson Mesa South Mounds	20190622	204943	29.1164	-79.4475	500.745	35.919	14.554	4.674
EX1903L2_D02_05B	Bathocyroe	5% Formalin	Stetson Mesa South Mounds	20190622	205509	29.1171	-79.4473	503.035	35.948	14.725	4.696
EX1903L2_D03_01B	Arcturidae	EtOH	Stetson Mesa South Scarp	20190623	162956	29.7526	-79.5726	867.636	35.03	7.429	4.83
EX1903L2_D03_01B_A01	Plexauridae	EtOH	Stetson Mesa South Scarp	20190623	162956	29.7526	-79.5726	867.636	35.03	7.429	4.83
EX1903L2_D03_01B_A02	Primnoidae	EtOH	Stetson Mesa South Scarp	20190623	162956	29.7526	-79.5726	867.636	35.03	7.429	4.83
EX1903L2_D03_01B_A03	Hydrozoa	EtOH	Stetson Mesa South Scarp	20190623	162956	29.7526	-79.5726	867.636	35.03	7.429	4.83
EX1903L2_D03_01B_A04	Ophiuroidea	EtOH	Stetson Mesa South Scarp	20190623	162956	29.7526	-79.5726	867.636	35.03	7.429	4.83

EX1903L2_D03_01B_A05	Plexauridae	EtOH	Stetson Mesa South Scarp	20190623	162956	29.7526	-79.5726	867.636	35.03	7.429	4.83
EX1903L2_D03_02B	Isididae	EtOH	Stetson Mesa South Scarp	20190623	182007	29.7506	-79.5746	797.572	35.014	7.301	4.799
EX1903L2_D03_03G_A01	Plexauridae	EtOH	Stetson Mesa South Scarp	20190623	185707	29.75	-79.5751	775.091	35.011	7.265	4.807
EX1903L2_D03_03G_A02	Enallopsammia skeleton (fossil)	washed and dried	Stetson Mesa South Scarp	20190623	185707	29.75	-79.5751	775.091	35.011	7.265	4.807
EX1903L2_D03_03G_A03	Caryophylliidae	washed and dried	Stetson Mesa South Scarp	20190623	185707	29.75	-79.5751	775.091	35.011	7.265	4.807
EX1903L2_D03_04B	Porifera	EtOH	Stetson Mesa South Scarp	20190623	195526	29.7493	-79.5745	774.281	35.011	7.291	4.776
EX1903L2_D03_04B_A01	Ophiuroidea	EtOH	Stetson Mesa South Scarp	20190623	195526	29.7493	-79.5745	774.281	35.011	7.291	4.776
EX1903L2_D03_04B_A02	Enallopsammia eton (fossil)	washed and dried	Stetson Mesa South Scarp	20190623	195526	29.7493	-79.5745	774.281	35.011	7.291	4.776
EX1903L2_D04_01B	Hexactinellid sponge s)	EtOH	Blake Plateau Knolls	20190624	153419	29.6494	-78.4518	763.415	35.285	10.17	4.231
EX1903L2_D04_02B	Periphylla	Formalin	Blake Plateau Knolls	20190624	155532	29.6495	-78.4521	765.515	35.296	10.281	4.192
EX1903L2_D04_02B_A01	Amphipoda	EtOH	Blake Plateau Knolls	20190624	155532	29.6495	-78.4521	765.515	35.296	10.281	4.192
EX1903L2_D04_02B_A02	Decapoda	EtOH	Blake Plateau Knolls	20190624	155532	29.6495	-78.4521	765.515	35.296	10.281	4.192
EX1903L2_D04_03B	Crinoidea stalked	70% EtOH	Blake Plateau Knolls	20190624	181102	29.6492	-78.4553	769.124	35.361	10.767	4.245
EX1903L2_D04_04B	Plexauridae	EtOH	Blake Plateau Knolls	20190624	181516	29.6492	-78.4553	769.027	35.376	10.928	4.269
EX1903L2_D04_05B	Siphonophorae	Formalin	Blake Plateau Knolls	20190624	193431	29.6495	-78.4551	764.89	35.377	10.858	4.272
EX1903L2_D05_01B	Chrysogorgia	EtOH	Central Plateau Mounds	20190625	173301	30.5379	-78.2185	808.179	35.276	9.944	4.395
EX1903L2_D05_01B_A01	Uroptychus	EtOH	Central Plateau Mounds	20190625	173301	30.5379	-78.2185	808.179	35.276	9.944	4.395
EX1903L2_D06_01B	Cranchiidae	10% Formalin	Stetson Mesa Seep	20190627	142550	30.4368	-79.5802	836.999	35.046	7.466	5.171
EX1903L2_D06_02G_A01	Ophiuroidea	EtOH	Stetson Mesa Seep	20190627	153021	30.4362	-79.5818	821.844	35.044	7.449	4.959
EX1903L2_D06_02G_A02	Scleractinia skeleton	washed and dried	Stetson Mesa Seep	20190627	153021	30.4362	-79.5818	821.844	35.044	7.449	4.959
EX1903L2_D06_03B	Vazella sponge	EtOH	Stetson Mesa Seep	20190627	172105	30.435	-79.5837	771.649	35.044	7.445	4.933
EX1903L2_D06_03B_A01	Ophiuroidea	EtOH	Stetson Mesa Seep	20190627	172105	30.435	-79.5837	771.649	35.044	7.445	4.933
EX1903L2_D06_03B_A02	Crinoidea	70% EtOH	Stetson Mesa Seep	20190627	172105	30.435	-79.5837	771.649	35.044	7.445	4.933
EX1903L2_D06_03B_A03	Stylasteridae il)	washed and dried	Stetson Mesa Seep	20190627	172105	30.435	-79.5837	771.649	35.044	7.445	4.933
EX1903L2_D06_03B_A04	Plexauridae	EtOH	Stetson Mesa Seep	20190627	172105	30.435	-79.5837	771.649	35.044	7.445	4.933
EX1903L2_D06_04B	Caryophylliidae	EtOH	Stetson Mesa Seep	20190627	175318	30.435	-79.5843	767.929	35.045	7.447	4.93

EX1903L2_D06_04B_A01	Microfossils	washed and dried	Stetson Mesa Seep	20190627	175318	30.435	-79.5843	767.929	35.045	7.447	4.93
EX1903L2_D06_05B	Ophioroidea	EtOH	Stetson Mesa Seep	20190627	200157	30.4345	-79.5857	751.316	35.038	7.501	4.823
EX1903L2_D06_05B_A01	Scleractinia skeleton	washed and dried	Stetson Mesa Seep	20190627	200157	30.4345	-79.5857	751.316	35.038	7.501	4.823
EX1903L2_D06_06B	Hydrozoa	5% Formalin	Stetson Mesa Seep	20190627	203714	30.4342	-79.5857	696.902	35.012	8.117	4.09
EX1903L2_D07_01G_A01	Plexauridae	EtOH	Shark Rock, Savannah Banks	20190628	180820	31.5948	-79.1036	455.077	35.298	10.491	4.073
EX1903L2_D07_02B	Raspaillidae	EtOH	Shark Rock, Savannah Banks	20190628	181349	31.5948	-79.1036	454.94	35.296	10.477	3.921
EX1903L2_D07_02B_A02	Caryophylliidae	EtOH	Shark Rock, Savannah Banks	20190628	181349	31.5948	-79.1036	454.94	35.296	10.477	3.921
EX1903L2_D07_02B_A03	Caryophylliidae skeleton (fossil)	washed and dried	Shark Rock, Savannah Banks	20190628	181349	31.5948	-79.1036	454.94	35.296	10.477	3.921
EX1903L2_D07_02B_A04	Hydrozoa	EtOH	Shark Rock, Savannah Banks	20190628	181349	31.5948	-79.1036	454.94	35.296	10.477	3.921
EX1903L2_D07_03B	Stylasteridae	EtOH	Shark Rock, Savannah Banks	20190628	184027	31.5948	-79.1038	456.13	35.27	10.262	3.988
EX1903L2_D07_03B_A01	Chordata	EtOH	Shark Rock, Savannah Banks	20190628	184027	31.5948	-79.1038	456.13	35.27	10.262	3.988
EX1903L2_D07_03B_A02	Hexactinellida	EtOH	Shark Rock, Savannah Banks	20190628	184027	31.5948	-79.1038	456.13	35.27	10.262	3.988
EX1903L2_D07_03B_A03	Plexauridae	EtOH	Shark Rock, Savannah Banks	20190628	184027	31.5948	-79.1038	456.13	35.27	10.262	3.988
EX1903L2_D07_03B_A04	Plexauridae	EtOH	Shark Rock, Savannah Banks	20190628	184027	31.5948	-79.1038	456.13	35.27	10.262	3.988
EX1903L2_D07_04B	Porifera	EtOH	Shark Rock, Savannah Banks	20190628	185908	31.5947	-79.1039	456.571	35.252	10.097	4.065
EX1903L2_D07_04B_A02	Scleractinia skeleton	washed and dried	Shark Rock, Savannah Banks	20190628	185908	31.5947	-79.1039	456.571	35.252	10.097	4.065
EX1903L2_D07_04B_A03	Actiniaria	EtOH	Shark Rock, Savannah Banks	20190628	185908	31.5947	-79.1039	456.571	35.252	10.097	4.065
EX1903L2_D07_04B_A04	Hexactinellida	EtOH	Shark Rock, Savannah Banks	20190628	185908	31.5947	-79.1039	456.571	35.252	10.097	4.065
EX1903L2_D07_04B_A05	Amphipoda	EtOH	Shark Rock, Savannah Banks	20190628	185908	31.5947	-79.1039	456.571	35.252	10.097	4.065
EX1903L2_D08_01G_A01	Bryozoa	EtOH	Central Plateau Scarp	20190629	134951	30.9211	-78.084	1006.515	35.011	5.029	7.768
EX1903L2_D08_02B	Nemertean	EtOH	Central Plateau Scarp	20190629	151621	30.9232	-78.0866	924.426	35.044	5.709	7.097
EX1903L2_D08_03B	Squid	Formalin	Central Plateau Scarp	20190629	190847	30.9259	-78.0894	838.522	35.252	9.709	4.436
EX1903L2_D08_04B	Ctenophora	5% Formalin	Central Plateau Scarp	20190629	194441	30.9251	-78.0873	699.96	35.87	14.168	4.914
EX1903L2_D09_01G_A01	Porifera	EtOH	Blake Escarpment Mid	20190630	142314	31.5265	-77.1616	1418.769	34.967	4.059	8.261
EX1903L2_D09_01G_A02	Porifera	EtOH	Blake Escarpment Mid	20190630	142314	31.5265	-77.1616	1418.769	34.967	4.059	8.261
EX1903L2_D09_01G_A03	Hydrozoa	EtOH	Blake Escarpment Mid	20190630	142314	31.5265	-77.1616	1418.769	34.967	4.059	8.261

EX1903L2_D09_01G _A04	Brachiopoda	EtOH	Blake Escarpment Mid	20190630	142314	31.5265	-77.1616	1418.769	34.967	4.059	8.261
EX1903L2_D09_01G _A05	Bryozoa (potentially)	EtOH	Blake Escarpment Mid	20190630	142314	31.5265	-77.1616	1418.769	34.967	4.059	8.261
EX1903L2_D09_02B	Antipatharia	EtOH	Blake Escarpment Mid	20190630	174403	31.5265	-77.1651	1326.558	34.968	4.084	8.168
EX1903L2_D09_02B _A01	Uroptychus	EtOH	Blake Escarpment Mid	20190630	174403	31.5265	-77.1651	1326.558	34.968	4.084	8.168
EX1903L2_D09_03B	Munida	EtOH	Blake Escarpment Mid	20190630	185842	31.5246	-77.166	1328.914	34.968	4.092	8.008
EX1903L2_D09_03B _A01	Microfossils	washed and dried	Blake Escarpment Mid	20190630	185842	31.5246	-77.166	1328.914	34.968	4.092	8.008
EX1903L2_D09_04B	Hydrozoa	5% Formalin	Blake Escarpment Mid	20190630	201543	31.5252	-77.1675	999.118	34.988	4.461	7.689
EX1903L2_D09_05B	Ctenophore	5% Formalin	Blake Escarpment Mid	20190630	202653	31.5254	-77.1672	990.801	34.989	4.464	7.789
EX1903L2_D09_06B	Hydrozoa	5% Formalin	Blake Escarpment Mid	20190630	210413	31.5259	-77.1671	698.302	35.742	13.385	4.985
EX1903L2_D10_01B	Tomopteridae olychaete)	5% Formalin	Richardson Jellyfish	20190701	152033	32.0936	-77.6668	789.936	35.08	8.115	4.693
EX1903L2_D10_02B	Bryozoa	EtOH	Richardson Jellyfish	20190701	163532	32.0924	-77.6678	756.28	35.083	8.181	4.621
EX1903L2_D10_02B _A01	Ophiuroidea	EtOH	Richardson Jellyfish	20190701	163532	32.0924	-77.6678	756.28	35.083	8.181	4.621
EX1903L2_D10_02B _A02	Microfossils	washed and dried	Richardson Jellyfish	20190701	163532	32.0924	-77.6678	756.28	35.083	8.181	4.621
EX1903L2_D10_02B _A03	Unknown	EtOH	Richardson Jellyfish	20190701	163532	32.0924	-77.6678	756.28	35.083	8.181	4.621
EX1903L2_D10_03B	Isididae	EtOH	Richardson Jellyfish	20190701	174520	32.0915	-77.6686	716.277	35.077	8.317	4.471
EX1903L2_D10_04B	Plexauridae	EtOH	Richardson Jellyfish	20190701	184701	32.0901	-77.6689	638.832	35.107	8.823	4.15
EX1903L2_D10_04B _A01	Amphipoda	EtOH	Richardson Jellyfish	20190701	184701	32.0901	-77.6689	638.832	35.107	8.823	4.15
EX1903L2_D10_05B	Gilbertaster	EtOH	Richardson Jellyfish	20190701	200218	32.0891	-77.6703	592.963	35.15	9.188	4.147
EX1903L2_D10_05B _A01	Primnoidae	EtOH	Richardson Jellyfish	20190701	200218	32.0891	-77.6703	592.963	35.15	9.188	4.147
EX1903L2_D10_05B _A02	Hydrozoa	EtOH	Richardson Jellyfish	20190701	200218	32.0891	-77.6703	592.963	35.15	9.188	4.147
EX1903L2_D13_01B	Gastropoda	EtOH	Roanoke Minor Canyon	20190705	195801	35.9281	-74.7674	860.271	34.997	4.762	7.74
EX1903L2_D14_01B	Osteichthyes	10% Formalin	Bodie Island Seep	20190706	131727	35.7336	-74.8126	445.122	35.064	6.152	6.553
EX1903L2_D14_02B	Bathymodiolus	EtOH	Bodie Island Seep	20190706	143536	35.7337	-74.814	413.196	35.111	7.092	5.604
EX1903L2_D14_02B _A01	Bathymodiolus	EtOH	Bodie Island Seep	20190706	143536	35.7337	-74.814	413.196	35.111	7.092	5.604
EX1903L2_D14_02B	Caprellidae	EtOH	Bodie Island Seep	20190706	143536	35.7337	-74.814	413.196	35.111	7.092	5.604
EX1903L2_D14_02B	Bathymodiolus eton	Washed and dried	Bodie Island Seep	20190706	143536	35.7337	-74.814	413.196	35.111	7.092	5.604

EX1903L2_D14_03G	Porifera	EtOH	Bodie Island Seep	20190706	164055	35.7335	-74.8152	401.66	35.101	7.148	5.455
EX1903L2_D14_04B	Decapoda	70% EtOH	Bodie Island Seep	20190706	193605	35.735	-74.8186	367.647	35.151	8.301	4.803
EX1903L2_D14_05B	Osteichthyes	10% Formalin	Bodie Island Seep	20190706	999999	-	-	-	-	-	-
EX1903L2_D14_06B	Osteichthyes	10% Formalin	Bodie Island Seep	20190706	999999	-	-	-	-	-	-
EX1903L2_D15_01B	Flabellum	EtOH	Currituck Base	20190707	163934	36.3545	-74.6251	1611.782	34.955	3.881	8.256
EX1903L2_D15_02B	Platyctenida	5% Formalin	Currituck Base	20190707	165923	36.3547	-74.6252	1592.048	34.957	3.925	8.255
EX1903L2_D15_02B_A01	Gastropoda	EtOH	Currituck Base	20190707	165923	36.3547	-74.6252	1592.048	34.957	3.925	8.255
EX1903L2_D15_03G_A01	Unknown	EtOH	Currituck Base	20190707	191538	36.3555	-74.6257	1500.659	34.957	4.007	8.218
EX1903L2_D15_03G_A02	Polychaeta	EtOH	Currituck Base	20190707	191538	36.3555	-74.6257	1500.659	34.957	4.007	8.218
EX1903L2_D15_03G_A03	Polychaeta	EtOH	Currituck Base	20190707	191538	36.3555	-74.6257	1500.659	34.957	4.007	8.218
EX1903L2_D16_01B	White Tubes (likely Polycheates)	5% Formalin	Washington Canyon	20190708	181151	37.4098	-74.4084	820.333	34.996	4.77	7.704
EX1903L2_D16_01B_A01	Copepoda	EtOH	Washington Canyon	20190708	181151	37.4098	-74.4084	820.333	34.996	4.77	7.704
EX1903L2_D16_01B_A02	Copepoda	EtOH	Washington Canyon	20190708	181151	37.4098	-74.4084	820.333	34.996	4.77	7.704
EX1903L2_D17_01B	Acanella, Isididae	EtOH	Wilmington Canyon	20190709	193247	38.3217	-73.4269	1397.915	34.952	3.824	8.271
EX1903L2_D17_01B_A01	Potential Egg Mases	EtOH	Wilmington Canyon	20190709	193247	38.3217	-73.4269	1397.915	34.952	3.824	8.271
EX1903L2_D17_01B_A02	Polynoidae	EtOH	Wilmington Canyon	20190709	193247	38.3217	-73.4269	1397.915	34.952	3.824	8.271
EX1903L2_D17_02B	Paramuricea	EtOH	Wilmington Canyon	20190709	194131	38.3217	-73.4269	1397.822	34.953	3.826	8.292
EX1903L2_D17_02B_A01	Plexauridae swiftia	EtOH	Wilmington Canyon	20190709	194131	38.3217	-73.4269	1397.822	34.953	3.826	8.292
EX1903L2_D17_02B_A02	Asteroschema,	EtOH	Wilmington Canyon	20190709	194131	38.3217	-73.4269	1397.822	34.953	3.826	8.292
EX1903L2_D17_02B_A03	Plexauridae	EtOH	Wilmington Canyon	20190709	194131	38.3217	-73.4269	1397.822	34.953	3.826	8.292
EX1903L2_D17_02B_A04	Polynoidae	EtOH	Wilmington Canyon	20190709	194131	38.3217	-73.4269	1397.822	34.953	3.826	8.292
EX1903L2_D17_03B	Osteichthyes	10% Formalin	Wilmington Canyon	20190709	999999	-	-	-	-	-	-
EX1903L2_D18_01B	Pandalidae	70% EtOH	Baltimore Canyon	20190710	191045	38.1205	-73.8494	516.076	35.064	5.907	6.899
EX1903L2_D18_01B_A01	Pandalidae	70% EtOH	Baltimore Canyon	20190710	191045	38.1205	-73.8494	516.076	35.064	5.907	6.899
EX1903L2_D18_01B_A02	Amphipoda	EtOH	Baltimore Canyon	20190710	191045	38.1205	-73.8494	516.076	35.064	5.907	6.899
EX1903L2_D18_02B	Paragorgia	EtOH	Baltimore Canyon	20190710	193304	38.1205	-73.8493	508.249	35.094	6.432	6.62
EX1903L2_D18_02B	Pandalidae	70% EtOH	Baltimore	20190710	193304	38.1205	-73.8493	508.249	35.094	6.432	6.62

_A01			Canyon								
EX1903L2_D18_02B_A02	Pandalidae	70% EtOH	Baltimore Canyon	20190710	193304	38.1205	-73.8493	508.249	35.094	6.432	6.62
EX1903L2_D18_03G_A01	Porifera	EtOH	Baltimore Canyon	20190710	195200	38.12378	-73.8476	507.112	35.094	6.596	6.446
EX1903L2_D18_03G_A02	Hydrozoa	EtOH	Baltimore Canyon	20190710	195200	38.12378	-73.8476	507.112	35.094	6.596	6.446
EX1903L2_D18_03G_A03	Annelida	EtOH	Baltimore Canyon	20190710	195200	38.12378	-73.8476	507.112	35.094	6.596	6.446
EX1903L2_D18_03G_A04	Porifera	EtOH	Baltimore Canyon	20190710	195200	38.12378	-73.8476	507.112	35.094	6.596	6.446
EX1903L2_D18_04B	Pandalidae	70% EtOH	Baltimore Canyon	20190710	999999	-	-	-	-	-	-
EX1903L2_D18_05B	Pandalidae	70% EtOH	Baltimore Canyon	20190710	999999	-	-	-	-	-	-
EX1903L2_D19_02B	Kophobelemnon	70% EtOH	Norfolk Deep Seep	20190711	191904	36.8685	-74.4836	1523.331	34.952	3.847	8.699
EX1903L2_D19_02B_A01	Polychaeta	95% EtOH	Norfolk Deep Seep	20190711	191904	36.8685	-74.4836	1523.331	34.952	3.847	8.699
EX1903L2_D19_02B_A02	Sediment with	95% EtOH	Norfolk Deep Seep	20190711	191904	36.8685	-74.4836	1523.331	34.952	3.847	8.699

8.1.1 Sample Repositories

Details for all repositories that have archived specimens from EX1903L2 can be found below:

- Invertebrate Zoology Collections, National Museum of Natural History, Smithsonian Institution, Museum Support Center, MRC 534, 4210 Silver Hill Road, Suitland, MD 20746
  Contact: Abigail Reft, ReftAJ@si.edu
  Website: https://invertebrates.si.edu/LoanPolicy.html
- Biorepository, National Museum of Natural History, Smithsonian Institution, Museum Support Center, 4210 Silver Hill Road, Suitland, MD 20746
  Contact: Chris Huddleston, huddlestonc@si.edu
  Website: https://naturalhistory.si.edu/research/biorepository
- Ocean Genome Legacy Center, Northeastern University, 430 Nahant Road, Nahant, MA 01908
  Contact: Hannah Appiah-Madson, h.appiah-madson@northeastern.edu
  Website: https://www.northeastern.edu/ogl/
- Marine and Geology Repository, Oregon State University
  Burt 346, Corvallis, OR 97331-5503
  Contact: Kevin Konrad, Konradke@geo.oregonstate.edu
  Website: http://osu-mgr.org/noaa-ex/

8.2 Accessing ROV Data

Data from this expedition is available through OER's Digital Atlas: https://www.ncddc.noaa.gov/website/google_maps/OE/mapsOE.htm. To specifically access data from this expedition, use the "Enter Search Text" feature on the "Search" tab and type in "EX1903L2" in the text box available. Click on the dot that represents the expedition (the map will center around this dot), which will provide options for data access. ROV dive data organized by dive can be found here: https://service.ncddc.noaa.gov/rdn/oer-rov-cruises/ex1903L2

8.3 Seafloor Mapping

Table 7. Mapping Statistics for EX1903L2.

Dates	June 20, 2019 - July 12, 2019
Departure Port	Port Canaveral , FL
Arrival Port	Norfolk VA
Days at Sea	23
EM 302 Linear Kilometers Mapped	4,016.3262
EM 302 Square Kilometers Mapped	14, 314
Number of XBT Casts	141
Number of ROV CTD Casts Applied	17

A summary of mapping operations conducted on EX1903L2 can be found in Table 7. Background data used to guide exploratory mapping operations included mapping data collected during NOAA Ship *Okeanos Explorer* expeditions, notably cruises from the Atlantic Canyons Undersea Mapping Expeditions (ACUMEN) campaign, EX1403, EX1806, EX1805, and EX1903L1 as well as Extended Continental Shelf (ECS) data. Dive planning and mapping operations were conducted using bathymetric grids created using all available bathymetry archived with the NOAA National Centers for Environmental Information (NCEI) using NCEI's Autogrid tool. Sandwell et al (2014) satellite altimetry data was also used to plan operations.

The schedule of operations included overnight transit mapping and mapping operations whenever the ROVs were on deck (Table 3). Survey lines were planned to maximize either edge matching of existing data or filling in gaps between areas where modern bathymetric

coverage existed. In regions with no existing data, exploratory transit or focused survey lines targeted areas to optimize potential discoveries. In areas with existing data, focused mapping operations edge matched existing data and targeted potential seafloor features within the satellite bathymetry.

Mapping operations included Kongsberg EM 302 multibeam, Simrad EK60 and EK80 split-beam, Knudsen sub-bottom profiles, and Teledyne ADCP data collection. Expendable bathythermographs (XBTs) were collected approximately every 2 - 4 hours and applied in real time using Seafloor Information System (SIS) software. Sound speed at the sonar head was determined using sound speed from a flow through thermosalinograph (TSG).

Throughout the cruise, multibeam data quality was monitored in realtime by acquisition watchstanders. Ship speed was adjusted to maintain data quality as necessary. Much of the mapping was conducted along transit lines to ROV dive sites; however, in places where time allowed, focused surveying was completed over areas lacking multibeam data. In these focus areas, line spacing was generally planned to ensure 30% overlap between lines at all times. Cutoff angles in SIS were generally adjusted on both the port and starboard sides to ensure the best balance between data quality and coverage.

The ADCPs were always turned off for general mapping operations due to noticeable interference between the Ocean Surveyor 38kHz ADCP, the Workhorse 300kHz ADCP and the EM 302 multibeam. This interference has been documented during previous cruises.

During normal mapping operations, data were collected with the EM 302, EK60 and EK80, and sub-bottom profiler. During ROV operations, both ADCPs were turned on to provide information on currents in the vicinity of each dive site. Also, during ROV operations, the EK60 and EK80 were turned on to better understand the interaction between the ROVs and biology in the water column.

Figures 2 and 3 show detailed coverage areas in the northern extent of the operating area for EX1903L2. Additional information about the mapping conducted during EX1903L2, including data quality assessments, can be found in the EX1903L2 mapping data report (Hoy et al., 2019).

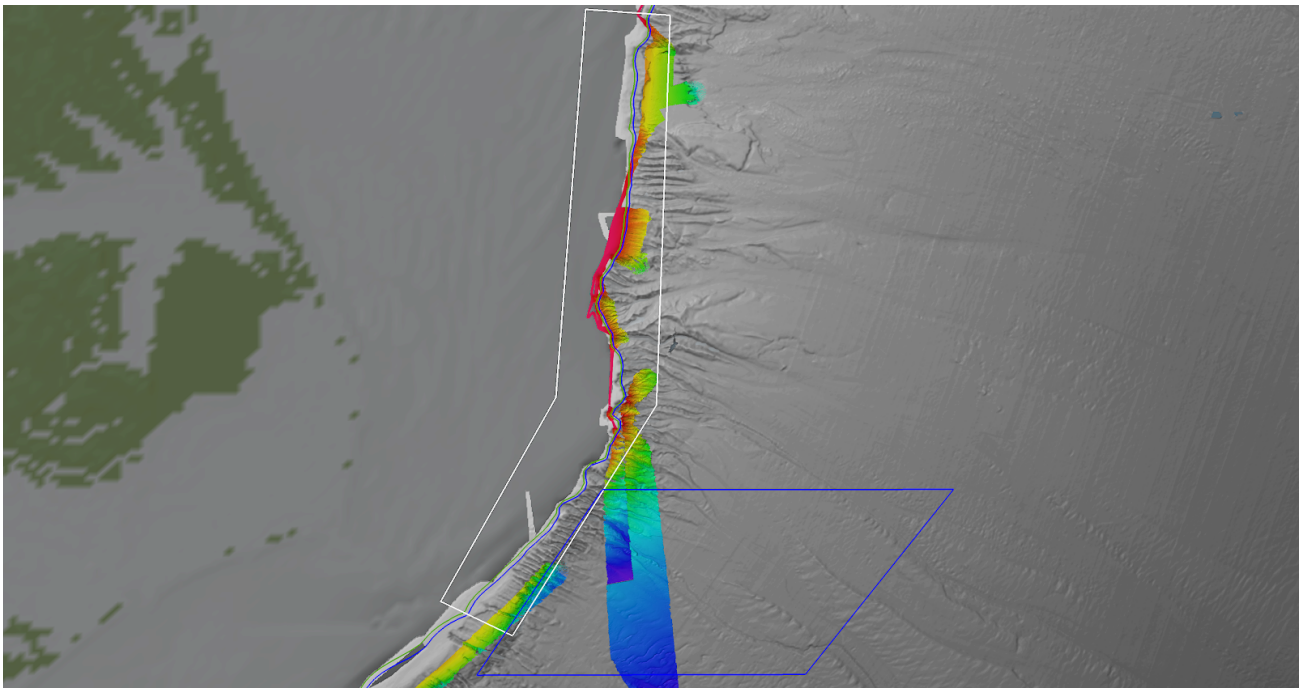

Figure 2: Targeted UCH survey efforts during EX1903L2. Blue and white polygons represent search areas provided by the NOAA Office of National Marine Sanctuaries Maritime Heritage Program. No immediately apparent targets were detected in this region. Figure created in Fledermaus.

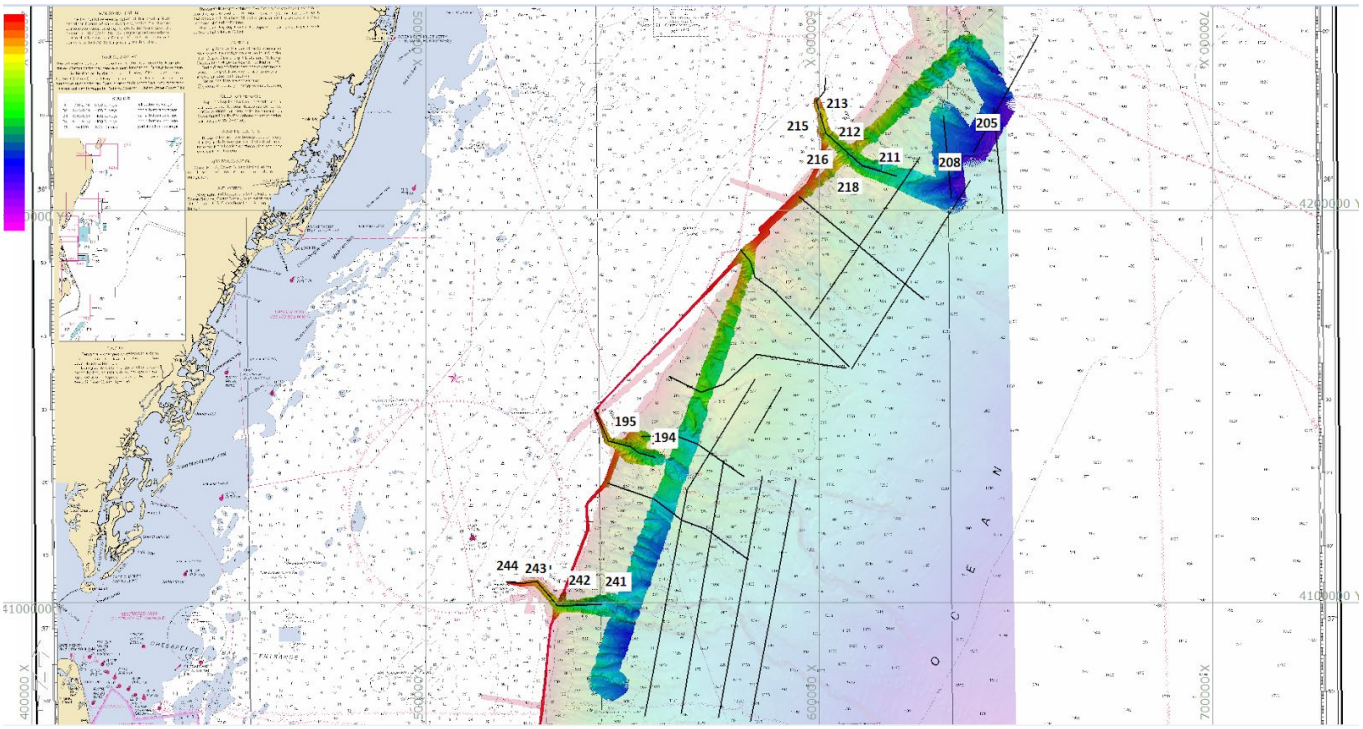

Figure 3: Multibeam bathymetry displayed along with sub-bottom profiling requests from USGS (black lines) over the NOAA Nautical Chart. Areas where multibeam bathymetry shown overlap with the black lines represents areas where sub-bottom profiling surveys were conducted. Image created using HYPACK.

8.3.1 Mapping Data Access

Multibeam Sonar (Kongsberg EM 302)

The multibeam dataset for the expedition is archived at NOAA's NCEI and accessible from the following online map viewer service: https://maps.ngdc.noaa.gov/viewers/bathymetry/. To access data from this expedition use the "Search Bathymetric Surveys" function, selecting "NOAA Ship OKEANOS EXPLORER" as the Platform Name, "NOAA Office of Ocean Exploration and Research" as the Source Institution, and type "EX1903L2" in as the Survey ID. Click "OK" and the ship track for the expedition will appear on the map. If you click on the ship track, options to download data will appear.

Sub-Bottom Profiler (Knudsen Chirp 3260)

The sub-bottom profiler was not run during any ROV dive operations, but generally was operated during multibeam mapping operations. Geophysical data for the area covered by the expedition can be located at NOAA's NCEI's online Geophysical Data Viewer: https://maps.ngdc.noaa.gov/viewers/geophysics/. To access data from this expedition use the "Search Marine Surveys" function, and enter "EX1903L2" in as the Survey ID. Click "OK" and the ship track for the expedition will appear on the map. Click on the ship track for options to download data.

Split-beam Sonars (Simrad EK60 and EK80)

These sonars were used continuously throughout the cruise during both overnight mapping operations and daytime ROV operations. EK60 and EK80 water column data for the expedition can be accessed from the following online data portal: https://www.ngdc.noaa.gov/maps/water_column_sonar/index.html. To access data from this expedition, use the "Additional Filters" tool, and select "EX1903L2" under Survey ID. Click "OK" and the ship track for the expedition will appear on the map. Click on the ship track for options to download data.

Acoustic Doppler Current Profiler (Teledyne Marine Workhorse Mariner ADCP)

ADCP data for the expedition were collected at each ROV dive location, and can be accessed from this data portal: https://www.nodc.noaa.gov/gocd/sadcp_oer_inv.html. The Accession number for this dataset is #0195408. Data can be found by searching for the Accession number or the cruise identification number, "EX1903L2."

Sun Photometers Measurements

Sun photometer measurements were taken on the expedition as time and a clear sky allowed. More information about AERONET can be found here: https://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html.

Other Oceanographic Data

Additional oceanographic data from this expedition can be found here: https://data.nodc.noaa.gov/cgi-bin/iso?id=gov.noaa.nodc:0195408#. These include data acquisition from shipboard sensors such as navigational data, meteorological data (wind), and oceanographic data (bathythermograph, sound velocity probe, thermosalinograph). Additional data include Profile Data (ASVP, CTD, and XBT), raw and processed CTD data, event logs, images, ROV ancillary data, and specimen data.

8.4 Education and Outreach Activities

EX1903L2 engaged with audiences around the world, opening a window of understanding into the deep sea. Highlights are listed below:

- Conducted five live interactions and two ship tours to engage a diversity of audiences.
- Science leads Amy Wagner and Alexis Weinnig participated in an Instagram Takeover for the American Geophysical Union (AGU) during the expedition, providing viewers with a sneak peek into a day in the life of a NOAA Ship *Okeanos Explorer* science lead.
- Over 200 news articles covered the expedition with stories about the expedition appearing in national media as well as local outlets in landlocked areas and on both U.S. coasts such as Fox News, CNN, Time, New York Post, HuffPost, BBC, and many more. Media outlets amplified the impact of the expedition, increasing the audience reached, including one repost of the highlight video “Oh My Grouper, Look at that Shark” that received over four million views.
- Live video feeds received over 419,300 views and web content received 129,398 visits during the expedition.

9. Summary

Conducted 19 ROV dives ranging in depth from 298 to 3,490 meters (978-11,450 feet) to improve knowledge of unexplored areas within the U.S. Exclusive Economic Zone (EEZ) and to inform management needs for sensitive habitats, maritime heritage sites, and potential resources. Data collected can be used to increase understanding of deep-sea ecosystem connectivity across the Atlantic basin.

- Conducted six ROV dives and mapping operations in the Stetson Miami Terrace Deep Coral Habitat Area of Particular Concern (HAPC).

    - Mapped over 4,860 square kilometers (5,405 square miles) in the HAPC, bringing the total OER-supported bathymetry collected since 2011 within the HAPC to 34,037 square kilometers (13,142 square miles).
    - Expanded our knowledge of the "Million Mounds" region of the Stetson Miami Terrace Deep Coral HAPC, an area nicknamed for the numerous mounding features that comprise one of the largest areas of deep-sea coral reef habitat that have been discovered in U.S. waters to date. The two legs of EX1903 gathered additional bathymetry over the "Million Mounds" region of the HAPC, and revealed the first indication of an eastern boundary of this habitat. ROV exploration revealed extensive deep-sea coral and sponge habitat, including five sites with highly diverse communities.
- Conducted the first mapping (during both Leg 1 and Leg 2 of EX1903) and ROV exploration of a portion of the central Blake Plateau where previously unknown mound features were discovered. Two ROV dives documented expansive live coral communities, and confirmed that these features were likely created by the accumulation of *Lophelia pertusa* skeletal matrix over time. Prior to this expedition, this area of the Plateau was thought to be flat, featureless, and composed primarily of soft sediment.
- Conducted four ROV dives in the Frank. R. Lautenberg Deep-Sea Coral Protection Area, offshore Delaware, Maryland, and Virginia.
    - Found deep-sea corals and sponges on every dive in the protected area, including two sites with high diversity in Wilmington Canyon and Baltimore Canyon.
    - Conducted one ROV dive on a seep site, just south of Norfolk Canyon.
- Conducted mapping and ROV exploration to support UCH objectives put forward by the NOAA Sanctuaries Maritime Heritage Program, SEARCH Inc., and the Bureau of Ocean Energy Management (BOEM).
    - Confirmed that a potential target on the Blake Plateau was not the *Bloody Marsh*, an oil tanker lost during WWII.
    - Conducted five nights of focused UCH mapping in the search box for wrecks associated with the Battle of the Atlantic, and an additional survey offshore eastern shore of Maryland and Virginia in search of World War II casualty *Olinda*, a target identified by BOEM.
    - Additional review of mapping data collected during this expedition is ongoing by the marine archaeology community, and may provide additional targets for future expeditions in the region.
- Collected 166 biological and 12 geological specimens. Biological samples were representative of new records, potential new species, dominant fauna, or were collected to support trans-Atlantic connectivity studies. Geological samples will be

used to better understand the geologic history of this region, as well as to characterize habitat substrate.
    - Collected three biological samples to support trans-Atlantic connectivity studies including *Anthomastus sp.*, *Lophelia pertusa,* and *Bathymodiolus childressi.*
    - Deployed a new suction sampler, allowing ROV *Deep Discoverer* to collect mobile fauna for the first time. 30 samples were collected using the new suction sampler, including cephlapods, jellyfish, siphonophores, ctenophores, and difficult to sample associates of deep-sea corals.

Located and characterized deep-sea coral, sponge, and chemosynthetic communities.

- Documented ten dive sites with high biological diversity and observed deep-sea corals and sponges on 18 ROV dives.
- Documented two new seeps sites, one at Bodie Island off North Carolina and another at an unexplored extension of the Norfolk Deep Seep site. At Bodie Island both *Bathymodiolus childressi* and *Bathymodiolus heckerae* mussels were present, creating an extensive mussel habitat, a rarity at this depth (360-415 meters, or about 110-126 feet). Additionally, large authigenic carbonate outcrops were observed, likely indicating that this site has persisted for a long time. At Norfolk Deep unusual fluid seepage from the seafloor was observed. While similar features have been seen in the Gulf of Mexico, this type of emission was not previously known from the U.S. Atlantic margin.
- Observed several potential new species, recorded significant depth and geographic range extensions for several species, and documented the presence of commercially important species - including wreckfish (*Polyprion americanus*), Atlantic Roughy (*Hoplostethus occidentalis*), red crab (*Chaceon quinquedens),* golden crab (*Chaceon fenneri*), and a large aggregation of Alfonsino *(Beryx decadactylus)* - in areas not previously investigated.

Extended bathymetric mapping coverage in the U.S. EEZ and international waters in support of Seabed 2030.

- Mapped 14, 314 square kilometers of seafloor.
- Made new insights in this region, including the discovery (originally mapped on Leg 1 of EX1903) of previously unknown coral mound features in the center of the Blake Plateau. Due to their size, these features cannot be resolved from satellite data and were only revealed in detail using the ship-mounted multibeam sonar.
- Added bathymetric coverage to the Blake Plateau, bringing the total mapping in this area supported by NOAA OER on NOAA Ship *Okeanos Explorer* since 2011, to over

77,400 square kilometers (29,884 square miles), an area larger than the state of Nebraska.

Documented several rarely observed life history events. Highlights included:

- A swordfish fall being devoured by several dogfish sharks, one of which was subsequently eaten whole by a wreckfish in the Stetson Miami Terrace Deep Coral Habitat Area of Particular Concern.
- Numerous observations (~40 individuals) of brooding Warty Octopus (*Graneledone verrucosa*) in the Wilmington Canyon within the Frank. R. Lautenberg Deep-Sea Coral Protection Area.
- First *in situ* observations of mating Jonah crabs at depth in Baltimore Canyon, as well as documentation of several instances of mating *Chaceon* crabs (both red and gold) throughout the expedition's operating area.
- Observation of a *Chaceon* crab eating pallid sculpin (*Cottunculus thomsonii*) eggs.
- Multiple observations of a rare polyphyletic group of starfish feeding on a sponge.

Collected mapping data and conducted ROV dives to support enhanced predictive capabilities for vulnerable marine habitats and submarine geohazards.

- Discovered numerous areas of deep-sea coral and sponge habitat, which has not only improved our understanding of this region, but will also contribute to habitat suitability models. Several areas where dense and diverse coral communities were found were mapped for the first time during this expedition.
- Conducted one ROV dive and detailed bathymetry data over Currituck landslide feature, one of the largest submarine landslides on the U.S. East Coast, to better understand past and potential future submarine geohazards.
- Conducted three nights of focused sub-bottom profiling surveys (Figure 3) within the Mid-Atlantic Canyons to gather information about slope stability to inform geohazard predictive capabilities.

Characterized water column habitats using acoustics, visual observations, and emerging technologies.

- Conducted midwater exploration at depths ranging from 300 to 1,000 meters (~984-3,280 feet) during five ROV dives to investigate the diversity and abundance of largely unknown pelagic fauna.
- Conducted an ROV dive which confirmed two distinct water masses (originally identified during a CTD cast on EX1903L1) marked by a four degree Celsius temperature differential and a high dissolved oxygen concentration on the central Blake Plateau in an area mapped for the first time on EX1903L1.

Engaged over 130 scientists, resource managers, and students in this expedition through telepresence

- Participants were from 27 U.S. states and territories, as well as eight international countries including Russia, Portugal, Japan, Germany, Canada, Ireland, Scotland, and Colombia.

Data collected during this expedition is intended to inform initial characterization of the areas visited and includes multibeam, single beam, subbottom, ADCP, XBT, CTD, and dissolved oxygen profiles; surface oceanographic and meteorological sensors; video and imagery; and physical specimens. All data from this expedition will be publicly available through national archives. Oceanexplorer.noaa.gov will provide a direct link to the expedition data archive once available.

10. References

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Research, NOAA, Silver Spring, MD 20910, 38 p.,
https://repository.library.noaa.gov/view/noaa/22037

11. Appendices

11.1 Appendix A: Dive Summaries

Dive summaries and associated ROV data from EX1903L2 can be found here: https://service.ncddc.noaa.gov/rdn/oer-rov-cruises/ex1903L2

Note these summaries typically take approximately 90 days post expedition conclusion to be publicly available. If you have trouble accessing the dive summaries in the interim, please contact Kasey.Cantwell@noaa.gov.

11.2 Appendix B: EX1903L2 Data Management Plan

Data Management Plan

NOAA Ship *Okeanos Explorer* (EX1903L2): Mid and Southeast U.S. (ROV & Mapping)

OER Data Management Objectives

Provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities.

1.0 General Description of Data to be Managed

1.1 Name and Purpose of the Data Collection Project

NOAA Ship *Okeanos Explorer* (EX1903L2): Mid and Southeast U.S. (ROV & Mapping)

1.2 Summary description of the data to be collected.

Operations will include the use of the ship's deepwater mapping systems (Kongsberg EM302 multibeam sonar, Simrad EK60 and EK80 split-beam fisheries sonars, Knudsen 3260 chirp sub-bottom profiler sonar, and Teledyne Acoustic Doppler Current Profilers), XBTs in support of multibeam sonar mapping operations, CTD casts, the OER's two-body ROV *Deep Discoverer* and *Seirios*, and the ship's high-bandwidth satellite connection for continuous real-time ship-to- shore communications.

1.3 Keywords or phrases that could be used to enable users to find the data.

expedition, exploration, explorer, marine education, noaa, ocean, ocean discovery, ocean education, ocean exploration, ocean exploration and research, ocean literacy, ocean research, OER, science, scientific mission, scientific research, sea, stewardship, systematic exploration, technology, transformational research, undersea, underwater, Davisville, mapping survey, multibeam, multibeam backscatter, multibeam sonar, multi-beam sonar, noaa fleet, okeanos, okeanos explorer, R337, Rhode Island, scientific computing system, SCS, single beam sonar, singlebeam sonar, single-beam sonar, sub-bottom profile, water column backscatter, oceans, ASPIRE, deepwater habitats, Southeastern U.S., marine protected areas, Southeast Deep-sea Coral Initiative, SEDCI, Essential fish habitats, habitat areas of particular concern, EFH, HAPC, National Marine Sanctuaries, deep sea coral communities, deep sea sponge communities, deep sea ecosystems, biogeographic patterns, transatlantic connectivity study

1.4 If this mission is part of a series of missions, what is the series name?

Okeanos ROV Cruises

1.5 Planned or actual temporal coverage of the data.

Dates: 6/20/2019 to 7/12/2019

1.6 Planned or actual geographic coverage of the data.

Latitude Boundaries: 26.41 to 37.61

Longitude Boundaries: -79.85 to -71.34

1.7 What data types will you be creating or capturing and submitting for archive?

Cruise Plan, Cruise Summary, Data Management Plan, Highlight Images, Quick Look Report, ADCP, Bottom Backscatter, CTD (processed), CTD (product), CTD (raw), Dive Summaries, EK60 Singlebeam Data, Expedition Cruise Report, Mapping Summary, Multibeam (image), Multibeam (processed), Multibeam (product), Multibeam (raw), Raw Video (digital), Raw video inventory logs, Sample Logs, SCS Output (compressed), SCS Output (native), Sub-Bottom Profile data, Temperature data, Water Column Backscatter, XBT (raw)

1.8 What platforms will be employed during this mission?

NOAA Ship *Okeanos Explorer*, *Deep Discoverer* ROV, *Seirios* ROV

2.0 Point of Contact for this Data Producing Project

Overall POC: Ms. Kasey Cantwell
Title: Expedition Coordinator
Affiliation/Dept: NOAA Office of Ocean Exploration and Research
E-Mail: kasey.cantwell@noaa.gov
Phone: 301-734-1050

3.0 Point of Contact for Managing the Data

Data POC Name: Megan Cromwell, Christopher Dunn, Joshua Carlson
Title: Stewardship Data Manager, Sample Data Manager, Onboard/Shoreside Data Manager
E-Mail: megan.cromwell@noaa.gov, christopher.dunn@noaa.gov, joshocar@gmail.com

4.0 Resources

4.1 Have resources for management of these data been identified? yes

4.2 Approximate percentage of the budget devoted to data management. (specify % or "unknown")

unknown

5.0 Data Lineage and Quality

5.1 What is the processing workflow from collection to public release?

SCS data shall be delivered in its native format as well as an archive-ready, documented, and compressed NetCDF3 format to NCEI-MD; multibeam data and metadata will be compressed and delivered in a bagit format to NCEI-CO.

5.2 What quality control procedures will be employed?

Quality control procedures for the data from the Kongsberg EM302 is handled at UNH CCOM/JHC. Raw (level-0) bathymetry files are cleaned/edited into new data files (level-1) and converted to a variety of products (level-2). Data from sensors monitored through the SCS are archived in their native format and are not quality controlled. Data from CTD casts and XBT firings are archived in their native format. CTDs are post-processed by the data management team as a quality control measure and customized CTD profiles are generated for display on the Okeanos Atlas.

6.0 Data Documentation

6.1 Does the metadata comply with the Data Documentation Directive?

yes

6.1.1 If metadata are non-existent or non-compliant, please explain:

not applicable

6.2 Where will the metadata be hosted?

An ISO format collection-level metadata record will be generated during pre-cruise planning and published in the NOAA OneStop catalog and an OER Web Accessible Folder (WAF) hosted at NCEI-MS for public discovery and access.

https://www.ncddc.noaa.gov/oer-waf/ISO/Resolved/2019/

ISO 19115-2 Geographic Information with Extensions for Imagery and Gridded Data will be the metadata standard employed.

6.3 Process for producing and maintaining metadata:

Metadata will be generated via xml editors or metadata generation tools.

7.0 Data Access

7.1 Do the data comply with the Data Access Directive?

Yes

7.1.1 If the data will not be available to the public, or with limitations, provide a valid reason.

Not Applicable

7.1.2 If there are limitations, describe how data are protected from unauthorized access.

Account access to mission systems are maintained and controlled by the Program. Data access prior to public accessibility is documented through the use of Data Request forms and standard operating procedures.

7.2 Name and URL of organization or facility providing data access.

NOAA National Centers for Environmental Information (NCEI)
https://www.ncei.noaa.gov

7.3 Approximate delay between data collection and dissemination. By what authority?

Data are considered immediately publicly accessible as soon as possible after the mission, unless there are documented restrictions.

7.4 Prepare a Data Access Statement

No data access constraints, unless data are protected under the National Historic Preservation Act of 1966.

8.0 Data Preservation and Protection

8.1 Actual or planned long-term data archive location:

Data from this mission will be preserved and stewarded through the NOAA National Centers for Environmental Information. Refer to the Okeanos Explorer Data Management Plan at NOAA's EDMC DMP Repository for detailed descriptions of the processes, procedures, and partners involved in this collaborative effort.

8.2 If no archive planned, why?
not applicable

8.3 If any delay between data collection and submission to an archive facility, please explain.

90-120 days

8.4 How will data be protected from accidental or malicious modification or deletion?

Data management standard operating procedures minimizing accidental or malicious modification or deletion are in place aboard the Okeanos Explorer and will be enforced.

8.5 Prepare a Data Use Statement

Data use shall be credited to NOAA Office of Ocean Exploration and Research.

11.3 Appendix C: EX1903L2 NEPA Categorical Exclusion

The Categorical exclusion for EX1903L2 can be found here:
https://drive.google.com/open?id=1IOVOe7HAU3FOZ8rD3aMczTHk9LK9aOjd

If you are unable to access this document, you can request a copy from ex.expeditioncoordinator@noaa.gov.

11.4 Appendix D: Environmental Compliance

A copy of OER's relevant ESA Letter of Concurrence can be found here:
https://drive.google.com/open?id=1tG-ThJHRne5iyq46d_lOF2D-N6tkp-1_

An Essential Fish Habitat letter issued for NOAA OER's *Okeanos Explorer* operations in the Atlantic Basin can be found here:
https://drive.google.com/open?id=1cbKrWXKXtPzXdPLutG8rnDBnpXYGZUsg

If you are unable to access these documents, you can request a copy from ex.expeditioncoordinator@noaa.gov .

11.5 Appendix E: NMFS Letters of Acknowledgement (LOAs) for operations

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
https://www.fisheries.noaa.gov/region/southeast

06/06/2019

F/SER25:FH

Mr. Craig Russell
NOAA Office of Ocean Exploration and Research (OER)
7600 Sand Point Way, NE
Seattle, WA 98115

Dear Mr. Russell:

This letter of acknowledgement (LOA) recognizes the activities outlined in your May 30, 2019, request as scientific research in accordance with the definitions and guidance at 50 CFR 600.10 and 600.745(a). As such, the proposed activities are not subject to fishing regulations at 50 CFR 622 developed in accordance with the Magnuson-Stevens Fishery Conservation and Management Act. This LOA is effective from date of issuance through December 31, 2019.

NOAA Fisheries understands primary operations aboard the NOAA Ship *Okeanos Explorer* will take place throughout federal waters of the South Atlantic and U.S. Caribbean in areas deeper than 250 m. OER anticipates supporting cruises that will be some combination of mapping and remote operating vehicle (ROV) operations. Specifically, these efforts will (1) survey deep-sea coral ecosystems using ROV, including using a suction sampler to take 4-6 biological samples per ROV dive, (2) map deep-water habitats using multi-beam echosounders, and (3) sample the physical and chemical properties of the water column. From June 20 through July 12, 2019, NOAA OER will conduct a seafloor and water column mapping cruise (EX-19-03-L2) to collect data to help improve fundamental understanding in this region. Operations will consist of daytime ROV dives and overnight mapping operations. ROV dive sites are expected to include deep-sea coral and sponge habitats, submarine canyons, potential methane seeps, maritime heritage sites and midwater exploration. Another cruise (EX-19-07) will be conducted from November 1-23, 2019, with similar ROV and mapping operations. The combined dives will enable scientists and managers to have a better understanding of the diversity and distribution of deep-water habitats in this region, and enable informed resource management decisions.

Project participants covered under this LOA include: Kasey Cantwell, Eric Johnson, Elizabeth Lobecker, Rosemary Abbitt, Craig Russell, and Alan Leonardi. Copies of this LOA and the scientific research plan for the project should be onboard the vessel during all sampling activities. This LOA is separate and distinct from any permit or consultation required by the Marine Mammal Protection Act, Endangered Species Act, or any other applicable law.

Please send a copy of any cruise report or other publications resulting from the scientific research activity to me and to the Director, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, Florida 33149-1003.

Sincerely,

STRELCHECK.ANDREW.J.1365863152 Digitally signed by STRELCHECK.ANDREW.J.1365863152 Date: 2019.06.06 08:29:50 -04'00'

for Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure

cc: F/SEFSC, F/EN3

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

Kasey Cantwell
Expedition Coordinator
NOAA Office of Ocean Exploration and Research
331 Fort Johnson Road, Bldg. HML
Charleston, SC 29412

JUL 09 2019

Dear Ms. Cantwell:

We have reviewed your request on behalf of NOAA's Office of Ocean Exploration and Research (OER) for a Letter of Acknowledgment (LOA) for the R/V *Okeanos Explorer* to conduct the exploration and mapping expedition "EX-1903L2." Enclosed is an LOA for the work described in the Scientific Research Plan you submitted.

The participating vessel is not subject to the Atlantic Coastal Fisheries Cooperative Management Act or the Magnuson-Stevens Fishery Conservation and Management Act regulations published at 50 CFR parts 697 or 648 while participating in the scientific research activities described in the Scientific Research Plan, and while under the control of the OER during the study period.

The LOA is separate and distinct from any permit or consultation required under the Marine Mammal Protection Act, the Endangered Species Act, or other applicable law. To determine if such a permit is required, please contact the Greater Atlantic Region's Protected Resources Division at (978) 281-9328. All necessary permits must be obtained prior to embarking on any research activity.

Please submit a copy of any cruise report or other publication created as a result of the project to Ryan Silva, at ryan.silva@noaa.gov.

Please carry copies of the Scientific Research Plan and the LOA on board participating vessels while conducting this research. In addition, it is recommended that any fish or fish parts retained for research should be accompanied by a copy of the LOA.

If you have any additional questions, please contact Laura Hansen at (978) 281-9225 or **Laura.Hansen@noaa.gov. We wish you success in your research.**

Sincerely,

Moira Kelly

Sarah Heil
Assistant Regional Administrator
for Sustainable Fisheries

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

SCIENTIFIC RESEARCH LETTER OF ACKNOWLEDGMENT

Principal Investigators: Kasey Cantwell
Expedition Coordinator
NOAA Office of Ocean Exploration and Research
331 Fort Johnson Road, Bldg. HML
Charleston, SC 29412
(301)-717-7776
Kasey.Cantwell@noaa.gov

Issuance Date: July 09, 2019

Acknowledged Study Period: July 9, 2019, through July 12, 2019

Vessel Owner or Operator	Vessel Name	Hull ID	Federal Permit Number
NOAA	R/V *Okeanos Explorer*	R337	N/A

This letter acknowledges that the above vessel is acting as a scientific research vessel, and is not subject to the Atlantic Coastal Fisheries Cooperative Management Act, the Magnuson-Stevens Fishery Conservation and Management Act, and fishery regulations published in 50 CFR parts 648 and 697. This acknowledgement applies only while the vessel is participating in research activities described in the Scientific Research Plan, within the specified study period, and while under the control of NOAA's Office of Ocean Exploration and Research (OER).

Project Description

The R/V *Okeanos Explorer* will be conducting mapping and survey operations covering waters of the U.S. mid-Atlantic in the Frank R. Lautenberg Deep-Sea Coral Protection Area. Research will consist of multibeam and sonar mapping, CTD (conductivity, temperature, and depth) casts, and remotely operated vehicle (ROV) operations at selected sites throughout the study area, in water depths ranging from 250 m to approximately 5,000 m. Target sites will include seamounts, undersea canyon and slope areas, deep-sea coral and sponge habitats, chemosynthetic communities, and unmapped or poorly mapped areas.

Cruise operations will take place 24 hours a day, with daytime ROV dives and overnight mapping. The CTD casts will record the chemical and physical properties of the water column at sample sites, and the ROV dives will include high-resolution visual surveys of seafloor and water-column habitats, as well as sampling of rocks and biological specimens. The OER will direct all research operations. No fishing gear will be deployed during research cruises.

SCIENTIFIC RESEARCH LETTER OF ACKNOWLEDGMENT

Please carry copies of the Scientific Research Plan and this Letter of Acknowledgment (LOA) on board the vessel(s) while conducting this research. In addition, we recommend that a copy of this LOA be kept with any fish or fish parts retained for research on and off of the vessel.

This letter does not acknowledge any activities conducted outside the scope of the Scientific Research Plan; including those which may not be considered scientific research activities and require a separate permit. This letter is not intended to inhibit or prevent any scientific research activity conducted by the research vessel(s). In addition, state requirements apply to the above vessel(s).

This letter is separate and distinct from any permit or consultation required under the Marine Mammal Protection Act, the Endangered Species Act, or any other applicable law. If research will occur within NOAA's Stellwagen Bank National Marine Sanctuary, additional permits may be required. All necessary permits should be obtained prior to embarking on any research activity.

Acknowledged by:

Sarah Heil
Assistant Regional Administrator
for Sustainable Fisheries

11.6 Appendix E: NASA Maritime Aerosols Network Survey of Opportunity

NASA Maritime Aerosols Network Survey of Opportunity

Survey or Project Name
Maritime Aerosol Network

Lead POC or Principle Investigator (PI & Affiliation)
POC: Dr. Alexander Smirnov

Supporting Team Members Ashore
Alexander Smirnov (NASA)

Supporting Team Members Aboard (if required)
N/A

Activities Description(s)(Include goals, objectives and tasks)
The Maritime Aerosol Network (MAN) component of AERONET provides ship-borne aerosol optical depth measurements from the Microtops II sun photometers. These data provide an alternative to observations from islands as well as establish validation points for satellite and aerosol transport models. Since 2004, these instruments have been deployed periodically on ships of opportunity and research vessels to monitor aerosol properties over the World Oceans.