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Expedition Report: EX-22-05
Voyage to the Ridge 2 (ROV and Mapping)

Mid-Atlantic Ridge, Azores Plateau
Norfolk, Virginia to Horta, Faial, Azores
July 3-30, 2022

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Abstract

From July 9-30, 2022 (Norfolk, VA to Horta, Faial, Azores), NOAA Ocean Exploration completed the Voyage to the Ridge 2 expedition (EX-22-05), a combined mapping and remotely operated vehicle (ROV) expedition to the Mid-Atlantic Ridge and Azores Plateau. Operations during this 22-day expedition included the completion of 10 successful ROV exploration dives in the vicinity of the Azores and the Mid-Atlantic Ridge north of the Azores. ROV dives were conducted in water depths ranging from 420 m to 3,350 m for a total of almost 53 hours of bottom time. EX-22-05 also included the collection of 49,417 square kilometers of seafloor bathymetry and associated water column data using an EM 304 multibeam sonar. All data associated with this expedition have been archived and are publicly available through the NOAA Archives.

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1. Introduction

NOAA Ocean Exploration is dedicated to exploring the unknown ocean, unlocking its potential through scientific discovery, technological advancements, and data delivery. By working closely with partners across public, private, and academic sectors, we are filling gaps in our basic understanding of the marine environment. This allows us, collectively, to protect ocean health, sustainably manage our marine resources, accelerate our national economy, better understand our changing environment, and enhance appreciation of the importance of the ocean in our everyday lives.

With priority placed on exploration of deep waters and the waters of the U.S. Exclusive Economic Zone, NOAA Ocean Exploration applies the latest tools and technologies to explore previously unknown areas of the ocean, making discoveries of scientific, economic, and cultural value. By making collected data publicly available in increasingly innovative and accessible ways, we provide a unique and centralized national resource of critical ocean information. And, through live exploration video, online resources, training and educational opportunities, and public events, we share the excitement of ocean exploration with people around the world and inspire and engage the next generation of ocean scientists, engineers, and leaders.

1.1 Atlantic Seafloor Partnership for Integrated Research and Exploration

Data collected during expeditions on *Okeanos Explorer* from 2018 to 2022 directly contribute to the Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE), a major multiyear, multinational collaborative field program focused on raising collective knowledge and understanding of the North Atlantic Ocean. ASPIRE builds on the momentum of past U.S. campaigns and international initiatives to support ecosystem-based management of marine resources. ASPIRE also provides information relevant to NOAA's emerging Blue Economy priorities, which, in addition to ocean exploration, are seafood production, tourism and recreation, marine transportation, and coastal resilience.

2. Expedition Overview

From July 9 to July 30, 2022, NOAA Ocean Exploration and partners conducted a telepresence-enabled ocean exploration expedition on *Okeanos Explorer* to collect critical baseline information and improve knowledge about unexplored and poorly understood deepwater areas of the Mid-Atlantic Ridge and the Azores Plateau (EX-22-05). EX-22-05 was part of a series of expeditions contributing to ASPIRE. EX-22-05 was designed to provide timely, actionable

information to support decision-making based on reliable and authoritative science. Like other ASPIRE expeditions, it also served as an opportunity for NOAA to highlight the uniqueness and importance of deepwater environments and leverage international partnerships as part of the Galway Statement on Atlantic Ocean Cooperation and the Atlantic Ocean Research Alliance's deep-sea mapping and exploration efforts.

2.1 Rationale for Exploration

Spanning the north-south length of the Atlantic Ocean and stretching an impressive 16,000 km, the Mid-Atlantic Ridge (MAR) is part of the longest mountain range in the world and one of the most prominent geological features on Earth. The majority of it sits underwater and thus much of it remains largely unexplored. With active tectonic spreading, the MAR is the site of frequent earthquakes. Spectacular hydrothermal vents may form where magma provides heat as it rises to the seafloor. These vents are known to support diverse chemosynthetic communities. However, little is known about life at these sites once vents go extinct, or what life lies beyond the vents, further away from the rift zone. The Azores Islands (part of Portugal) are located on the Azores Plateau - representing a shallower region than the rest of the MAR that is dotted with islands of volcanic origin. While extensive research has been done assessing marine communities of the Azores Plateau in shallower waters, very little of the region has been explored in depths exceeding 1,000 m. This expedition sought to close some of these knowledge gaps and increase our understanding of the North Atlantic's geological context and past and future geohazards, the diversity and distribution of coral and sponge communities, and how populations of deep-sea species are related across these regions and throughout the deepwater Atlantic basin.

As part of the planning for this expedition, NOAA Ocean Exploration collaborated with the scientific and management community to assess exploration needs and data gaps in unknown and poorly known areas of the MAR and the Azores Plateau. To define the operating area for this expedition, we considered the 2018 Call for Input, results from the 2018 ASPIRE Workshop (NOAA, n.d.a), and priorities from regional researchers and resource managers.

Data and information from this expedition helped improve our understanding of the deep-ocean habitats of the MAR and Azores Plateau; supported local scientists and managers seeking to understand and manage deep-sea resources; and will stimulate subsequent exploration, research, and management activities.

2.2 Objectives

General objectives pertaining to the entire field season can be found in the "NOAA Ship *Okeanos Explorer* FY22 Field Season Instructions" document (Wang, 2021). The complete mission objectives for the expedition can be found in the document "Project Instructions: EX-22-05, Voyage to the Ridge 2 (ROV and Mapping)" (Sowers, 2022).

Mission objectives for EX-22-05 included a variety of objectives focused on science, mapping, education, outreach, and data management, including to:

- Improve knowledge of unexplored areas along the MAR and Azores Plateau to inform management needs for sensitive habitats, geological features, and potential resources.
- Locate and characterize deep-sea coral, sponge, and hydrothermal communities.
- Ground truth existing bathymetric data, habitat suitability models, seafloor composition models, and inferred hydrothermal vent sites.
- Characterize water column habitats along the MAR using acoustics, visual observations, and emerging technologies.
- Collect data to enhance predictive capabilities for vulnerable marine habitats, seafloor composition, island formation, plate tectonics, hydrothermal vents, critical minerals, and submarine geohazards.
- Investigate biogeographic patterns of deep-sea ecosystems and connectivity across the MAR and Azores Plateau for use in broader comparisons of deepwater habitats throughout the Atlantic Basin.
- Map, survey, and sample geological features, including ocean spreading centers, hydrothermal vents, extinct polymetallic sulfide systems, fracture zones, and rift zones, to better understand the geological context of the region and improve knowledge of past and potential future geohazards.
- Utilize the dual-body ROVs for seafloor habitat exploration to accomplish:
    - close-up imaging operations on potential new, rare, and poorly documented organisms, as well as dominant members of benthic communities;
    - the collection of biological samples of potential new species, new records, dominant community members if not easily recognized, and other animals to aid in site characterization;
    - the collection of geological samples that can be used to age a feature, provide additional insight into the geological context of the region, or improve knowledge of marine minerals and potential future or past geohazards.
- Collect water samples using ROV-mounted Niskin bottles and filter samples in the laboratory to obtain eDNA samples for shoreside processing.

- 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. Participants

EX-22-05 included onboard mission personnel as well as shore-based science personnel who participated remotely via telepresence. See **Table 1** for the onboard personnel who supported EX-22-05. **Appendix A** contains the shore-based personnel.

Table 1. EX-22-05 onboard mission team personnel

Name	Title	Affiliation
Derek Sowers	Expedition Coordinator	NOAA Ocean Exploration
Scott France	Science Lead	University of Louisiana at Lafayette
Ashton Flinders	Science Lead	U.S. Geological Survey
Shannon Hoy	Mapping Lead	NOAA Ocean Exploration
Marcel Peliks	Mapping Watch Lead	University Corporation for Atmospheric Research
Arvind Shantharam	Sample Data Manager	NOAA National Centers for Environmental Information
Kim Galvez	Mapping Watchstander	NOAA Ocean Exploration (FedWriters)
Chris Ritter	GFOE Operations Manager	Global Foundation for Ocean Exploration
Levi Unema	Engineering Team	Global Foundation for Ocean Exploration
Chris Wright	Engineering Team	Global Foundation for Ocean Exploration
Andrew O'Brien	Engineering Team	Global Foundation for Ocean Exploration
Jonathan Allen	Engineering Team	Global Foundation for Ocean Exploration

Name	Title	Affiliation
Lars Murphy	Engineering Team	Global Foundation for Ocean Exploration
Jon Mefford	Engineering Team	Global Foundation for Ocean Exploration
Caitlin Bailey	Videographer	Global Foundation for Ocean Exploration
Anna Sagatov	Videographer	Global Foundation for Ocean Exploration
Roland Brian	Engineering Team	Global Foundation for Ocean Exploration
Brian Doros	Engineering Team	Global Foundation for Ocean Exploration
Jon Simmons	Engineering Team	Global Foundation for Ocean Exploration
Fernando Aragon	Engineering Team	Global Foundation for Ocean Exploration
Sean Kennison	Engineering Team	Global Foundation for Ocean Exploration

4. Methodology

To accomplish its objectives, EX-22-05 used:

- NOAA Ocean Exploration's 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 samples to help further characterize the deepwater fauna and geology of the region.
- Sonar systems (Kongsberg EM 304 multibeam sonar, Knudsen 3260 sub-bottom profiler, Simrad EK60 and EK80 split-beam sonars, and Teledyne acoustic Doppler current profilers) to conduct mapping operations at night and when the ROVs were on deck.
- A high-bandwidth satellite connection to provide real-time ship-to-shore communications (telepresence).

All environmental data collected by NOAA must be covered by a data management plan to ensure they are archived and publicly accessible. The data management plan for EX-22-05 is in the "Project Instructions: EX-22-05, Voyage to the Ridge 2 (ROV and Mapping)" (Sowers, 2022).

4.1 ROV Seafloor Surveys

ROV dive operations supported the expedition objectives in Section 2.2 and included high-resolution visual surveys of seafloor and water column habitats as well as geological and biological sampling. During each dive, the ROVs descended to 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. Dives were primarily conducted during the day (operations are described in detail in Quattrini et al., 2015 and Kennedy et al., 2019). Information about the general process of site selection, collaborative dive planning, scientific equipment on the ROVs, and the approach to benthic exploration used on *Okeanos Explorer* can be found in Kennedy et al., (2019).

Onboard and shore-based scientists identified each organism encountered to the lowest taxon possible based on data available during real-time assessment. Additionally, they provided geological interpretations of the observed substrate throughout each ROV seafloor survey. These geological and biological observations were recorded using Ocean Networks Canada's SeaTube. These data will be quality controlled and quality assured at the University of Louisiana at Lafayette by ASPIRE science advisor Dr. Scott France and his laboratory.

For the water column exploration dive completed on this expedition, a series of transects were performed during vehicle ascent from the seafloor. Transects explored the benthic boundary layer (25-50 m above the seafloor at approximately 1,800 m), 1,200 m, 900 m, 700 m, and the deep scattering layer located at approximately 500 m depth. Approximately 45 minutes was spent exploring each transect depth. Specific transect depths and times are noted in each dive summary (see Section 7.1.1).

4.2 Sampling Operations

A limited number of geological and biological samples were collected on the seafloor using ROV *Deep Discoverer*'s five chamber suction sampler and two manipulator arms in conjunction with geological and biological collection boxes. The primary goal of the sampling operations was to collect voucher samples to be made publicly available for site characterization.

For each sample collected, 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 analysis. Biological 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, and/or rare morphotypes. Samples targeted to contribute to transatlantic connectivity studies were also collected.

After vehicle recovery, samples were examined for associated organisms, labeled, photographed, and entered into a database with all relevant metadata. Any associated organisms found were separated from primary samples and processed separately as "associate" samples.

Geological samples were air dried and placed in rock bags or small containers depending on the size of the sample. These samples will be shipped to the Marine and Geological Repository at Oregon State University after the conclusion of the NOAA Ocean Exploration field season aboard *Okeanos Explorer*. The samples will be photographed, and their data will be entered into the university's online database. Thin and polished sections will be made for each hard-rock sample. Descriptions and photos are included in the database.

Biological samples were subsampled for inclusion in the Smithsonian's National Museum of Natural History 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 (EtOH).

For most of the biological samples, the remainder of the sample was also preserved in 95% ethanol. For select taxa, vouchers or subsamples were preserved in 10%, 5%, or 4% buffered formalin per recommendation from taxonomic experts and guidance provided by the Smithsonian's National Museum of Natural History. Full details of the preservation of each biological sample are in the associated metadata record. All voucher samples and subsamples were shipped to the Smithsonian's National Museum of Natural History for long-term archiving and public access.

During this expedition, five 1.7-liter water samples per dive were collected in ROV Niskin bottles for environmental DNA (eDNA) processing. For benthic dives, water samples were taken at 500 m during descent; at the start, approximate middle, and end of the benthic transect; and one other time at the discretion of the biological leads. For midwater dives, water samples were taken at the start of each transect. Full details of the timing and associated collection data for each water sample are in the metadata record. Water samples were filtered, and filters with DNA fixed on the ship. For each set of samples, a negative control of tap water was processed at the same time. All filters with DNA were shipped to the Smithsonian's National Museum of Natural History for further processing, long-term archiving, and public access.

4.3 Acoustic Operations

Acoustic operations included Kongsberg EM 304 multibeam, Simrad EK60 and EK80 split-beam, Knudsen sub-bottom profiler, and acoustic Doppler current profiler (ADCP) data collection (Candio et al., 2022). The schedule of mapping operations included overnight transits and

whenever the ROVs were on deck. Given the long transit required from Virginia to the MAR, the first 11 days of the expedition were dedicated primarily to transit mapping operations. Lines were planned to maximize edge matching of existing data or filling of data gaps in areas with incomplete bathymetry coverage. In regions with no existing data, exploration transit lines were planned to optimize potential discoveries. Targeted mapping operations were conducted specifically over the Newfoundland Seamounts, Milne Seamount group, Altair Seamount, MAR spreading center axis, and the Kurchatov Fracture Zone.

4.3.1 Multibeam Sonar (Kongsberg EM 304)

Multibeam seafloor mapping data were collected using the Kongsberg EM 304 sonar, which operates at a nominal frequency of 26 kHz. Multibeam mapping operations were conducted during all overnight transits between ROV dive sites. Multibeam data quality was monitored in real time by acquisition watchstanders. Ship speed was adjusted to maintain data quality as necessary.

Whenever possible, transits were designed to maximize coverage over seafloor areas with no previous high-resolution mapping data. In these focus areas, line spacing was generally planned to ensure 30% overlap between lines at all times. Cutoff angles in the Seafloor Information System (SIS) software were generally adjusted on both the port and starboard sides to ensure the best balance between data quality and coverage. 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 sites to collect seafloor mapping data to help refine dive plans. These operations collected data on seafloor depth (bathymetry), seafloor acoustic reflectivity (seafloor backscatter), and water column reflectivity (water column backscatter).

Background data used to guide exploratory multibeam mapping operations included some non-public (restricted) bathymetry data from previous oceanographic expeditions shared by partnering scientists. Some dive planning and mapping operations were conducted using publicly accessible bathymetric grids created using all available bathymetry archived at NOAA's National Centers for Environmental Information (NCEI) and their Autogrid tool, as well as the Global Multi-Resolution Topography (GMRT) synthesis from the Lamont-Doherty Earth Observatory of Columbia University (Ryan et al., 2009). Sandwell et al., 2014 satellite altimetry-derived bathymetry data were also used to plan operations.

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 m 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 to provide supplemental information about the sedimentary features underlying the seafloor.

4.3.3 Split-Beam Sonars (Simrad EK60 and EK80)

Okeanos Explorer is equipped with five split-beam transducers, three Simrad EK60 general purpose transceivers, and two Simrad EK80 wideband transceivers. The frequencies of the EK60 are 18, 38, 120, and 200 kHz. The frequency of the EK80 is 70 kHz. The ship underwent an emergency dry dock repair just prior to the start of EX-22-05, and there was no time to conduct EK sonar calibrations during the expedition. However, all of the EK sonars were calibrated during the following EX-22-06 expedition, and the calibration files from that expedition can be post-applied to EX-22-05 data.

These sonars were used continuously throughout EX-22-05 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 and schools of fish. EK60 and EK80 data were also used during midwater transects of ROV dives to detect the depth of the deep scattering layers, which are aggregations of biological organisms in the water column.

4.3.4 Acoustic Doppler Current Profiler (Teledyne Workhorse Mariner and Teledyne Ocean Surveyor ADCPs)

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. The ADCPs were not used during multibeam mapping due to sonar interference with the EM 304.

4.3.5 Expendable Bathythermograph (XBT) Systems

Expendable bathythermographs (XBTs) were collected every several hours as needed (not to exceed six hours between casts) and applied in real time using SIS. Sound speed at the sonar head was measured with a Reson sound velocity probe and quality checked with sound speed values derived from a flow-through thermosalinograph (TSG) with a water intake located near the multibeam transducers.

4.4 Conductivity, Temperature, and Depth

Conductivity, temperature, and depth (CTD) measurements were collected by two different methods. The most frequent method was with the integrated ROV CTD system. This system

records data from the CTD and associated sensors on every dive. The second method was with a dedicated CTD lowered with a winch to provide better information on the critical properties of the water column. Additional sensors installed on both of the CTDs measured light scattering (LSS), dissolved oxygen (DO), and oxygen reduction potential (ORP).

4.5 Sun Photometer Measurements

NOAA Ocean Exploration gathers limited at-sea measurements aboard *Okeanos Explorer* to support a NASA-led, long-term research effort that assesses marine aerosols. As time allowed on cloud-free days, onboard personnel collected georeferenced sun photometer measurements for the Maritime Aerosol Network (MAN) component of the Aerosol Robotic Network (AERONET). AERONET is a network of sun photometers that measure atmospheric aerosol properties around the world. MAN complements AERONET by conducting sun photometer measurements on ships of opportunity to monitor aerosol properties over the global ocean.

5. Clearances and Permits

Pursuant to the National Environmental Policy Act (NEPA), NOAA Ocean Exploration 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. The companion manual for NOAA Administrative Order 216-6A describes the agency's specific procedures for NEPA compliance.

An environmental review memorandum was completed for all *Okeanos Explorer* expeditions in 2022 in accordance with Section 4 of the companion manual in the form of a categorical exclusion worksheet. Based on this review, a categorical exclusion was determined to be the appropriate level of NEPA analysis necessary, as no extraordinary circumstances existed that required the preparation of an environmental assessment or environmental impact statement. Refer to **Appendix B** for a copy of the categorical exclusion worksheet. NOAA Ocean Exploration is preparing a programmatic environmental assessment to cover future expeditions.

NOAA Ocean Exploration conducted an analysis on the potential impacts to marine mammal species as a result of *Okeanos Explorer*'s oceanographic research and seafloor mapping under the Marine Mammal Protection Act (MMPA). It was determined that, due to the high-frequencies, narrow beamwidths, relatively low source levels of the onboard sonars, and the transient nature of the expeditions, it is unlikely that activities aboard *Okeanos Explorer* would meet the definition of harassment under the MMPA.

As required under Section 7 of the Endangered Species Act (ESA), NOAA Ocean Exploration conducted an informal consultation with NOAA Fisheries' Office of Protected Resources to

request their concurrence with our biological evaluation determining that *Okeanos Explorer* operations conducted as part of ASPIRE may affect, but are not likely to adversely affect, ESA-listed marine species. NOAA Ocean Exploration received a letter dated March 14, 2022, from the NMFS ESA Interagency Cooperation Division that concurs with NOAA Ocean Exploration that the proposed action may affect, but is not likely to adversely affect ESA-listed species and designated and proposed critical habitat in the action area.

In addition, NOAA Ocean Exploration requested an Essential Fish Habitat (EFH) consultation for expeditions on NOAA Ship *Okeanos Explorer* to the Greater Atlantic, Southeast, and Gulf of Mexico Regions for operations during the 2022 field season. The Letter of Acknowledgement was received on February 18, 2022, from the Assistant Regional Administrator for the NOAA Office of Habitat Conservation stating that these expeditions will not adversely impact EFH.

Marine Scientific Research (MSR) clearances for deepwater mapping and ROV operations inside the waters of Canada and Portugal were approved by both countries for this expedition (see **Appendix B** for permit letters). Much of this expedition took place in high seas areas that did not require an MSR permit.

6. Schedule and Map

EX-22-05 included a total of 22 days at sea, from July 9 to July 30, 2022. The ship departed from Norfolk, Virginia, and returned to port in Horta, Faial, Azores. See **Table 2** for a day-by-day breakdown of EX-22-05 operations. There were originally 25 days scheduled for possible ROV dives; however, only 10 ROV dives were completed (see **Tables 5 and 6** for details) due to a required emergency dry dock prior to the start of the expedition. The expedition was originally planned to depart port in St. John's, Newfoundland, on June 16, 2022. While in port in St. John's, it was discovered that the stern thruster seal on the ship was leaking oil and an emergency dry dock was needed to fix this problem. The nearest available dry dock was in Norfolk, Virginia, so the ship transited to this location and underwent an emergency repair from June 29 to July 1, 2022. Following the stern thruster repair, there were additional unscheduled delays due to personnel shortages impacting the NOAA fleet and delays in acquiring food stores. These delays resulted in the expedition being shortened from the originally planned 28 days to 22 days. The increased distance of the starting port to the primary working grounds on the Mid-Atlantic Ridge required that the first eight days of the expedition were spent transit mapping without stopping for ROV dives. The reduced sea days and long transit requirements resulted in limiting this expedition to the possibility of completing 11 ROV dives. The first attempted ROV dive on July 17 was not able to be completed due to rough seas and an electrical issue with the ROVs. The following 10 ROV dive opportunities were successfully

completed. See **Figure 1** for a map of EX-22-05's trackline, ROV dive sites, and bathymetry collected.

As this expedition was completed immediately following a dry dock, a multibeam sonar patch test was conducted on July 10, 2022, near the junction of Hudson Canyon and the continental shelf edge. The need to complete a patch test resulted in additional potential ROV dive time lost, but was necessary to ensure the quality of multibeam data collected during the expedition. Additional information about this patch test can be found in Hoy et al., 2022.

Table 2. EX-22-05 schedule

Date (UTC)	Activity
7/7	Mobilization in Norfolk, Virginia. ROV dunk test completed.
7/8	Mobilization in Norfolk, Virginia.
7/9	Departure from Norfolk at 1000 EST. Following departure, the time zone onboard was changed to UTC -2 for the rest of the expedition. Transit mapping.
7/10	Transit mapping. EM304 multibeam sonar patch test calibration completed.
7/11	Transit mapping.
7/12	Transit mapping.
7/12	Transit mapping.
7/14	Transit mapping.
7/15	Transit mapping.
7/16	Transit mapping. Focused mapping of the Milne Seamount Marine Protected Area.
7/17	Attempted ROV dive on Milne Seamount (unsuccessful due to rough weather and an ROV electrical issue). Transit mapping.
7/18	Transit mapping.
7/19	Transit mapping.
7/20	ROV Dive 01, MARNA Shallow. Overnight transit mapping.
7/21	ROV Dive 02, Moytirra Vent. Overnight transit mapping.
7/22	ROV Dive 03, MARNA Midwater. Overnight transit mapping.

Date (UTC)	Activity
7/23	ROV Dive 04, AVR1. Overnight transit mapping.
7/24	ROV Dive 05, Zenith. Overnight transit mapping.
7/25	ROV Dive 06, Kurchatov Ridge. Overnight transit mapping.
7/26	ROV Dive 07, Kurchatov Deep. Overnight transit mapping.
7/27	ROV Dive 08, Crater Redonda. Overnight transit mapping.
7/28	ROV Dive 09, Cachalote. Overnight transit mapping.
7/29	ROV Dive 10, Kai Ridge. Overnight transit mapping.
7/30	Arrive in port in Horta, Faial, Azores, at 0930.
7/31	Demobilization day. Prepared for ship tours.
8/1	Completed tours of the ship for Portuguese scientists, managers, educators, students, and government officials.
8/2	Mission team departure day.

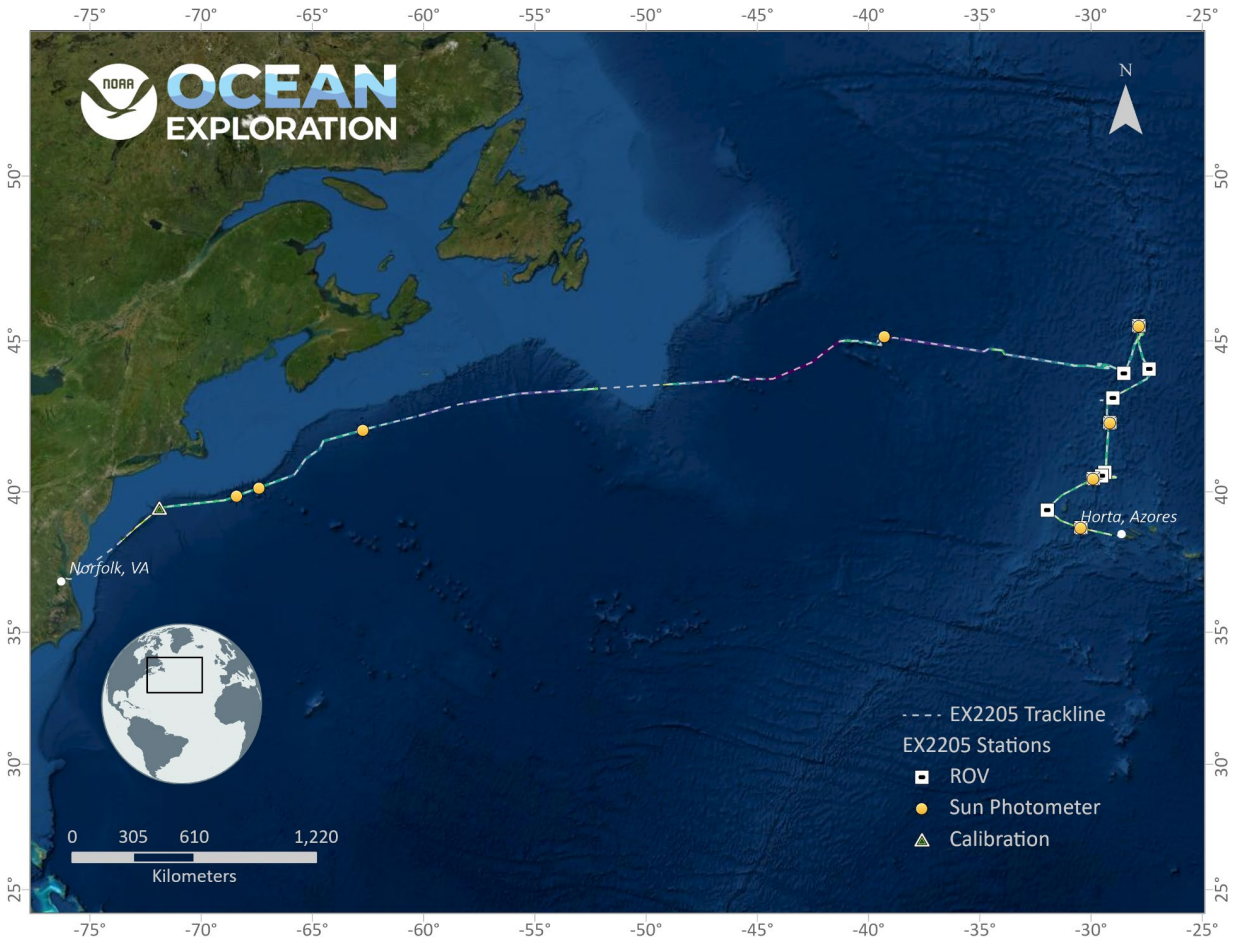

Figure 1. Map showing EX-22-05's trackline (dashed line), 10 completed ROV dive sites (white squares), sun photometer measurement locations (yellow circles), bathymetry data collected, and the location of the EM304 multibeam sonar calibration (triangle).

7. Results

Metrics for EX-22-05's major exploration and scientific work are summarized in **Tables 3 and 4**. More detailed results are presented in the subsections that follow.

Table 3. Summary of exploration metrics for EX-22-05

Exploration Metrics	Totals
Days at sea	22
Days at sea in U.S. waters	3
Linear km mapped by EM 304	5,351

Exploration Metrics	Totals
Square km covered by EM 304	49,417
Square km covered by EM 304 in U.S. waters	5,856
Vessel CTD casts	0
XBT casts	107
ROV dives	10
ROV dives in U.S. waters	0
Maximum ROV seafloor depth (m)	3,350
Minimum ROV seafloor depth (m)	420
Total time on bottom (hh:mm:ss)	52:47:40
Water column survey time (hh:mm:ss)	03:51:41
Total ROV time (hh:mm:ss)	75:58:34

Table 4. Summary of scientific metrics for EX-22-05: The first five metrics are also included as scientific metrics in Table 6

Scientific Metrics	Totals
Potential undescribed or novel species and new records observed*	~20/>24
Dives during which living corals and sponges were observed	10
Dives during which chemosynthetic communities were observed	1
Dives during which active seeps/vents were observed	1
Dives during which diverse benthic communities were observed	5
Total samples	220
Biological samples (primary)	44
Biological associate samples	80
Geological samples	14

Scientific Metrics	Totals
Geological associate samples	32
eDNA water samples	50
Actively participating scientists, students, and resource managers	97

* Organisms unknown to science or an extension of their known range of geolocation or depth.

7.1 ROV Survey Results

Depth ranges explored during the 10 ROV surveys were between 420 and 3,350 m. During the 10 dives, the ROVs spent a total of 52:47 hours on the bottom and 3:51 hours conducting water column exploration. See **Tables 5 and 6** for dive-specific information.

Table 5. Summary information for the 10 ROV dives conducted during EX-22-05

Dive #	Site Name	Date (yyyymmdd)	On Bottom Latitude (dd)	On Bottom Longitude (dd)	Max Depth (m)	Min Seafloor Depth (m)	Dive Duration (hh:mm:ss)	Bottom Time (hh:mm:ss)	Water Column Exploration Time (hh:mm:ss)
1	MARNA Shallow	20220720	43.97240° N	028.62020° W	833.2	419.9	8:14:37	6:46:14	00:00:00
2	Moytirra Vent	20220721	45.47410° N	027.84971° W	3038.5	2938.3	8:53:37	5:11:01	00:00:00
3	MARNA Midwater	20220722	43.89000° N	028.04000° W	1835.2	1826.1	8:06:04	6:28:01	3:51:41
4	AVR1	20220723	43.15826° N	029.02578° W	2711.7	2528.1	8:00:59	4:28:21	00:00:00
5	Zenith	20220724	42.34460° N	029.14150° W	1076.1	985	7:59:45	6:06:25	00:00:00
6	Kurchatov Ridge	20220725	40.66250° N	029.38250° W	1765	1643.8	8:06:40	5:49:19	00:00:00
7	Kurchatov Deep	20220726	40.54750° N	029.51870° W	3349.9	3154.6	9:56:23	6:05:33	00:00:00
8	Redonda	20220727	40.45280° N	029.90937° W	1235.4	1094.5	8:25:56	6:35:27	00:00:00
9	Cachalote	20220728	39.36340° N	031.96960° W	1501.4	1422.5	8:14:24	6:10:09	00:00:00
10	Kai Ridge	20220729	38.75170° N	030.45827° W	1924.5	1660	8:14:46	5:53:24	00:00:00

Table 6. Summary of scientific metrics for the 10 ROV dives conducted during EX-22-05.

Dive #	Site Name	Potential Undescribed Species	Corals & Sponges	Chemo-synthetic Community	Active Seeps & Vents	Diverse Benthic Community	Primary Biological Samples	Associate Biological Samples	Primary Geological Samples	Associate Geological Samples
01	MARNA Shallow	yes	yes	no	no	yes	6	16	0	0

Dive #	Site Name	Potential Undescribed Species	Corals & Sponges	Chemo-synthetic Community	Active Seeps & Vents	Diverse Benthic Community	Primary Biological Samples	Associate Biological Samples	Primary Geological Samples	Associate Geological Samples
02	Moytirra Vent	yes	yes	yes	yes	no	1	0	6	7
03	MARNA Midwater	yes	no	no	no	no	4	0	0	0
04	AVR1	yes	yes	no	no	yes	1	0	1	6
05	Zenith	yes	yes	no	no	yes	10	18	0	0
06	Kurchatov Ridge	yes	yes	no	no	yes	5	18	2	0
07	Kurchatov Deep	yes	yes	no	no	no	3	0	3	7
08	Redonda	yes	yes	no	no	yes	7	5	1	9
09	Cachalote	yes	yes	no	no	no	5	21	1	2
10	Kai Ridge	yes	yes	no	no	no	2	2	0	0

7.1.1 Accessing ROV Data

NOAA Ocean Exploration's Data Atlas

ROV data from EX-22-05 are archived at NCEI and available through the NOAA Ocean Exploration Data Atlas. To access these data, enter "EX2205" in the Text Search field, and click on the magnifying glass. Click the "Show on Map" link in the search return to access data options. In the pop-up window, click on "ROV Data Access By Dive" for links to the ROV dive data, which is organized by dive.

NCEI Archival Dataset

The EX-22-05 NCEI archival dataset is an alternate resource for the ship and ROV data collected during the expedition. This dataset contains data collected from shipboard sensors including navigational data, meteorological data (wind), and oceanographic data (bathythermograph, sound velocity probe, thermosalinograph). Additional data include profile data (ASVP, CTD, and XBT), event logs, images, ROV ancillary data, and sample data.

ROV Dive Summaries

Individual ROV dive summaries and associated ROV dive data are archived at NCEI and available on the EX-22-05 pages of NCEI's *Okeanos Explorer* website.

ROV Dive Video

To search, preview, and download dive video for *Okeanos Explorer*, go to the NOAA Ocean Exploration Video Portal.

SeaTube

NOAA Ocean Exploration works closely with Ocean Networks Canada to implement SeaTube, a web-based annotation interface for ROV operations on expeditions aboard *Okeanos Explorer*. SeaTube is the digital equivalent to a scientist's logbook. It is used by onboard and shore-based scientists to log real-time observations on a variety of topics. To watch a video of a dive and search and export annotations, click on the "Expeditions" tree and select "NOAA," "2022," and "NOAA OER EX2205 Voyage to the Ridge 2." To play an individual dive, hover the mouse over the desired dive and press the play icon (triangle). To search, click the magnifying glass icon in the top right corner of the list pane or hover the mouse over the desired dive and press the magnifying glass icon.

7.2 Sampling Operations Results

A total of 220 samples were collected during EX-22-05: 14 geological samples, 44 biological samples, 112 associate samples (biological specimens attached to primary biological or geological samples), and 50 water samples for eDNA (see **Table 6** for more cumulative results). **Appendix C** contains complete inventories of geological, biological, and eDNA water samples.

The geological samples included fragments of pillow basalts, carbonate concretions, and anhydrites and copper sulfates affiliated with an active vent site. See **Table C1** in **Appendix C** for full details of the geological samples collected.

There were 44 biological samples that were purposely collected (primary samples) as well as 112 samples that were incidentally collected (associate samples). In total, these samples amounted to 126 individuals. While all primary biological samples represent possible undescribed taxa or range extensions, some of the particularly noteworthy collections included:

- Gelatinous zooplankton that present collecting challenges because of their fragility and size. We used the suction sampler on Dive 03 to collect a tiny *Arctapodema* hydromedusa that was <2 mm diameter as well as a large (>21 cm) *Aulacoctena* ctenophore, and on Dive 07, a brightly colored *Benthocodon* hydromedusae.
- An umbrella-shaped tunicate colony (Dive 06).
- The easternmost known collection of a rock pen (*Anthoptilum* sp.) in the Atlantic (Dive 08).
- Several brightly pigmented and difficult to identify plexaurid seafans. For some of these we also preserved the pigment that leached into the ethanol preservative.

- A bryozoan colony with a nudibranch associate (Dive 09).
- Several coral species that had been observed by Azorean scientists in drop camera work but never collected and so are still unidentified.

See **Table C2** in **Appendix C** for full details of the biological samples collected.

Water samples were collected on each dive using Niskin bottles attached to the ROV. Five Niskin bottles were available to collect water for eDNA filtering onboard *Okeanos Explorer* (**Table C3, Appendix C**). One blank sample was taken for each day water samples were collected. The blank sample was collected from a water fountain aboard *Okeanos Explorer* right before filtering commenced.

Sample Repositories

The following repositories archive samples collected during NOAA Ocean Exploration expeditions on *Okeanos Explorer*.

Biological Samples

Invertebrate Zoology Collections
National Museum of Natural History
Smithsonian Institution, Museum Support Center
MRC 534, 4210 Silver Hill Road, Suitland, MD 20746

DNA and eDNA Samples

Biorepository
National Museum of Natural History
Smithsonian Institution, Museum Support Center
4210 Silver Hill Road, Suitland, MD 20746

Geological Samples

Marine and Geology Repository
Oregon State University
Burt 346, Corvallis, OR 97331-5503

7.3 Acoustic Operations Results

During EX-22-05, multibeam mapping operations results included 5,351 linear km mapped and 49,417 km^2 covered (5,856 of these in U.S. waters). Important new ocean mapping data coverage was completed over the Newfoundland Seamounts, Milne Seamount Marine

Protected Area, Altair Seamount, Mid-Atlantic Ridge, Kurchatov Fracture Zone, and key areas adjacent to the Azores Islands. In support of multibeam surveying operations, 107 expendable bathythermograph (XBT) casts profiling the temperature of the water column were completed during the expedition. The general area of multibeam mapping coverage is shown in **Figure 2,** with an inset of the Mid-Atlantic Ridge and the Azores Plateau shown in **Figure 3**.

The EM 304 multibeam sonar was calibrated using a standard patch test calibration procedure on the second day of the expedition before leaving U.S. waters. The results of the calibration are detailed as a supporting document to the 2022 Readiness Report (Candio et al., 2022). Additional information about the mapping conducted during EX-22-05, including data quality assessments, is in the EX-22-05 Mapping Data Report (Hoy et al., 2022). Due to the emergency dry dock following EX-22-04, the June EK calibrations are no longer relevant to the EX-22-05 EK dataset. Calibrations were performed during the following expedition (EX-22-06) on the Azores Plateau and these calibration values are most appropriate for the EX-22-05 dataset. The calibration files are archived with the sonar data and an updated calibration report is available in the NOAA Central Library as a supplemental document to the 2022 Readiness Report.

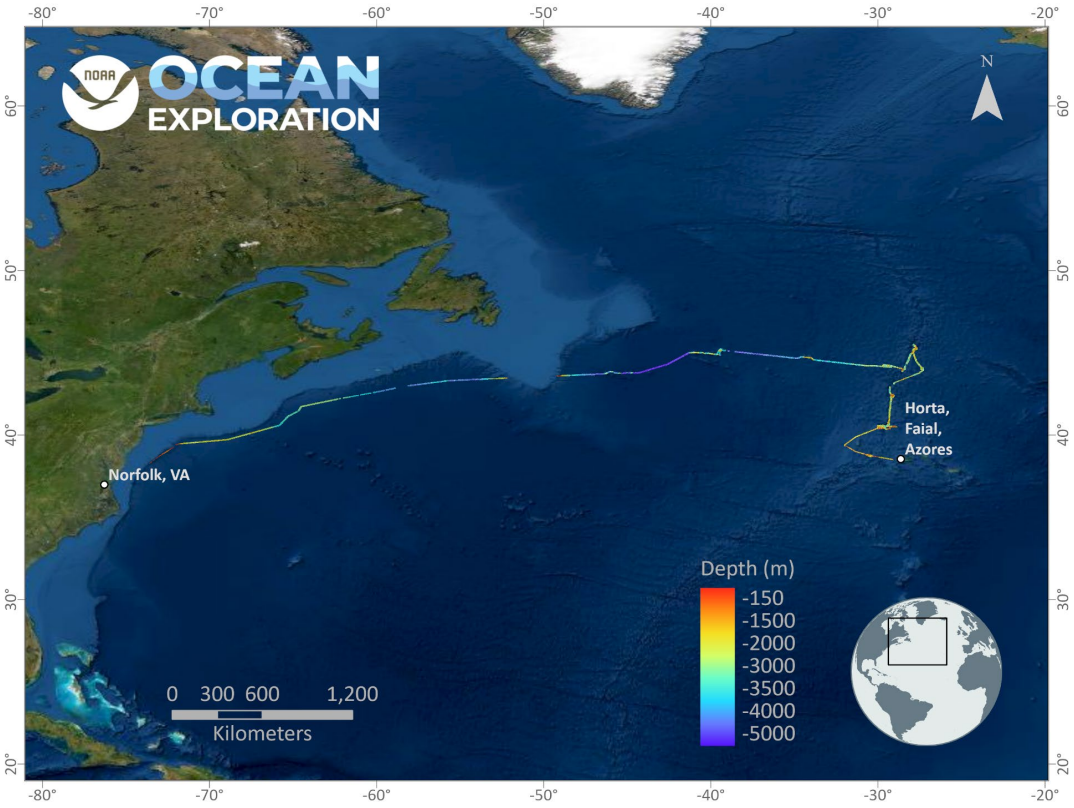

Figure 2. Overview of bathymetric mapping coverage collected during Voyage to the Ridge 2 (EX-22-05). Depths are in meters.

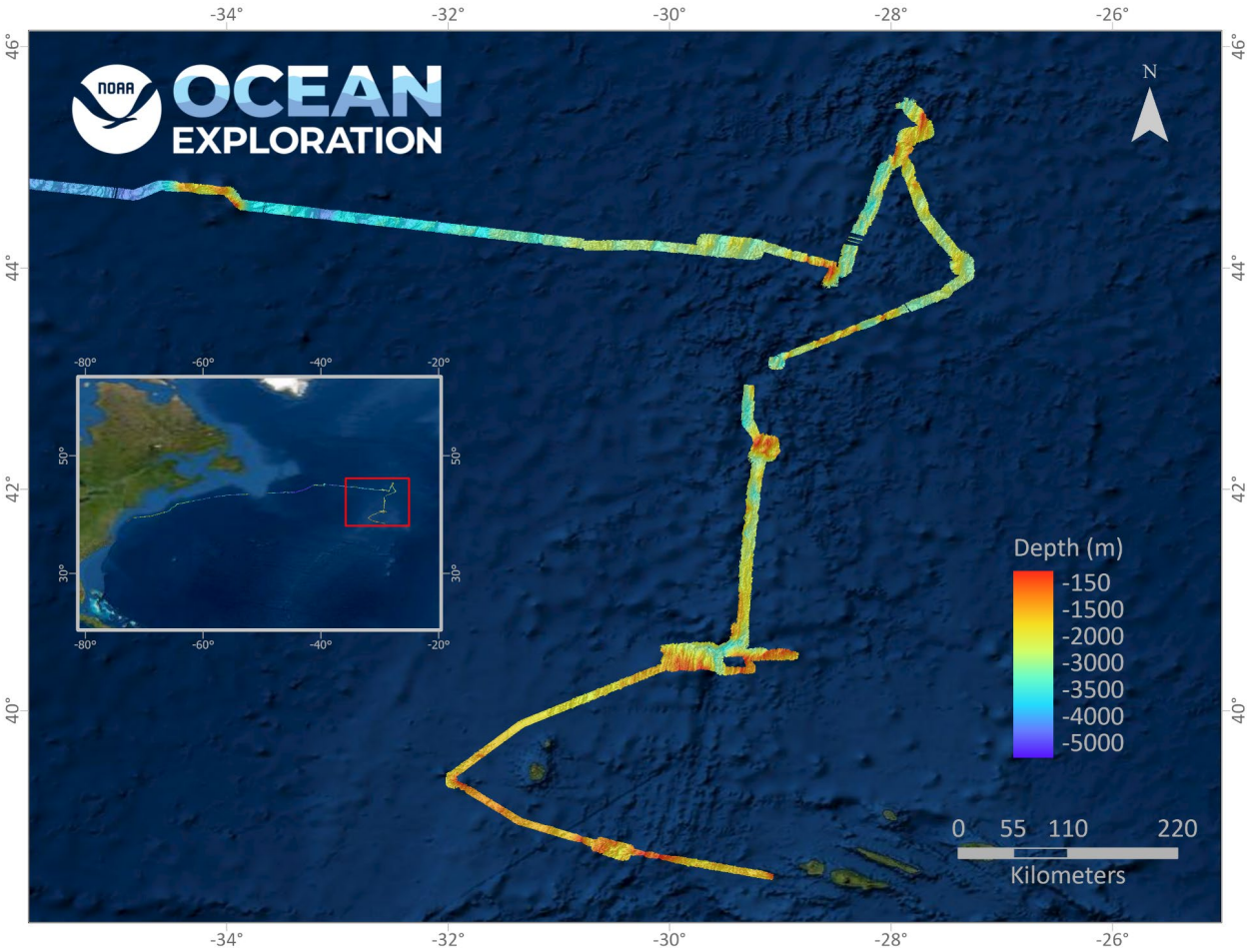

Figure 3. Bathymetric coverage along the Mid-Atlantic Ridge collected during Voyage to the Ridge 2 (EX-22-05).

7.3.1 Acoustic Operations Data Access

Multibeam Sonar (Kongsberg EM 304)

The multibeam dataset for the expedition is archived at NCEI and accessible through their Bathymetric Data Viewer. To access these data, click on the Search Bathymetric Surveys button, select "NOAA Ship Okeanos Explorer" from the Platform Name dropdown menu, and "EX2205" from the Survey ID dropdown menu. Click OK, and the ship track will appear on the map. Click the ship track for options to download data.

Sub-Bottom Profiler (Knudsen Chirp 3260)

The sub-bottom profiler was not run during any of EX-22-05's ROV dive operations, but generally was operated during multibeam mapping operations. These data are archived at NCEI and accessible through the Trackline Geophysical Data Viewer. To access these data, select "Subbottom Profile" under Marine Surveys and click on Search Marine Surveys. In the pop-up

window, select “EX2205” in the Filter by Survey IDs dropdown menu. Click OK, and the ship track will appear on the map. Click the ship track for options to download data.

Split-Beam Sonars (Simrad EK60 and EK80)

EK60 and EK80 water column data for EX-22-05 are archived at NCEI and available through the Water Column Sonar Data Viewer. To access these data, click on the Additional Filters button, deselect “All” next to Survey ID, and select “EX2205” from the Survey ID list. Click OK, and the ship track will appear on the map. Click on the ship track for options to download data.

Acoustic Doppler Current Profilers (Teledyne Marine Workhorse Mariner and Teledyne Ocean Surveyor ADCPs)

ADCP data collected at each ROV dive location are archived at NCEI and available through the Global Ocean Currents Database. Access these data by searching the table for the Expedition identifier “EX2205.”

7.4 Conductivity, Temperature, and Depth Measurements

Expedition summary data, CTD profile data, and data collected by the ROV from EX-22-05 are archived at NCEI and available through the NOAA Ocean Exploration Data Atlas. To access these data, enter “EX2205” in the Expedition Names field and click on the “zoom to results” button. In the pop-up window, select the Data Access tab for links to download the desired dataset.

Data from EX-22-05 can also be found on the EX-22-05 landing page on NCEI’s *Okeanos Explorer* website. To access these data, click on the 2022 Expeditions tab at the top of the page and then click on the link to Voyage to the Ridge 2 – EX2205.

7.5 Sun Photometer Measurements

Sun photometer measurements are available through NASA’s Marine Aerosol Network. Access these data by searching the table for “2022,” “Okeanos Explorer,” and “Atlantic Ocean.” Click on the links to download the data. (Note: There may be more than one entry for *Okeanos Explorer* in a region in a given year.)

7.6 Engagement

EX-22-05 engaged with audiences around the world, opening a window of understanding into the deep sea. Highlights are listed below:

- Live video feeds received approximately 90,800 views, and web content received nearly 36,400 pageviews during EX-22-05.

- Over 130 news/web articles covered EX-22-05. Stories appeared in national and local media outlets and on websites throughout the country, including the New York Times, Newsweek, MSN, Forbes, and CBC Radio Canada. This coverage amplified the impact of the expedition, increasing the audience reached.

8. Summary

The Atlantic Seafloor Partnership for Integrated Research and Exploration, or ASPIRE, is a major multi-year, multi-national collaborative ocean exploration field program focused on raising collective knowledge and understanding of the North Atlantic Ocean. The Voyage to the Ridge 2022 series of expeditions was a key field exploration effort in the larger ASPIRE campaign.

Specific accomplishments from the Voyage to the Ridge 2 expedition include the following:

- Conducted 10 ROV dives ranging in depth from 420 m to 3350 m for a total of almost 53 hours of seafloor exploration time. Data collected can be used to increase understanding of deep-sea ecosystem connectivity across the Atlantic basin.
- Collected 156 biological samples (44 primary and 112 associates), 14 geological samples, and 50 water samples for eDNA.
    - Biological samples generally represented new records, potential new species, or dominant fauna.
    - The geological samples included fragments of pillow basalts, carbonate concretions, as well as anhydrites and copper sulfates affiliated with an active vent site.
    - Water samples were collected for environmental DNA (eDNA) processing using ROV *Deep Discoverer* (five samples per dive). Samples were collected at the deep scattering layer in the water column on the descent and ascent of the vehicles, at the seafloor at the start and end of benthic exploration transects, and at one location of interest to scientists participating in each dive.
- Completed two ROV dives within the OSPAR-designated Mid-Atlantic Ridge North of the Azores Marine Protected Area. The first dive explored the top of a seamount and resulted in the discovery of a massive *Eguchipsammia* coral reef extending from 551 to ≈412 m depth. The second dive was dedicated to exploring the biology of the water column with horizontal transects located at the benthic boundary layer; at depths of 1,200 m, 900 m, and 700 m; and within the deep scattering layer (~500 m).
- Explored the Moytirra active geothermal vent site and adjacent inactive areas to better characterize the biological and geological nature of inactive chemosynthetic vent areas

on the MAR. This is important as areas like this could be vulnerable to impacts from potential deep-sea mining operations in the future.

- Discovered several extinct hydrothermal vents near the summit of an axial volcanic ridge (Dive 04).
- Documented the presence of deep-sea corals and sponges on all 10 ROV dive sites, 5 of which displayed high diversity.
- Revealed some different noteworthy biological observations during each dive, which will contribute to a better understanding of the deep communities of the Mid-Atlantic Ridge.
    - On Dive 01, a magnificent and extensive field of bright yellow live stony coral (*Eguchipsammia*) sprinkled with sponges, black corals, and carrier crabs was observed covering much of the upper slope traversed.
    - On Dive 02, close-ups of the surface of rocks in the inactive zone of the Moytirra vent field revealed considerable abundances of skeleton shrimp (caprellid amphipods).
    - Notable midwater observations (Dive 03) included a hyperiid amphipod feeding on a ctenophore; a "cow-tongue" worm (pelagic nemertean); a "horned" ctenophore and a large (>21 cm) *Aulacoctena* ctenophore (sampled); a squid with apparent mimicry as a siphonophore (*Planctoteuthis*); starburst foraminifera; and a tiny *Arctapodema* hydromedusa, imaged and sampled despite being <2 mm in diameter.
    - Dive 05 was notable for the wide variety and high density of colorful corals and sponges (and their many associates) seen throughout the entire dive track – this was our richest dive in terms of community diversity.
    - Dive 06 had many unfamiliar tunicates and several individuals of a stalked crinoid species whose stalks were covered by a colonial hydroid.
    - On Dive 07, we found approximately one-meter-tall unbranched carnivorous sponges (*Asbestopluma*, Cladorhizdae) and a grenadier (*Ventrifossa*) that was below the known depth range of any other member of the genus.
    - Dive 08 revealed unexpectedly high diversity within a caldera and included as many as 10 different species of black corals and an *Eknomisis* bamboo coral colony with dozens (hundreds?) of small epibenthic ctenophores on it.
    - On Dive 08, an observation of a rock pen (Octocorallia, Pennatulacea) was the easternmost known record, and a stalked crinoid with a [presumed] coprophagous snail laying eggs had been recorded *in situ* only once before to our knowledge, in the Pacific during CAPSTONE.
    - Dive 09 included several observations of fauna that are less frequently encountered, including a rarely observed cutthroat eel (*Atractodenchelys phrix*) and opisthobranch gastropods (a pleurobranch “sea slug” and a nudibranch).
    - Dive 10 revealed the first Ceriantharia tube anemones of the expedition, an unusual observation in that they are typically more common.
- Observed sublinear sets of holes in the sediment on Dive 04 (AVR1) and Dive 09 (Chachalote), as previously reported from the region by Vecchione and Bergstad 2022

and which still have no explained origin.

- Mapped 49,417 km^2 of seafloor, obtaining important new ocean mapping data coverage of the Newfoundland Seamounts, Milne Seamount Marine Protected Area, Altair Seamount, Mid-Atlantic Ridge, Kurchatov Fracture Zone, and key areas adjacent to the Azores Islands.

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Appendix A. EX-22-05 Shore-Based Science Team Members

Table A1. EX-22-05 shore-based science team members

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Appendix B. EX-22-05 Permits and Clearances

Figure B1. Copy of NEPA Categorical Exclusion Worksheet for EX-22-05, six pages

Categorical Exclusion (CE) Evaluation Worksheet

Project Identifier: EX2205

Date Review Completed: 3/25/2022

Completed by: Amanda Maxon, Environmental Compliance Specialist, Contractor, NOAA Office of Exploration and Research

OAR Functional Area: OER

Worksheet File Name: 2022-03-OER-E3-EX2205

Step 1. CE applicability

1. **Is this federal financial assistance, including via grants, cooperative agreements, loans, loan guarantees, interest subsidies, insurance, food commodities, direct appropriations, and transfers of property in place of money?**

   no

2. **What is the proposed federal action?**

   The proposed action is the NOAA Ocean Exploration (Office of Exploration and Research (OER)) to complete a ROV and mapping expedition focused on exploring deep waters (greater than 250 m for ROV operations and greater than 200 m for mapping operations) offshore of Canada, within the high seas, and the Azores. Acoustic Doppler Current Profiler (ADCPs) are run in shallow waters <50 meters when the vessel enters and exits ports to gather data on currents ensuring that the vessel heading alignment angles are correct in a non-destructive manner to support sampling operations. Operations will be conducted 24 hours per day and consist of remotely operated vehicle (ROV) dives, mapping operations (primarily overnight), and full shore-based participation via telepresence. Expedition operations will include using NOAA Ship Okeanos Explorer's deepwater mapping systems (Kongsberg EM 304 multibeam, EK60/EK80 split-beam sonars, Knudsen 3260 Chirp sub-bottom profiler, and Teledyne acoustic Doppler current profilers), expendable bathythermograph (XBTs) in support of multibeam sonar mapping operations, conductivity, temperature, depth profiler (CTD) casts, OER's two-body ROV system (Deep Discoverer and Seirios), and a high-bandwidth satellite connection for continuous ship-to-shore communications. EX-22-05 Voyage to the Ridge 2 ROV and Mapping expedition will commence operations on June 16, 2022 and will conclude in

1

Horta, Faial, Azores on July 13, 2022. The exact start and end dates may vary by a few days or weeks depending on weather and other logistical considerations.

EX-22-05 will focus on ROV and mapping operations conducted at depths between 200 meters and 6,000 meters in depth. Actions taken during operations demonstrate independent utility are not connected to other federal actions.

3. **Which class of CE in Appendix E of the NAO 216-6A Companion Manual is applicable to this action and why?**
    a. E3: Activities to collect aquatic, terrestrial, and atmospheric data in a non-destructive manner.
    b. The scope of this action is consistent with Categorical Exclusion E3 in Appendix E of the Companion Manual to NOAA Administrative Order (NAO) 216-6A: to collect aquatic, terrestrial, and atmospheric data in a non-destructive manner. The expedition will use remote sensing, video, images, and a limited number of physical samples to collect baseline information on unexplored deep-water (>250m) areas off of Canada's east coast near St John's, Canada and within the high seas before reaching the Azores. During EX-22-05 operations, deployment, operation, and retrieval of a limited number of ROVs, buoys, CTDs, and similar instrumentation to conduct non-destructive sampling and collection of data from those instruments including physical, chemical, and biological measurements, and visual data will take place in aquatic environments.

Step 2. Extraordinary Circumstances Consideration

4. **Would the action result in adverse effects on human health or safety that are not negligible?**

The actions of the NOAA Ship Okeanos Explorer operating in remote deep-sea (>200 m) areas located offshore of Canada and in the high seas will focus on ROV and mapping operations completed while transiting to the Azores. All operations are conducted underwater which has no human presence. The vessel will transit through different depths as it transits from the ports of call to the areas of operations in deeper waters. These actions do not involve any procedures or outcomes known to result in impacts on human health or safety. All Best Management Practices and Mitigation Measures will be applied during mapping and the limited number of physical sample collection operations in order to ensure the safety of those onboard and the marine community.

5. **Would the action result in adverse effects on an area with unique environmental characteristics that are not negligible?**

Data collection will primarily focus offshore in deep waters (greater than 200 meters), including areas offshore St. Johns, Newfoundland and Labrador, Canada, the Charlie -Gibbs Fracture zone, and the high seas before reaching port in Horta, Faial, Azores. The effects will be negligible in the proposed action areas with unique environmental characteristics, as acoustic mapping and ROV operations are transient and will not cause any permanent impact on the seabed or water column since OER's operations are well-documented following accepted Best Management Practices and Mitigation Measures.

6. **Would the action result in adverse effects on species or habitats protected by the ESA, MMPA, MSA, NMSA, or MBTA that are not negligible?**

The activities are not likely to have a negative effect on species or habitats protected by the ESA, MMPA, MSA, NMSA, or MBTA as all proposed actions are assessed in order to detmained the impact on species or habitats in the region. According to NOAA Fisheries, two Endangered Species Act-listed species have critical habitat sectors in the action area: loggerhead sea turtles (breeding, sargassum, constricted migratory habitat), and North Atlantic right whale. Okeanos Explorer operations will abide by the Best Management Practices and Mitigation Measures developed in collaboration with the various regulatory and federal agencies that the Okeanos Explorer follows ensures that operations in the these areas would not result in any activities having adverse effects on the species or habitats protected under ESA, MMPA, MSA, NMSA, or MBTA.

7. **Would the action result in the potential to generate, use, store, transport, or dispose of hazardous or toxic substances, in a manner that may have a significant effect on the environment?**

The cruise operations will be in the compliance with FEC 07 Hazardous Materials and Hazardous Waste Management Requirements for Visiting Scientific Parties (or the NOAA OMAO procedure that supersedes it) to ensure generation, use, storage, transport, and disposal of such substances will not result in significant impacts.

8. **Would the action result in adverse effects on properties listed or eligible for listing on the National Register of Historic Places authorized by the National Historic Preservation Act of 1966, National Historic Landmarks designated by the Secretary of the Interior, or National Monuments designated through the Antiquities Act of 1906; Federally recognized Tribal and Native Alaskan lands, cultural or natural**

resources, or religious or cultural sites that cannot be resolved through applicable regulatory processes?

The proposed action will not result in adverse effects that cannot be resolved through applicable regulatory processes since we will not be operating within listed or eligible properties, lands, resources or sites coming under the umbrella of protection referenced above.

9. **Would the action result in a disproportionately high and adverse effect on the health or the environment of minority or low-income communities, compared to the impacts on other communities (EO 12898)?**

The NOAA Ship Okeanos Explorer will be operating in remote and offshore areas near St. Johns, Newfoundland and Labrador, Canada, the High Seas, and near the Charlie -Gibbs Fracture Zone before reaching the Azores during EX-22-05. There are no communities within or near the geographic scope of the expedition and the expedition does not involve actions known or likely to result in adverse impacts on human health of minority or low-income communities during the expedition operations at any point in time.

10. **Would the action contribute to the introduction, continued existence, or spread of noxious weeds or nonnative invasive species known to occur in the area or actions that may promote the introduction, growth, or expansion of the range of the species?**

During EX-22-05, NOAA Ship Okeanos Explorer will not make landfall in areas other than commercial ports in St. Johns, Newfoundland and Labrador, Canada and in Horta, Faial, Azores. The ship and mission team will comply with all applicable local and federal regulations regarding the prevention or spread of invasive species. At the completion of every CTD cast and ROV dive, the equipment will be thoroughly rinsed with fresh water and completely dried to prevent spreading organisms from one site to another. Also the Engineering Department aboard NOAA Ship Okeanos Explorer attends yearly Ballast Management Training in accordance with NOAA Form 57-07-13 NPDES VGP Annual Inspection and Report to prevent the introduction of invasive species.

11. **Would the action result in a potential violation of Federal, State, or local law or requirements imposed for protection of the environment?**

OER has taken measures to ensure that any effects on species or habitats protected by the ESA, MMPA, MSA or NMSA meet the definition of negligible. The proposed actions will not result in any Federal, State, or local law violations or requirements imposed for protection of the environment. OER has received a letter dated March 14, 2022 from the NMFS ESA Interagency Cooperation Division that concurs with OER that the proposed action may affect, but is not likely

to adversely affect ESA-listed species and designated and proposed critical habitat in the action area.The ESA Section 7 Letter of Concurrence will be updated and provided in the FY22 Field Season Instructions.

Given the offshore focus of most of our proposed work, it is not likely that we will encounter marine mammals protected under the MMPA, or sea birds protected under the MBTA often found in territorial and state waters. If we did encounter any such protected animals, our impacts would be negligible because of the best management practices to which we adhere to avoid or minimize environmental impacts. These best management practices are all outlined in the Field Season Instructions. OER requested a Essential Fish Habitat (EFH) consultation for expeditions by NOAA Ship Okeanos Explorer to the Greater Atlantic, Southeast, and Gulf of Mexico Regions for operations during the 2022 field season. The Letter of Acknowledgement was received on February 18, 2022 from the Assistant Regional Administrator for the NOAA Office of Habitat Conservation stating that these expeditions will not adversely impact EFH. This letter will be provided in appendices of the EX FY22 Project Instructions. An additional Letter of Acknowledgement was requested for the Southeast Regional Fisheries Office to determine if there are any effects of operations located in the Southeast region of the Atlantic.

12. Would the action result in highly controversial environmental effects?

No, the exploration activities will be localized and of short duration in any particular area at any given time with no notable or lasting changes to the environment following the best management practices and guidance developed to limit the potential effects. Given the project's scope and breadth, no notable or lasting changes or highly controversial effects to the environment by mapping operations conducted onboard the Okeanos Explorer as determined by the various consultations before planning of any proposed actions is done. Any effects would be small and considered minimal as the vessel transits through the area of interest continuously using acoustic sound sources which have been analyzed to determine the effects that may occur during operations.

13. Does the action have the potential to establish a precedent for future action or an action that represents a decision in principle about future actions with potentially significant environmental effects?

While each cruise contributes to the overarching goal of exploring, mapping, and sampling the ocean, every cruise is independently useful and not connected to subsequent future federal actions with potentially significant environmental effects.

14. Would the action result in environmental effects that are uncertain, unique, or unknown?

The techniques and equipment used are standard for this type of field study, and the effects are well known.

15. Does the action have the potential for significant cumulative impacts when the proposed action is combined with other past, present and reasonably foreseeable future actions, even though the impacts of the proposed action may not be significant by themselves?

By definition, actions that a federal agency classifies as a categorical exclusion have no potential, individually or cumulatively, to significantly affect the environment. This cruise is consistent with a class of CE established by NOAA and there are no extraordinary circumstances for this action that may otherwise result in potentially significant impacts.

CE Determination

☒I have determined that a Categorical Exclusion is the appropriate level of NEPA analysis for this action and that no extraordinary circumstances exist that would require preparation of an environmental assessment or environmental impact statement.

☐I have determined that an environmental assessment or environmental impact statement is required for this action.

Signature: SOSSA.GENENE.FISHER.1403930306 Digitally signed by SOSSA.GENENE.FISHER.1403930306 Date: 2022.04.04 08:23:22 -04'00'

Signed by: Genene Fisher, Deputy Director, OER

Date Signed: 4/4/2022

Figure B2. Copy of Marine Scientific Research permit for EX-22-05 from Canada, two pages

Affaires mondiales Canada | Global Affairs Canada

UNCLASSIFIED
IGR-1232

May 26, 2022

Mr. John Griffith
Deputy Director
Ocean Science Policy and Authorizations
Office of Ocean and Polar Affairs
United States Department of State
2201 C Street NW
Washington, D.C. 20520

Dear Mr. Griffith,

Authorization for U.S. Marine Scientific Research ship OKEANOS EXPLORER (Jun 03 - Jul 14 2022).

I am pleased to advise that the Government of Canada grants its consent to the request for the U.S. Research Ship **OKEANOS EXPLORER** to undertake marine scientific research in areas under Canadian jurisdiction or sovereignty during the above mentioned dates.

As this application indicates there will be no research activity taking place inside Canadian waters (territorial sea or internal waters), there are no reporting requirements to the Canada Border Services Agency (CBSA). Should the vessel's research activity take place inside Canadian waters (territorial sea or internal waters), please be aware of the Canada Border Services Agency (CBSA) marine reporting requirements:

Canada Border Services Agency (CBSA) - marine reporting requirements:

Foreign expeditions arriving in Canada by research vessel and entering Canadian waters (territorial sea or internal waters) are required to report to the nearest Canada Border Services Agency (CBSA) Marine Reporting office prior to arrival.

CBSA Marine Reporting Offices:

(Atlantic) Phone: 902-426-2071 Fax: 902-426-3339 and email: NP12REXC01G@cbsa-asfc.gc.ca

Canada

We are pleased that Canadian participants would be welcome to join the project, and that the scientific results and all the data from this cruise will be freely and generously shared. Additionally, Canada requires copies of all bathymetric data derived from these marine scientific research projects. This includes single and multi-beam data collected in passage to and from the research site as well as the bathymetric data collect at or in the investigation area". The attached document provides the information required and directions. We request copies of the preliminary and final cruise reports.

Yours sincerely,

Kevin Tunney
Deputy Director
Security and Defence Relations Division

Figure B3. Copy of Marine Scientific Research permit for EX-22-05 from the Azores, three pages

U.S. COAST GUARD AUXILIARY
INTERNATIONAL AFFAIRS
INTERPRETER CORPS

1

English Version:

S. R.

MINISTRY OF FOREIGN AFFAIRS
GENERAL DIRECTORATE OF FOREIGN POLICY

Ref.a 67868/2022
Proc.º DGPE/USEN-37/2022

MAY 30, 2022

The Ministry of Foreign Affairs presents its kind regards to the Embassy of the United States of America in Lisbon and, in reference to Nota Verbale (Verbal Note) No. 100 of 03.25.2022, has the honor to inform that entry into the Portuguese EEZ, sub-aerial of the Acores, from the oceanographic vessel "OKEANOS EXPLORER", is authorized, as well as the scientific investigation campaign to be carried out from June 1st to July 14th, 2022, on the assumption that all requirements contained in Annex I will be fulfilled.

Also attached are the internationally recognized certificate of conformity, the authorization for scientific research in a marine protected area, addendum the license for the study, capture and handling of marine wild animals, to be handed over to the head of Mission.

Considering this mission of great scientific interest, the Ministry of Foreign Affairs would like to thank you in advance for sending the report of the campaign in question, as well as a copy of the processed data to update the information and cartography in the areas under national jurisdiction, preferably in electronic form.

The Ministry of Foreign Affairs avails itself of the opportunity to reiterate to the Embassy of the United States of America in Lisbon the assurances of its highest consideration.

To the Embassy of the United States of America in Lisbon.

U.S. Coast Guard Auxiliary
International Affairs
Interpreter Corps

ANNEX 1

1. THE US SHIP “OKEANOS EXPLORER" INTENDS TO CARRY OUT THE OCEANOGRAPHIC SCIENTIFIC INESTIGATION CAMPAIGN F2022-024 THE PORTUGUESE ECONOMIC EXCLUSIVITY ZONE SUBAREA ACORES, IN THE PERIOD OF JUNE 1 TO JULY 14, 2022.
2. IT IS UNDERSTOOD THAT THE AREA OF OPERATIONS INTERFERES WITH THE SUBMARINE TRAFFIC ZONE
3. NO SUBMARINE NAVIGATION IS PLANNED IN THE PERIOD CONSIDERED, HOWEVER, IT IS NECESSARY TO HAVE 72 HOURS ADVANCE KNOWLEDGE OF THE INTENTIONS OF MOVEMENTS AND WORK POSITIONS OF THE SHIP "OKEANOS EXPLORER", IN ORDER TO GUARANTEE THE SAFETY OF NATIONAL AND FOREIGN SUBMARINE NAVIGATION THAT POTENTIALLY OCCURS.
4. FOR THIS EFFECT, THE SHIP MUST KEEP THE AIS ALWAYS IN OPERATION AND MAKE A DAILY COMMUNICATION, DIRECTED TO THE MARITIME OPERATIONS CENTER (COMAR), WITH THE FOLLOWING INFORMATION:

   A. SHIP IDENTIFICATION.

   B. POSITION/COURSE/SPEED REFERRED TO AT 12.00z.

   C. CURRENT ACTIVITY/POSITIONS OF ANCHORED EQUIPMENT.

   D. INTENT IN THE NEXT 24, 48 AND 72 HOURS.

   E.SHIP’S TELEX/INMARSAT FAX AND PHONE NUMBER AND EMAIL.

5. FURTHER, IT IS REQUESTED THAT WHENEVER THERE IS A CHANGE IN THE PLANNING DATA, IT IS COMMUNICATED WITH THE MAXIMUM EARLY POSSIBILITY, DESIRABLY WITH 72 HOURS AND NEVER LESS THAN 24 HOURS.
6. TO PASS THE INFORMATION REFERRED TO ABOVE, THE FOLLOWING MEANS CAN BE USED:

   A. FAX: 351 210 984 451

   B. E-MAIL COMAR.SUPERVISOR@MARINHA.PT; CZMA.EM.CSINF@MARINHA.PT

7. DURING THE SCIENTIFIC RESEARCH WORK, IN PARTICULAR DURING EQUIPMENT HANDLING OPERATIONS, OTHER SUBMERGED MATERIALS AND SIGNALING BUOYS, AS WELL AS IN THE MANEUVERS TO WHICH THE SHIP IS SUBJECT, THE MINIMUM SAFETY DISTANCES NEED TO BE SAFETY FOR SUBSEA CABLES (1/4 MILE) IDENTIFIED ON OFFICIAL NAUTICAL CHARTS, WHETHER TO SHIPS (1 MILE) INVOLVED IN REPAIRS OR CABLE LAUNCHING.
8. IN ORDER TO SEND THE NOTICES TO NAVIGATION IN A TIMELY MANNER, COMAR MUST BE INFORMED OF THE SHIP'S MOVEMENTS AND MANEUVERING LIMITATIONS 24 HOURS IN ADVANCE, THROUGH THE FOLLOWING E-MAIL: COMAR.SEGMAR@MARINHA.PT.

Appendix C. Inventories of Geological, Biological, and eDNA Water Samples

Table C1. Inventory of geological samples collected during EX-22-05

Dive #	Site Name	Sample #*	Sample ID	Preservation	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Weight (kg)
02	Moytirra Vent	EX2205_D02_03G	Copper sulphate with caprellids	Rinsed and Dried	Characteristic of Site	20220721	131544	45.47369766	-27.84922218	3031	4.3
02	Moytirra Vent	EX2205_D02_04G	Unidentified anhydrite	Rinsed and Dried	Characteristic of Site	20220721	135034	45.47351456	-27.84858131	3015	0.3
02	Moytirra Vent	EX2205_D02_05G	Rock	Rinsed and Dried	Characteristic of Site	20220721	140246	45.47320557	-27.84857178	3011	4.4
02	Moytirra Vent	EX2205_D02_06G	Rusticle	95% EtOH	Characteristic of Site	20220721	143504	45.47355652	-27.84832382	3002	n/a
02	Moytirra Vent	EX2205_D02_08G	Basalt talus	Rinsed and Dried	Characteristic of Site	20220721	155925	45.47350693	-27.84792709	2970	1.4
02	Moytirra Vent	EX2205_D02_10G	Basalt iron-oxide coating	Rinsed and Dried	Characteristic of Site	20220721	172636	45.47331619	-27.84844017	2922	3
04	AVR1	EX2205_D04_05G	Basalt	Rinsed and Dried	Characteristic of Site	20220723	162425	43.15552902	-29.02463531	2550	3.5
06	Kurchatov Ridge	EX2205_D06_04G	Pillow fragment	Rinsed and Dried	Characteristic of Site	20220725	130450	40.6624794	-29.38482475	1739	0.8
06	Kurchatov Ridge	EX2205_D06_06G	Basalt - likely not talus	Rinsed and Dried	Characteristic of Site	20220725	143912	40.66267014	-29.38576317	1712	0.8

Dive #	Site Name	Sample #*	Sample ID	Preservation	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Weight (kg)
07	Kurchatov Deep	EX2205_D07_03G	Pillow basalt fragment 1	Rinsed and Dried	Characteristic of Site	20220726	132845	40.54912949	-29.51877403	3322	3.1
07	Kurchatov Deep	EX2205_D07_06G	Pillow rind 1	Rinsed and Dried	Characteristic of Site	20220726	162020	40.54750824	-29.52229118	3230	3.2
07	Kurchatov Deep	EX2205_D07_09G	Pillow rind 2	Rinsed and Dried	Characteristic of Site	20220726	180730	40.54653549	-29.52276611	3159	2.7
08	Rendonda	EX2205_D08_08G	Coated carbonate concretion	Rinsed and Dried	Characteristic of Site	20220727	152020	40.45272827	-29.9072628	1133	2.3
09	Cachalote	EX2205_D09_03G	Mystery hole suction	Rinsed and Dried	Geology	20220728	120743	39.36444855	-31.97055626	1499	n/a

Table C2. Inventory of biological samples collected during EX-22-05

Dive #	Site Name	Sample #*	Field Sample ID	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (C)	DO mg/l)
01	MARNA Shallow	EX2205_D01_03B	White Plexauridae	95% EtOH	Dominant Fauna	20220720	120438	43.9534874	-28.5252838	823	35.37	8.644	5.89
01	MARNA Shallow	EX2205_D01_03B_A01	Crinoidea	95% EtOH	n/a	20220720	120438	43.9534874	-28.5252838	823	35.37	8.644	5.89
01	MARNA Shallow	EX2205_D01_03B_A02	*Aplacophora*	95% EtOH	n/a	20220720	120438	43.9534874	-28.5252838	823	35.37	8.644	5.89
01	MARNA Shallow	EX2205_D01_04B	*Anthothelidae*	95% EtOH	New or Unusual Morphotype	20220720	134410	43.95376968	-28.5266113	740	35.35	9.762	5.27
01	MARNA Shallow	EX2205_D01_04B_A01	*Ophiuroidea*	95% EtOH	n/a	20220720	134410	43.95376968	-28.5266113	740	35.35	9.762	5.27
01	MARNA Shallow	EX2205_D01_04B_A02	*Anemone*	10% Formalin	n/a	20220720	134410	43.95376968	-28.5266113	740	35.35	9.762	5.27

Dive #	Site Name	Sample #*	Field Sample ID	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (C)	DO mg/l)
01	MARNA Shallow	EX2205_D01_04B_A03	*Decapoda*	10% Formalin	n/a	20220720	134410	43.95376968	-28.5266113	740	35.35	9.762	5.27
01	MARNA Shallow	EX2205_D01_04B_A04	*Polychaeta*	95% EtOH	n/a	20220720	134410	43.95376968	-28.5266113	740	35.35	9.762	5.27
01	MARNA Shallow	EX2205_D01_04B_A05	*Gastropoda*	95% EtOH	n/a	20220720	134410	43.95376968	-28.5266113	740	35.35	9.762	5.27
01	MARNA Shallow	EX2205_D01_04B_A06	*Amphipoda*	95% EtOH	n/a	20220720	134410	43.95376968	-28.5266113	740	35.35	9.762	5.27
01	MARNA Shallow	EX2205_D01_05B	*Balanophyllia*	95% EtOH	Lab Assessment Required for ID	20220720	144918	43.95372772	-28.5271873	689	35.35	9.743	5.25
01	MARNA Shallow	EX2205_D01_05B_A01	*Amphipoda*	95% EtOH	n/a	20220720	144918	43.95372772	-28.5271873	689	35.35	9.743	5.25
01	MARNA Shallow	EX2205_D01_05B_A02	*Amphipoda*	10% Formalin	n/a	20220720	144918	43.95372772	-28.5271873	689	35.35	9.743	5.25
01	MARNA Shallow	EX2205_D01_06B	*Haliclona*	95% EtOH	Lab Assessment Required for ID	20220720	160354	43.95363998	-28.5282802	580	35.42	10.708	5.42
01	MARNA Shallow	EX2205_D01_06B_A01	*Amphipoda*	95% EtOH	n/a	20220720	160354	43.95363998	-28.5282802	580	35.42	10.708	5.42
01	MARNA Shallow	EX2205_D01_07B	*Chrysogorgia*	95% EtOH	New or Unusual Morphotype	20220720	162427	43.95367432	-28.5283031	577	35.44	11.017	5.44
01	MARNA Shallow	EX2205_D01_07B_A01	*Amphipoda*	95% EtOH	n/a	20220720	162427	43.95367432	-28.5283031	577	35.44	11.017	5.44
01	MARNA Shallow	EX2205_D01_07B_A02	*Hydroida*	95% EtOH	n/a	20220720	162427	43.95367432	-28.5283031	577	35.44	11.017	5.44
01	MARNA Shallow	EX2205_D01_08B	*Aphanipathidae*	95% EtOH	Potential Undescribed Species	20220720	170542	43.9536705	-28.5285930	552	35.47	11.339	5.45
01	MARNA Shallow	EX2205_D01_08B_A01	*Hydroida*	95% EtOH	n/a	20220720	170542	43.9536705	-28.5285930	552	35.47	11.339	5.45
01	MARNA Shallow	EX2205_D01_08B_A02	*Caprellida*	95% EtOH	n/a	20220720	170542	43.9536705	-28.5285930	552	35.47	11.339	5.45
01	MARNA Shallow	EX2205_D01_08B_A03	*Caprellida*	10% Formalin	n/a	20220720	170542	43.9536705	-28.5285930	552	35.47	11.339	5.45

Dive #	Site Name	Sample #*	Field Sample ID	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (C)	DO mg/l)
02	Moytirra Vent	EX2205_D02_03G_A01	*Caprellida*	5% Formalin	n/a	20220721	131544	45.47369766	-27.8492221	3032	34.93	3.494	24.05
02	Moytirra Vent	EX2205_D02_05G_A01	*Caprellida*	95% EtOH	n/a	20220721	140246	45.47320557	-27.8485717	3012	34.93	3.486	24.26
02	Moytirra Vent	EX2205_D02_07B	*Keratoisididae unbranched*	95% EtOH	Potential Undescribed Species	20220721	154056	45.47345734	-27.8479614	2981	34.93	3.478	25.74
02	Moytirra Vent	EX2205_D02_08G_A01	*Octocorallia*	95% EtOH	n/a	20220721	155925	45.47350693	-27.8479270	2971	34.93	3.476	25.68
02	Moytirra Vent	EX2205_D02_08G_A03	*Annelida?*	95% EtOH	n/a	20220721	155925	45.47350693	-27.8479270	2971	34.93	3.476	25.68
03	MARNA Midwater	EX2205_D03_03B	*Arctapodema*	95% EtOH	Potential Undescribed Species	20220722	125344	44.09869766	-27.3889808	1816	34.93	3.689	8.33
03	MARNA Midwater	EX2205_D03_05B	*Solmissus*	10% Formalin	Potential Undescribed Species	20220722	143039	44.09886169	-27.3889598	1196	35.04	5.214	7.61
03	MARNA Midwater	EX2205_D03_06B	*Aulacoctena*	10% Formalin	Potential Undescribed Species	20220722	154254	44.09910965	-27.3888263	903	35.19	7.725	6.11
03	MARNA Midwater	EX2205_D03_07B	*Solmissus*	10% Formalin	Potential Undescribed Species	20220722	155340	44.09898376	-27.3888149	902	35.15	7.618	6.12
04	AVR1	EX2205_D04_03B	*Keratoisididae*	95% EtOH	Potential Undescribed Species	20220723	141706	43.15483093	-29.0225009	2653	34.93	3.581	8.12
04	AVR1	EX2205_D04_05G_A01	*unknown*	95% EtOH	n/a	20220723	162425	43.15552902	-29.0246353	2550	34.94	3.563	8.03
04	AVR1	EX2205_D04_05G_A02	*unknown*	95% EtOH	n/a	20220723	162425	43.15552902	-29.0246353	2550	34.94	3.563	8.03
04	AVR1	EX2205_D04_05G_A03	*unknown*	95% EtOH	n/a	20220723	162425	43.15552902	-29.0246353	2550	34.94	3.563	8.03
04	AVR1	EX2205_D04_05G_A04	*unknown*	95% EtOH	n/a	20220723	162425	43.15552902	-29.0246353	2550	34.94	3.563	8.0

Dive #	Site Name	Sample #*	Field Sample ID	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (C)	DO mg/l)
04	AVR1	EX2205_D04_05G_A05	*unknown*	95% EtOH	n/a	20220723	162425	43.15552902	-29.0246353	2550	34.94	3.563	8.03
04	AVR1	EX2205_D04_05G_A06	*Bryozoa*	95% EtOH	n/a	20220723	162425	43.15552902	-29.0246353	2550	34.94	3.563	8.03
05	Zenith	EX2205_D05_03B	*Leiopathes*	95% EtOH	Lab Assessment Required for ID	20220724	122644	42.33963394	-29.1500053	1065	35.20	6.276	7.06
05	Zenith	EX2205_D05_03B_A01	*Crinoidea*	95% EtOH	n/a	20220724	122644	42.33963394	-29.1500053	1065	35.20	6.276	7.06
05	Zenith	EX2205_D05_03B_A02	*Caridea*	95% EtOH	n/a	20220724	122644	42.33963394	-29.1500053	1065	35.20	6.276	7.06
05	Zenith	EX2205_D05_03B_A03	*Chirostylidae*	95% EtOH	n/a	20220724	122644	42.33963394	-29.1500053	1065	35.20	6.276	7.06
05	Zenith	EX2205_D05_04B	*Keratoisididae*	95% EtOH	Lab Assessment Required for ID	20220724	130602	42.33974075	-29.1498317	1061	35.21	6.277	7.04
05	Zenith	EX2205_D05_04B_A01	*Chirostylidae*	95% EtOH	n/a	20220724	130602	42.33974075	-29.1498317	1061	35.21	6.277	7.04
05	Zenith	EX2205_D05_04B_A02	*Ctenophora*	95% EtOH	n/a	20220724	130602	42.33974075	-29.1498317	1061	35.21	6.277	7.04
05	Zenith	EX2205_D05_04B_A03	*Ctenophora*	10% Formalin	n/a	20220724	130602	42.33974075	-29.1498317	1061	35.21	6.277	7.04
05	Zenith	EX2205_D05_05B	*Pheronema carpenteri*	Dried	Connectivity Study	20220724	134412	42.3396759	-29.1494693	1056	35.22	6.405	6.99
05	Zenith	EX2205_D05_05B_A01	*Octocorallia*	95% EtOH	n/a	20220724	134412	42.3396759	-29.1494693	1056	35.22	6.405	6.99
05	Zenith	EX2205_D05_05B_A02	*Crinoidea*	95% EtOH	n/a	20220724	134412	42.3396759	-29.1494693	1056	35.22	6.405	6.99
05	Zenith	EX2205_D05_05B_A03	*Glyceridae*	95% EtOH	n/a	20220724	134412	42.3396759	-29.1494693	1056	35.22	6.405	6.994
05	Zenith	EX2205_D05_05B_A04	*Gastropoda*	95% EtOH	n/a	20220724	134412	42.3396759	-29.1494693	1056	35.22	6.405	6.99
05	Zenith	EX2205_D05_05B_A05	*Ophiuroidea*	95% EtOH	n/a	20220724	134412	42.3396759	-29.1494693	1056	35.22	6.405	6.99

Dive #	Site Name	Sample #*	Field Sample ID	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (C)	DO mg/l)
05	Zenith	EX2205_D05_06B	*Yellow Plexauridae*	95% EtOH	Potential Undescribed Species	20220724	151150	42.33990097	-29.1483879	982	35.25	6.934	6.66
05	Zenith	EX2205_D05_06B_A01	*Hyperiidea*	95% EtOH	n/a	20220724	151150	42.33990097	-29.1483879	982	35.25	6.934	6.66
05	Zenith	EX2205_D05_07B	*Purple plexaurid*	95% EtOH	Potential Undescribed Species	20220724	154415	42.34001923	-29.1483612	988	35.26	7.024	6.58
05	Zenith	EX2205_D05_09B	*Tylopathes*	95% EtOH	Potential Undescribed Species	20220724	161947	42.3403511	-29.1484813	999	35.24	6.794	6.64
05	Zenith	EX2205_D05_09B_A01	*Nemertea*	95% EtOH	n/a	20220724	161947	42.3403511	-29.1484813	999	35.24	6.794	6.64
05	Zenith	EX2205_D05_10B	*Amphitheater sponge Axinellidae*	Dried	Lab Assessment Required for ID	20220724	171239	42.34092712	-29.1483192	1011	35.22	6.571	6.65
05	Zenith	EX2205_D05_10B_A01	*Ophiuroidea*	95% EtOH	n/a	20220724	171239	42.34092712	-29.1483192	1011	35.22	6.571	6.65
05	Zenith	EX2205_D05_10B_A02	*nemertea*	95% EtOH	n/a	20220724	171239	42.34092712	-29.1483192	1011	35.22	6.571	6.65
05	Zenith	EX2205_D05_10B_A03	*Polychaeta*	95% EtOH	n/a	20220724	171239	42.34092712	-29.1483192	1011	35.22	6.571	6.65
05	Zenith	EX2205_D05_10B_A04	*Amphipoda*	95% EtOH	n/a	20220724	171239	42.34092712	-29.1483192	1011	35.22	6.571	6.65
06	Kurchatov Ridge	EX2205_D06_03B	*Plexauridae blue polyps*	95% EtOH	Potential Undescribed Species	20220725	121828	40.66242981	-29.3847465	1754	34.97	4.115	8.18
06	Kurchatov Ridge	EX2205_D06_03B_A01	*Thecostraca*	95% EtOH	n/a	20220725	121828	40.66242981	-29.3847465	1754	34.97	4.115	8.18
06	Kurchatov Ridge	EX2205_D06_03B_A02	*Hydroida*	95% EtOH	n/a	20220725	121828	40.66242981	-29.3847465	1754	34.97	4.115	8.18
06	Kurchatov Ridge	EX2205_D06_04G_A01		95% EtOH	n/a	20220725	130450	40.6624794	-29.3848247	1739	34.97	4.148	8.16

Dive #	Site Name	Sample #*	Field Sample ID	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (C)	DO mg/l)
06	Kurchatov Ridge	EX2205_D06_05B	*Tunicata*	95% EtOH	Potential Undescribed Species	20220725	140038	40.66262054	-29.3852577	1725	34.97	4.139	8.10
06	Kurchatov Ridge	EX2205_D06_05B_A01	*Bryozoa*	95% EtOH	n/a	20220725	140038	40.66262054	-29.3852577	1725	34.97	4.139	8.10
06	Kurchatov Ridge	EX2205_D06_05B_A02	*Caprellidea*	95% EtOH	n/a	20220725	140038	40.66262054	-29.3852577	1725	34.97	4.139	8.10
06	Kurchatov Ridge	EX2205_D06_05B_A03	*Porifera*	95% EtOH	n/a	20220725	140038	40.66262054	-29.3852577	1725	34.97	4.139	8.10
06	Kurchatov Ridge	EX2205_D06_05B_A04	*Crinoidea*	95% EtOH	n/a	20220725	140038	40.66262054	-29.3852577	1725	34.97	4.139	8.10
06	Kurchatov Ridge	EX2205_D06_05B_A05	*Polychaeta*	95% EtOH	n/a	20220725	140038	40.66262054	-29.3852577	1725	34.97	4.139	8.10
06	Kurchatov Ridge	EX2205_D06_05B_A06	*Octocorallia*	95% EtOH	n/a	20220725	140038	40.66262054	-29.3852577	1725	34.97	4.139	8.10
06	Kurchatov Ridge	EX2205_D06_07B	*Placogorgia*	95% EtOH	Lab Assessment Required for ID	20220725	150323	40.66277313	-29.3859748	1700	34.97	4.144	8.11
06	Kurchatov Ridge	EX2205_D06_07B_A01	*Lysianassidae*	95% EtOH	n/a	20220725	150323	40.66277313	-29.3859748	1700	34.97	4.144	8.11
06	Kurchatov Ridge	EX2205_D06_08B	*Hertwigia*	95% EtOH	Lab Assessment Required for ID	20220725	152559	40.66272354	-29.3861179	1689	34.97	4.134	8.11
06	Kurchatov Ridge	EX2205_D06_08B_A01	*Amphipoda*	95% EtOH	n/a	20220725	152559	40.66272354	-29.3861179	1689	34.97	4.134	8.11
06	Kurchatov Ridge	EX2205_D06_08B_A02	*Polychaeta*	95% EtOH	n/a	20220725	152559	40.66272354	-29.3861179	1689	34.97	4.134	8.11
06	Kurchatov Ridge	EX2205_D06_09B	*Porifera*	95% EtOH	Lab Assessment Required for ID	20220725	171826	40.6638031	-29.3872566	1664	34.98	4.169	8.06
06	Kurchatov Ridge	EX2205_D06_09B_A02	*Porifera*	95% EtOH	n/a	20220725	171826	40.6638031	-29.3872566	1664	34.98	4.169	8.06
06	Kurchatov Ridge	EX2205_D06_09B_A03	*Polychaeta*	95% EtOH	n/a	20220725	171826	40.6638031	-29.3872566	1664	34.98	4.169	8.06
06	Kurchatov Ridge	EX2205_D06_09B_A04	*Polychaeta*	95% EtOH	n/a	20220725	171826	40.6638031	-29.3872566	1664	34.98	4.169	8.06

Dive #	Site Name	Sample #*	Field Sample ID	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (C)	DO mg/l)
06	Kurchatov Ridge	EX2205_D06_09B_A05	*Amphipoda*	95% EtOH	n/a	20220725	171826	40.6638031	-29.3872566	1664	34.98	4.169	8.06
06	Kurchatov Ridge	EX2205_D06_09B_A06	*Serpulidae*	95% EtOH	n/a	20220725	171826	40.6638031	-29.3872566	1664	34.98	4.169	8.06
06	Kurchatov Ridge	EX2205_D06_09B_A07	*Porifera*	95% EtOH	n/a	20220725	171826	40.6638031	-29.3872566	1664	34.98	4.169	8.06
06	Kurchatov Ridge	EX2205_D06_09B_A08	*Asbestopluma*	95% EtOH	n/a	20220725	171826	40.6638031	-29.3872566	1664	34.98	4.169	8.06
07	Kurchatov Deep	EX2205_D07_03G_A01	*Porifera*	95% EtOH	n/a	20220726	132845	40.54912949	-29.5187740	3323	34.93	3.398	7.89
07	Kurchatov Deep	EX2205_D07_03G_A02	*Porifera*	95% EtOH	n/a	20220726	132845	40.54912949	-29.5187740	3323	34.93	3.398	7.89
07	Kurchatov Deep	EX2205_D07_04B	*Primnoidae*	95% EtOH	Potential Undescribed Species	20220726	141852	40.54894638	-29.5193080	3280	34.93	3.391	7.85
07	Kurchatov Deep	EX2205_D07_05B	*Benthocodon*	95% EtOH	Range Extension	20220726	154703	40.54753494	-29.5213623	3269	34.93	3.390	7.85
07	Kurchatov Deep	EX2205_D07_06G_A01	*Porifera*	95% EtOH	n/a	20220726	162020	40.54750824	-29.5222911	3231	35.02	3.393	7.86
07	Kurchatov Deep	EX2205_D07_06G_A02	*Polychaeta*	95% EtOH	n/a	20220726	162020	40.54750824	-29.5222911	3231	35.02	3.393	7.86
07	Kurchatov Deep	EX2205_D07_06G_A03	*Porifera*	95% EtOH	n/a	20220726	162020	40.54750824	-29.5222911	3231	35.02	3.393	7.86
07	Kurchatov Deep	EX2205_D07_06G_A04	*Porifera*	95% EtOH	n/a	20220726	162020	40.54750824	-29.5222911	3231	35.02	3.393	7.86
07	Kurchatov Deep	EX2205_D07_09G_A01	*Porifera*	95% EtOH	n/a	20220726	180730	40.54653549	-29.5227661	3159	34.93	3.377	7.84
07	Kurchatov Deep	EX2205_D07_10B	*Keratoisididae*	95% EtOH	Lab Assessment Required for ID	20220726	183855	40.5461235	-29.5231208	3155	34.94	3.376	7.84
08	Rendonda	EX2205_D08_03B	*Polymastia*	Dried	Potential Undescribed Species	20220727	123828	40.4527626	-29.9080295	1199	35.17	6.139	7.06

Dive #	Site Name	Sample #*	Field Sample ID	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (C)	DO mg/l)
08	Rendonda	EX2205_D08_03B_A01	*ophiuroidea*	95% EtOH	n/a	20220727	123828	40.4527626	-29.9080295	1199	35.17	6.139	7.06
08	Rendonda	EX2205_D08_03B_A02	*Octocorallia*	95% EtOH	n/a	20220727	123828	40.4527626	-29.9080295	1199	35.17	6.139	7.06
08	Rendonda	EX2205_D08_04B	*Dendrobrachia*	95% EtOH	Range Extension	20220727	132132	40.45286942	-29.9078578	1173	35.18	6.316	6.96
08	Rendonda	EX2205_D08_04B_A01	*Caridea*	95% EtOH	n/a	20220727	132132	40.45286942	-29.9078578	1173	35.18	6.316	6.96
08	Rendonda	EX2205_D08_05B	*Muriceides*	95% EtOH	Lab Assessment Required for ID	20220727	132843	40.45285416	-29.9078235	1175	35.18	6.362	6.94
08	Rendonda	EX2205_D08_05B_A01	*Ophiuroidea*	95% EtOH	n/a	20220727	132843	40.45285416	-29.9078235	1175	35.18	6.362	6.94
08	Rendonda	EX2205_D08_06B	*Iridogorgia*	95% EtOH	Characteristic of Site	20220727	140344	40.45280457	-29.9076366	1160	35.19	6.370	6.93
08	Rendonda	EX2205_D08_06B_A01	*Bathypalaemonella*	95% EtOH	n/a	20220727	140344	40.45280457	-29.9076366	1160	35.19	6.370	6.93
08	Rendonda	EX2205_D08_07B	*Anthoptilum rock pen*	95% EtOH	Range Extension	20220727	145007	40.45278549	-29.9074878	1146	35.19	6.469	6.87
08	Rendonda	EX2205_D08_08G_A01	*Ophiuroidea*	95% EtOH	n/a	20220727	152020	40.45272827	-29.9072628	1134	35.20	6.538	6.82
08	Rendonda	EX2205_D08_08G_A02	*Crypthelia*	95% EtOH	n/a	20220727	152020	40.45272827	-29.9072628	1134	35.20	6.538	6.82
08	Rendonda	EX2205_D08_08G_A03	*Tunicata*	95% EtOH	n/a	20220727	152020	40.45272827	-29.9072628	1134	35.20	6.538	6.82
08	Rendonda	EX2205_D08_08G_A04	*Porifera*	95% EtOH	n/a	20220727	152020	40.45272827	-29.9072628	1134	35.20	6.538	6.82
08	Rendonda	EX2205_D08_08G_A05	*Porifera*	95% EtOH	n/a	20220727	152020	40.45272827	-29.9072628	1134	35.20	6.538	6.82
08	Rendonda	EX2205_D08_08G_A06	*Porifera*	95% EtOH	n/a	20220727	152020	40.45272827	-29.9072628	1134	35.20	6.538	6.82
08	Rendonda	EX2205_D08_08G_A07	*Porifera*	95% EtOH	n/a	20220727	152020	40.45272827	-29.9072628	1134	35.20	6.538	6.82

Dive #	Site Name	Sample #*	Field Sample ID	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (C)	DO mg/l)
08	Rendonda	EX2205_D08_08G_A08	*Balanomorpha*	95% EtOH	n/a	20220727	152020	40.45272827	-29.9072628	1134	35.20	6.538	6.82
08	Rendonda	EX2205_D08_08G_A09	*Serpulidae*	95% EtOH	n/a	20220727	152020	40.45272827	-29.9072628	1134	35.20	6.538	6.82
08	Rendonda	EX2205_D08_09B	*Goniasteridae*	95% EtOH	Characteristic of Site	20220727	152929	40.4527359	-29.9072628	1133	35.20	6.518	6.82
09	Cachalote	EX2205_D09_03G_A01	*Porifera*	95% EtOH	n/a	20220728	120743	39.36444855	-31.9705562	1499	35.01	4.581	7.92
09	Cachalote	EX2205_D09_03G_A02	*Polychaeta*	95% EtOH	n/a	20220728	120743	39.36444855	-31.9705562	1499	35.01	4.581	7.92
09	Cachalote	EX2205_D09_04B	*Farreidae*	Dried	Lab Assessment Required for ID	20220728	122235	39.36450577	-31.9706192	1499	35.03	4.642	7.888
09	Cachalote	EX2205_D09_04B_A01	*Ctenophora*	95% EtOH	n/a	20220728	122235	39.36450577	-31.9706192	1499	35.03	4.642	7.88
09	Cachalote	EX2205_D09_04B_A02	*Crinoidea*	70% EtOH	n/a	20220728	122235	39.36450577	-31.9706192	1499	35.03	4.642	7.88
09	Cachalote	EX2205_D09_05B	*Acanthogorgia*	95% EtOH	Lab Assessment Required for ID	20220728	123705	39.36452103	-31.9705276	1497	35.03	4.656	7.85
09	Cachalote	EX2205_D09_05B_A01	*Crinoidea*	95% EtOH	n/a	20220728	123705	39.36452103	-31.9705276	1497	35.03	4.656	7.85
09	Cachalote	EX2205_D09_05B_A02	*Candidella*	95% EtOH	n/a	20220728	123705	39.36452103	-31.9705276	1497	35.03	4.656	7.85
09	Cachalote	EX2205_D09_05B_A03	*Acanella*	95% EtOH	n/a	20220728	123705	39.36452103	-31.9705276	1497	35.03	4.656	7.85
09	Cachalote	EX2205_D09_05B_A04	*Polynoidae*	95% EtOH	n/a	20220728	123705	39.36452103	-31.9705276	1497	35.03	4.656	7.85
09	Cachalote	EX2205_D09_05B_A05	*Porifera*	Dried	n/a	20220728	123705	39.36452103	-31.9705276	1497	35.03	4.656	7.85
09	Cachalote	EX2205_D09_05B_A06	*Hydrozoa*	95% EtOH	n/a	20220728	123705	39.36452103	-31.9705276	1497	35.03	4.656	7.85
09	Cachalote	EX2205_D09_05B_A07	*Polychaeta*	95% EtOH	n/a	20220728	123705	39.36452103	-31.9705276	1497	35.03	4.656	7.85

Dive #	Site Name	Sample #*	Field Sample ID	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (C)	DO mg/l)
09	Cachalote	EX2205_D09_05B_A08	*Eunicidae*	95% EtOH	n/a	20220728	123705	39.36452103	-31.9705276	1497	35.03	4.656	7.85
09	Cachalote	EX2205_D09_05B_A10	*Chrysogorgiidae*	95% EtOH	n/a	20220728	123705	39.36452103	-31.9705276	1497	35.03	4.656	7.85
09	Cachalote	EX2205_D09_07B	*Stalked crinoid*	95% EtOH	Potential Undescribed Species	20220728	161908	39.36582565	-31.9692192	1450	35.05	4.907	7.67
09	Cachalote	EX2205_D09_07B_A01	*Cumacea*	95% EtOH	n/a	20220728	161908	39.36582565	-31.9692192	1450	35.05	4.907	7.67
09	Cachalote	EX2205_D09_07B_A02	*Hydrozoa*	95% EtOH	n/a	20220728	161908	39.36582565	-31.9692192	1450	35.05	4.907	7.67
09	Cachalote	EX2205_D09_07B_A03	*Bryozoa*	95% EtOH	n/a	20220728	161908	39.36582565	-31.9692192	1450	35.05	4.907	7.67
09	Cachalote	EX2205_D09_07B_A04	*Porifera*	95% EtOH	n/a	20220728	161908	39.36582565	-31.9692192	1450	35.05	4.907	7.67
09	Cachalote	EX2205_D09_08B	*Yellow sponge*	95% EtOH	Lab Assessment Required for ID	20220728	164936	39.36585999	-31.9689846	1440	35.05	4.930	7.67
09	Cachalote	EX2205_D09_08B_A01	*Tunicata*	10% Formalin	n/a	20220728	164936	39.36585999	-31.9689846	1440	35.05	4.930	7.67
09	Cachalote	EX2205_D09_08B_A02	*Polychaeta*	95% EtOH	n/a	20220728	164936	39.36585999	-31.9689846	1440	35.05	4.930	7.67
09	Cachalote	EX2205_D09_10B	*Bryozoan w/nudibranch*	95% EtOH	Potential Undescribed Species	20220728	171735	39.36599731	-31.9687519	1433	35.06	4.986	7.64
09	Cachalote	EX2205_D09_10B_A01	*Polychaeta*	95% EtOH	n/a	20220728	171735	39.36599731	-31.9687519	1433	35.06	4.986	7.64
09	Cachalote	EX2205_D09_10B_A02	*Tunicata*	95% EtOH	n/a	20220728	171735	39.36599731	-31.9687519	1433	35.06	4.986	7.64
09	Cachalote	EX2205_D09_10B_A03	*Nudibranchia*	95% EtOH	n/a	20220728	171735	39.36599731	-31.9687519	1433	35.06	4.986	7.64
09	Cachalote	EX2205_D09_10B_A04	*Amphipoda*	95% EtOH	n/a	20220728	171735	39.36599731	-31.9687519	1433	35.06	4.986	7.64

Dive #	Site Name	Sample #*	Field Sample ID	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (C)	DO mg/l)
10	Kai Ridge	EX2205_D10_04B	*Hexactinella*	Dried	Potential Undescribed Species	20220729	162346	38.75604248	-30.4624538	1694	35.02	4.579	7.73
10	Kai Ridge	EX2205_D10_04B_A01	*Lepadiformes*	95% EtOH	n/a	20220729	162346	38.75604248	-30.4624538	1694	35.02	4.579	7.73
10	Kai Ridge	EX2205_D10_04B_A02	*Cornulariidae*	95% EtOH	n/a	20220729	162346	38.75604248	-30.4624538	1694	35.02	4.579	7.73
10	Kai Ridge	EX2205_D10_06B	*Primnoid whip*	95% EtOH	Potential Undescribed Species	20220729	172056	38.75608444	-30.4626731	1667	35.02	4.583	7.71

*Biological sample numbers with "_A##" indicate associate samples.

Table C3. Inventory of water samples collected for eDNA during EX-22-05

Dive #	Site Name	Sample #	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (°C)	Dissolved Oxygen (mg/l)
01	MARNA Shallow	EX2205_D01_01W	Longmire's	eDNA	20220720	105550	43.95345	-28.526562	509	35.48	11.436	5.49
01	MARNA Shallow	EX2205_D01_02W	Longmire's	eDNA	20220720	115020	43.95351	-28.525169	831	35.36	8.740	5.78
01	MARNA Shallow	EX2205_D01_09W	Longmire's	eDNA	20220720	171656	43.95383	-28.528772	531	35.49	11.460	5.47
01	MARNA Shallow	EX2205_D01_10W	Longmire's	eDNA	20220720	180955	43.954	-28.530085	410	35.58	12.278	5.48
01	MARNA Shallow	EX2205_D01_11W	Longmire's	eDNA	20220720	182148	43.95431	-28.529776	324	35.77	13.497	5.56
02	Moytirra Vent	EX2205_D02_01W	Longmire's	eDNA	20220721	111601	45.47424	-27.849463	1537	34.98	4.324	11.56

Dive #	Site Name	Sample #	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (°C)	Dissolved Oxygen (mg/l)
02	Moytirra Vent	EX2205_D02_02W	Longmire's	eDNA	20220721	121419	45.47364	-27.84988	3038	34.93	3.565	23.69
02	Moytirra Vent	EX2205_D02_09W	Longmire's	eDNA	20220721	171857	45.47337	-27.848045	2942	34.93	3.481	26.17
02	Moytirra Vent	EX2205_D02_11W	Longmire's	eDNA	20220721	172856	45.47319	-27.847666	2907	34.93	3.541	25.72
02	Moytirra Vent	EX2205_D02_12W	Longmire's	eDNA	20220721	185747	45.47269	-27.848562	403	35.61	12.537	7.23
03	MARNA Midwater	EX2205_D03_01W	Longmire's	eDNA	20220722	104931	44.09686	-27.38574	400	35.68	12.859	7.20
03	MARNA Midwater	EX2205_D03_02W	Longmire's	eDNA	20220722	120205	44.09869	-27.389069	1828	34.93	3.684	8.38
03	MARNA Midwater	EX2205_D03_04W	Longmire's	eDNA	20220722	133917	44.09923	-27.388784	1200	35.05	5.244	7.58
03	MARNA Midwater	EX2205_D03_08W	Longmire's	eDNA	20220722	162312	44.09895	-27.388941	699	35.34	10.003	5.91
03	MARNA Midwater	EX2205_D03_09W	Longmire's	eDNA	20220722	171905	44.09895	-27.388763	496	35.53	11.944	7.00
04	AVR1	EX2205_D04_01W	Longmire's	eDNA	20220723	110237	43.15355	-29.019806	573	35.40	10.597	6.21
04	AVR1	EX2205_D04_02W	Longmire's	eDNA	20220723	123751	43.15445	-29.020863	2711	34.91	3.624	8.17
04	AVR1	EX2205_D04_04W	Longmire's	eDNA	20220723	154134	43.15538	-29.023817	2575	34.93	3.575	8.10
04	AVR1	EX2205_D04_06W	Longmire's	eDNA	20220723	170321	43.15549	-29.025282	2528	34.93	3.559	8.10
04	AVR1	EX2205_D04_07W	Longmire's	eDNA	20220723	181433	43.15496	-29.030056	525	35.43	10.966	6.22

Dive #	Site Name	Sample #	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (°C)	Dissolved Oxygen (mg/l)
05	Zenith	EX2205_D05_01W	Longmire's	eDNA	20220724	105622	42.33798	-29.148916	570	35.41	10.868	5.79
05	Zenith	EX2205_D05_02W	Longmire's	eDNA	20220724	114634	42.33954	-29.150192	1074	35.20	6.238	7.07
05	Zenith	EX2205_D05_08W	Longmire's	eDNA	20220724	154749	42.34007	-29.148399	990	35.25	6.964	6.60
05	Zenith	EX2205_D05_11W	Longmire's	eDNA	20220724	174931	42.34105	-29.147591	1000	35.22	6.756	6.51
05	Zenith	EX2205_D05_12W	Longmire's	eDNA	20220724	180824	42.34103	-29.148384	552	35.41	10.994	5.50
06	Kurchatov Ridge	EX2205_D06_BLW	Longmire's	Blank	20220725	n/a	n/a	n/a	n/a	n/a	n/a	n/a
06	Kurchatov Ridge	EX2205_D06_01W	Longmire's	eDNA	20220725	105849	40.66263	-29.381222	580	35.54	11.772	5.82
06	Kurchatov Ridge	EX2205_D06_02W	Longmire's	eDNA	20220725	114657	40.66246	-29.384562	1761	34.97	4.113	8.13
06	Kurchatov Ridge	EX2205_D06_10W	Longmire's	eDNA	20220725	172615	40.66387	-29.387487	1653	34.97	4.153	8.07
06	Kurchatov Ridge	EX2205_D06_11W	Longmire's	eDNA	20220725	173328	40.66389	-29.38744	1645	34.98	4.192	8.03
06	Kurchatov Ridge	EX2205_D06_12W	Longmire's	eDNA	20220725	181607	40.66176	-29.390242	540	35.51	11.605	6.70
07	Kurchatov Deep	EX2205_D07_BLW	Longmire's	Blank	20220726	n/a	n/a	n/a	n/a	n/a	n/a	n/a
07	Kurchatov Deep	EX2205_D07_01W	Longmire's	eDNA	20220726	105939	40.54856	-29.515671	597	35.50	11.465	6.75
07	Kurchatov Deep	EX2205_D07_02W	Longmire's	eDNA	20220726	124409	40.54907	-29.518261	3342	34.93	3.397	7.82

Dive #	Site Name	Sample #	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (°C)	Dissolved Oxygen (mg/l)
07	Kurchatov Deep	EX2205_D07_07W	Longmire's	eDNA	20220726	162900	40.54746	-29.522371	3221	34.93	3.384	7.83
07	Kurchatov Deep	EX2205_D07_08W	Longmire's	eDNA	20220726	162947	40.54738	-29.52224	3221	34.93	3.390	7.88
07	Kurchatov Deep	EX2205_D07_11W	Longmire's	eDNA	20220726	201005	40.54418	-29.534422	575	35.49	11.423	6.70
08	Rendonda	EX2205_D08_BLW	Longmire's	Blank	20220727	n/a	n/a	n/a	n/a	n/a	n/a	n/a
08	Rendonda	EX2205_D08_01W	Longmire's	eDNA	20220727	105339	40.45443	-29.910454	599	35.48	11.293	6.69
08	Rendonda	EX2205_D08_02W	Longmire's	eDNA	20220727	112801	40.45281	-29.909122	1232	35.18	6.251	7.01
08	Rendonda	EX2205_D08_10W	Longmire's	eDNA	20220727	170840	40.4519	-29.906151	1108	35.19	6.319	6.94
08	Rendonda	EX2205_D08_11W	Longmire's	eDNA	20220727	175646	40.45095	-29.906101	1095	35.18	6.244	6.97
08	Rendonda	EX2205_D08_12W	Longmire's	eDNA	20220727	181950	40.45135	-29.906267	606	35.46	11.032	6.46
09	Cachalote	EX2205_D09_BLW	Longmire's	Blank	20220728	n/a	n/a	n/a	n/a	n/a	n/a	n/a
09	Cachalote	EX2205_D09_01W	Longmire's	eDNA	20220728	105342	39.3653	-31.969992	522	35.58	12.112	6.60
09	Cachalote	EX2205_D09_02W	Longmire's	eDNA	20220728	114803	39.36445	-31.970627	1498	35.02	4.553	7.97
09	Cachalote	EX2205_D09_06W	Longmire's	eDNA	20220728	144731	39.36528	-31.969805	1465	35.03	4.815	7.75
09	Cachalote	EX2205_D09_09W	Longmire's	eDNA	20220728	165656	39.36601	-31.968891	1435	35.06	4.939	7.65
09	Cachalote	EX2205_D09_11W	Longmire's	eDNA	20220728	181305	39.36556	-31.969015	552	35.54	11.855	6.46
10	Kai Ridge	EX2205_D10_BLW	Longmire's	Blank	20220729	n/a	n/a	n/a	n/a	n/a	n/a	n/a
10	Kai Ridge	EX2205_D10_01W	Longmire's	eDNA	20220729	104431	38.75652	-30.460222	580	35.47	11.233	6.09

Dive #	Site Name	Sample #	Preservative	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (°C)	Dissolved Oxygen (mg/l)
10	Kai Ridge	EX2205_D10_02W	Longmire's	eDNA	20220729	114230	38.75577	-30.459332	1922	35.02	4.534	7.78
10	Kai Ridge	EX2205_D10_05W	Longmire's	eDNA	20220729	170111	38.75603	-30.462561	1679	35.02	4.580	7.74
10	Kai Ridge	EX2205_D10_07W	Longmire's	eDNA	20220729	173243	38.75602	-30.462835	1653	35.03	4.606	7.67
10	Kai Ridge	EX2205_D10_08W	Longmire's	eDNA	20220729	181231	38.75425	-30.46369	564	35.46	11.146	6.00