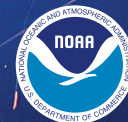


# Deep Connections 2019: Exploring Atlantic Canyons and Seamounts of the United States and Canada (EX1905 Legs 1 and 2)

NOAA Ship *Okeanos Explorer*  
August 6 – September 15, 2019

ASPIRE



Ocean Exploration and Research

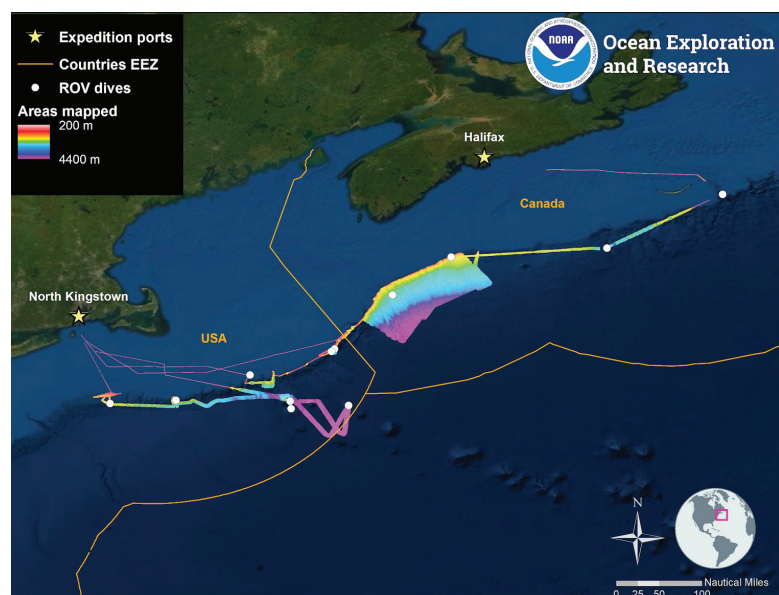
Deep Connections 2019: Exploring Atlantic Canyons and Seamounts of the United States and Canada was one of several expeditions conducted aboard NOAA Ship *Okeanos Explorer* in support of the [Atlantic Seafloor Partnership for Integrated Research and Exploration](#) (ASPIRE) campaign, a major multiyear, multinational collaborative field program focused on raising collective knowledge and understanding of the North Atlantic Ocean.

## Expedition Summary

The Deep Connections 2019: Exploring Atlantic Canyons and Seamounts of the United States and Canada (EX1905 Legs 1 and 2) was a two-part, telepresence-enabled ocean exploration expedition to collect critical baseline information about unknown and poorly understood deepwater areas of the U.S. and Canadian Atlantic continental margin. As with previous NOAA Ship *Okeanos Explorer* expeditions, NOAA's Office of Ocean Exploration and Research worked closely with a variety of partners to address priorities put forward by scientists and managers from the U.S. and Canada as well as international working groups supporting [Seabed 2030](#), the [Atlantic Ocean Research Alliance](#), and the European Union's [Horizon 2020](#) program. Priorities for exploration included submarine canyons, seamounts, slope habitats, deep-sea coral and sponge habitats, fish habitats, marine managed areas, submarine landslides, and other potential geohazards. Mapping data collected during this expedition filled data gaps in the region and will contribute to Seabed 2030 goals for mapping unexplored regions of Earth's ocean. Major accomplishments of this expedition are summarized below.

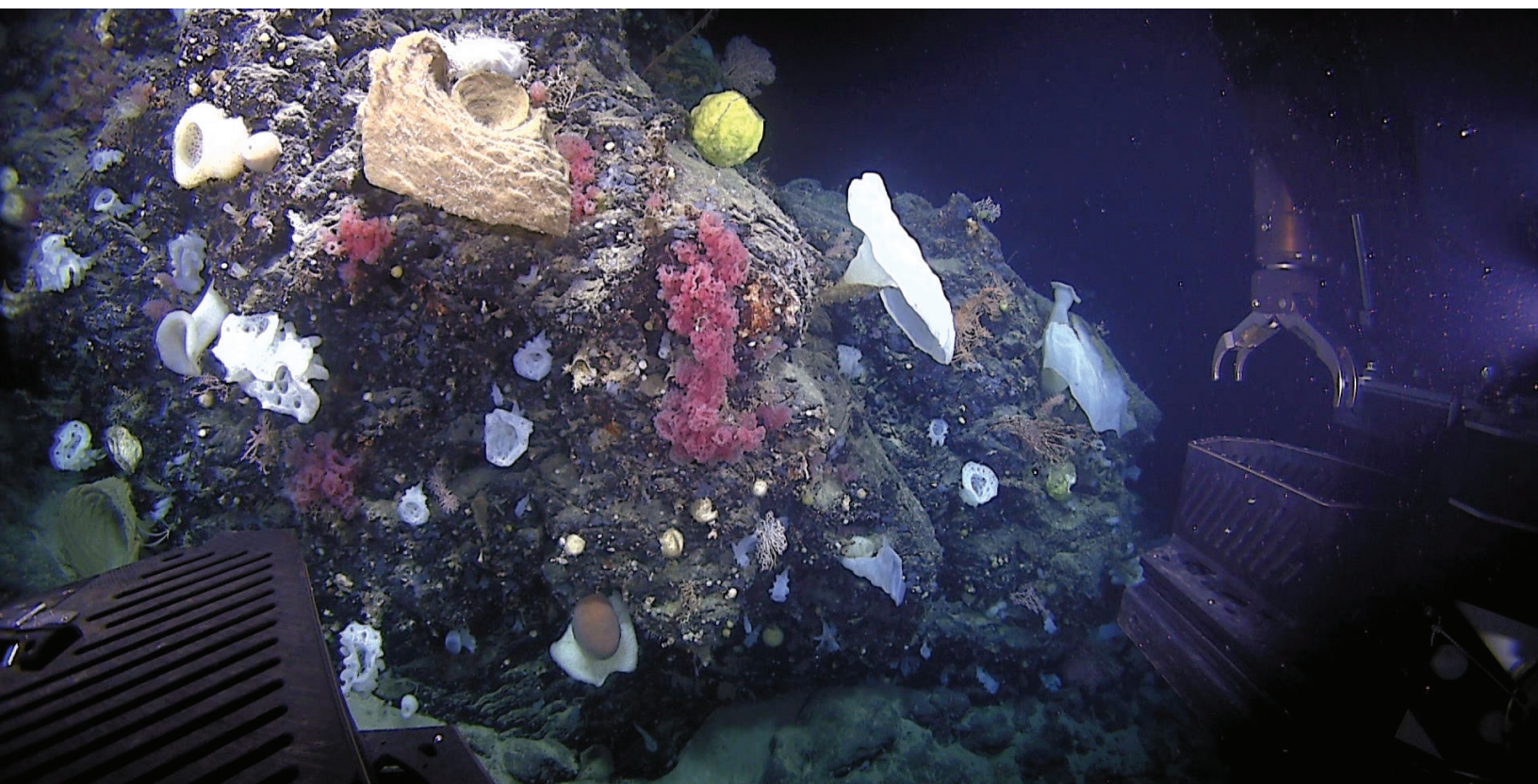
## Acquired data on deepwater habitats to support science and management needs in North Atlantic waters of the U.S. and Canada and to support ASPIRE.

- Conducted a total of 12 remotely operated vehicle (ROV) dives in deep waters off the U.S. and Canadian Atlantic continental margin for a total dive time of 85 hours, 58 minutes and a total on-bottom time of 54 hours, 49 minutes. Collectively, these dives explored seafloor habitats at depths between 306 and 2,668 meters (~1,004-8,753 feet) over a linear distance of 5.996 kilometers (~3.7 miles). Hundreds of different species of animals were documented during these dives. Observations of particular note included several species that are potentially new to science, numerous range extensions, and new behaviors.



This map shows the locations of mapping and ROV operations conducted during the **Deep Connections 2019** expedition. *Map courtesy of the NOAA Office of Ocean Exploration and Research.*

- Documented high-density communities of deep-sea corals and sponges on five dives and across a wide depth range (921-2,668 meters, ~3,022-8,753 feet). These included a high-density forest of bamboo corals at a depth of 1,100 meters (~3,609 feet) inside the Gully Canyon, a highly diverse and dense assemblage of deep-sea sponges at depths of 2,500-2,650 meters (~8,202-8,694 feet) on Retriever Seamount, as well as patches of high-density communities on Kinlan Canyon, Bear Seamount, and Veatch Canyon.
- Collected 124 biological samples (35 primary and 89 associated taxa). Twenty-six of the primary biological samples represented range extensions, and several of these may be new species to science. The other biological samples were collected to support studies on connectivity and biogeographic patterns across the Atlantic Ocean, an important goal of the ASPIRE campaign.



A very high-density community of corals and sponges was documented at a depth of 2,600 meters (~8,530 feet) during a dive on Retriever Seamount. This community is among the deepest high-density communities known in the northeastern U.S. *Image courtesy of the NOAA Office of Ocean Exploration and Research, Deep Connections 2019.*

### **Explored deepwater areas relevant to resource managers, including marine protected areas (MPAs) and other priority management areas.**

- Conducted six ROV dives in three marine managed areas: the Gully Marine Protected Area, the Northeast Canyons and Seamounts Marine National Monument, and the Frank R. Lautenberg Deep-Sea Coral Protection Area. Additionally, the expedition included one ROV dive just outside the Northeast Channel Coral Conservation Area to collect data to support management decisions.
- Conducted seafloor and water column mapping operations inside the Northeast Canyons and Seamounts Marine National Monument and the Frank R. Lautenberg Deep-Sea Coral Protection Area. Water column mapping operations were also conducted in the Gully MPA to help characterize the rich midwater fauna of the region. While the seafloor in these protected areas had been largely mapped during previous explorations, very few water column mapping surveys had been conducted in these areas prior to this mission.
- Collected sub-bottom profiler data south of Retriever Seamount in support of the U.S. Extended Continental Shelf project.



Striped shrimp were seen on a bubblegum coral during Dive 05 of the expedition. *Image courtesy of the NOAA Office of Ocean Exploration and Research, Deep Connections 2019.*

**Mapped, surveyed, and characterized the diversity and distribution of deep-sea benthic communities, particularly those found within deep-sea coral and sponge habitats, fish habitats, and other vulnerable marine habitats.**

- Deep-sea corals and sponges were recorded on all eleven of the benthic-focused ROV dives of the expedition and across a range of depths (306-2,668 meters, ~1,004-8,753 feet).
- High-density communities of deep-sea corals and sponges were documented during five different dives of the expedition. These high-density communities were found at depths ranging between 921 and 2,668 meters (~3,022-8,753 feet), including one that is currently among the deepest high-density communities (at 2,668 meters, ~8,753 feet) known in the Northeast U.S. region.
- Documented three large individuals (>1 meter) of the endangered Atlantic halibut *Hippoglossus hippoglossus* in an unnamed canyon north of Kinlan Canyon.
- Water column mapping operations documented activity at various known seeps near Veatch and Oceanographer Canyons, thereby increasing our knowledge of the temporal persistence of these ephemeral features.



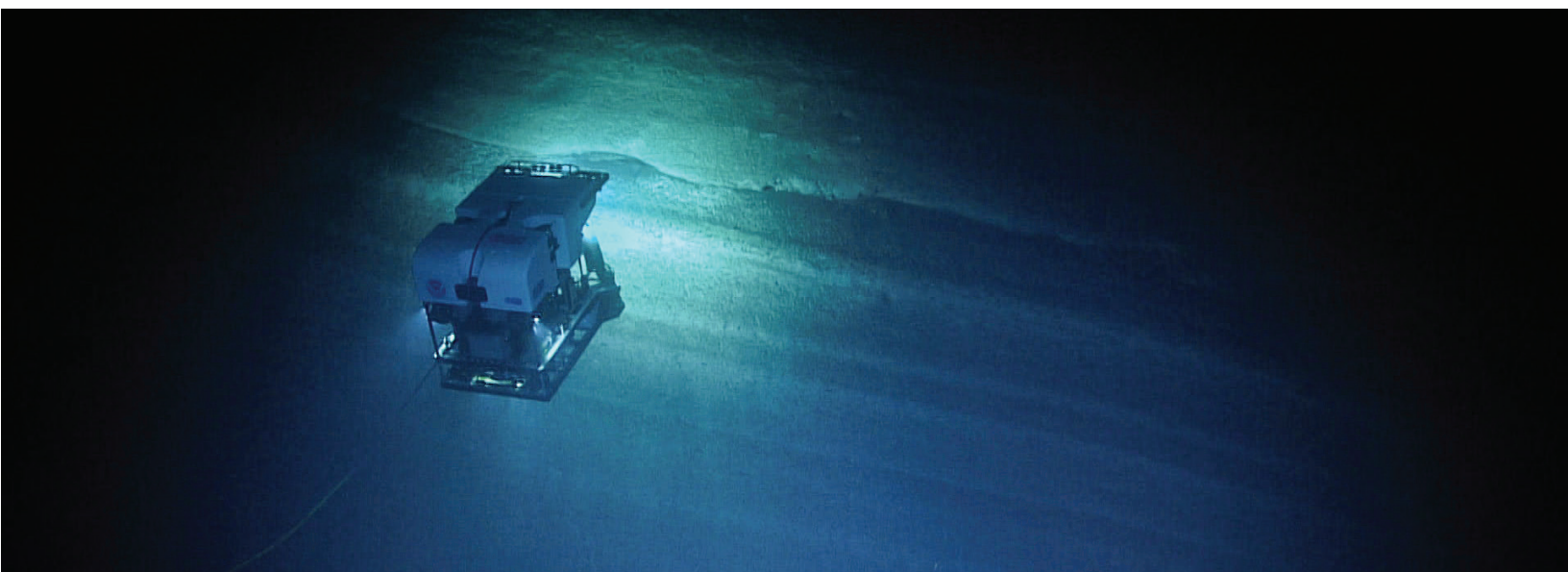
A wide diversity of sponges and corals were seen on Dive 08 of the expedition, which took place in the Northeast Canyons and Seamounts Marine National Monument. *Image courtesy of the NOAA Office of Ocean Exploration and Research, Deep Connections 2019.*

**Investigated biogeographic patterns and connectivity of deep-sea organisms across the Atlantic margin for use in broader comparisons of deepwater habitats across the Atlantic Basin.**

- The 12 ROV dives completed during the expedition will likely represent the northwesternmost range that will be explored by NOAA Ship *Okeanos Explorer* during the 2018-2020 ASPIRE campaign. Hundreds of different species of animals were observed during the expedition, including numerous significant range extensions and several potential new species. These data will provide valuable information for the interpretation of biogeographic patterns across the entire Atlantic range.
- Three biological specimens were collected specifically to support studies on connectivity and broad biogeographic patterns across the Atlantic Basin.

**Mapped, surveyed, and sampled geologic features to better understand the geological context of the region, and improve knowledge of past and future geohazards.**

- Explored a variety of geological features, including submarine seamounts, submarine canyons, intercanyon areas, and slopes.
- Documented and sampled inactive fluid expulsion features during one ROV dive on the steep walls of Verrill Canyons. These unique features were similar to those observed during previous ROV dives farther south on the Atlantic margin.
- Found visual evidence of active sediment transport within Oceanographer Canyon, including a flushed canyon axis, erosional features carved into recently deposited marine clays.
- Documented a stunning, unbroken sequence of carbonate rock with near-vertical relief at Veatch Canyon. The feature is more than 100 meters thick and comparable in height to the Cliffs of Dover.
- Found evidence for seabed instability over short timeframes (less than seven years) by remapping a submarine landslide scarp at the head of an unnamed canyon located between Gilbert and Lydonia Canyons.
- Collected five geological samples that can be used for future geochemical composition analyses and age-dating to increase our understanding of the geological history of the region.



A stunning, unbroken sequence of carbonate rock over 100 meters thick was documented at a depth of 1,200 meters at Veatch Canyon. This near-vertical relief structure is comparable in height to the Cliffs of Dover. *Image courtesy of the NOAA Office of Ocean Exploration and Research, Deep Connections 2019.*

**Collected high-resolution bathymetry and backscatter data in areas with no (or low-resolution) sonar data. These data were also collected in support of ROV operations and to identify potential maritime heritage sites.**

- Mapped more than 29,510 square kilometers (11,394 square miles) of seafloor, including 7,644 square kilometers (2,952 square miles) in the U.S. Exclusive Economic Zone (EEZ), 21,515 square kilometers (8,307 square miles) in the Canadian EEZ, and 351 square kilometers (136 square miles) in marine areas beyond national jurisdiction.
- Mapping operations included several areas that had never before been mapped with high-resolution multibeam sonars, including areas around the Northeast Channel and Fundian Valley, north of Alvin Canyon, and along the U.S.-Canadian boundary.
- High-resolution multibeam data were collected over most ROV dive sites and used to refine dive plans and safely conduct dive operations.
- While no maritime heritage sites were identified during seafloor mapping operations, the expedition included mapping in large areas around the Northeast Channel that were identified as priorities by maritime archaeologists.

## Acquired a foundation of ROV, sonar, and oceanographic data to better understand the characteristics of the water column and the pelagic fauna living within it.

- Dedicated midwater transects were conducted during one ROV dive for a total of 3 hours, 40 minutes, at depths between 700 and 2,170 meters (~2,297-7,119 feet).
- Additional data on midwater habitats were collected during all ascents and descents of the 12 ROV dives of the expedition. The total time was 31 hours, 9 minutes.
- One specimen of a midwater ctenophore was collected during the expedition, which likely represents a species new to science.

## Engaged a broad spectrum of the scientific community and public in telepresence-based exploration and provided a foundation of publicly accessible data products to spur further exploration, research, and management activities.

- A total of 51 scientists, managers, and students from seven different countries and 13 U.S. states participated in the expedition regularly via telepresence as members of the shore-side science team. Additionally, 306 scientists, managers, and students signed up for the expedition science listserv and participated intermittently via telepresence.
- Three students sailed as explorers-in-training during the mapping leg of the expedition and gained valuable at-sea experience.
- Live video feeds from the expedition received more than 112,830 views.
- [Expedition content](#) on the NOAA Office of Ocean Exploration and Research's website received over 23,500 views during the expedition.
- Reached broader audiences through public displays of live video from the expedition hosted at the Canadian Museum of Nature in Ottawa, the Natural History Museum in Halifax, and the Bedford Institute of Oceanography during all dives in Canadian waters. Collectively, these displays reached over 10,700 visitors.
- Established a new exploration command center at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia, facilitating participation by Canadian scientists and resource managers throughout the expedition.
- Conducted five live telepresence interactions with a total of 243 individuals at various venues, including visitors to the NOAA exploration command center in Silver Spring, Maryland; the New England Aquarium; and the Mystic Aquarium.
- Conducted four tours of NOAA Ship *Okeanos Explorer* while the ship was docked in Dartmouth, Nova Scotia, reaching 83 Canadian partners representing management agencies, nongovernmental institutions, academic institutions, and the private sector.
- Published one [feature story](#) on the NOAA.gov website, which received over 15,800 views.
- Received web and media coverage from international, national, and local sources, including the National Observer (Canada), the Canada Broadcasting Company, the Ottawa Citizen, CTV News, and Boston Magazine.
- All 9.2 TB of data collected during the expedition, including video and environmental data from each ROV dive and mapping, oceanographic, and meteorological data, will be made publicly available through national archives. Highlight images, videos, and descriptions of the accomplishments of the expedition, as well as educational materials, are already available via [the expedition website](#).



Several different tools were used to engage the public during this expedition, including webinar presentations, ship tours, public displays of live video, web stories, social media, and live interactions, including one with the New England Aquarium. *Image courtesy of the New England Aquarium.*

### For More Information

[OceanExplorer.NOAA.gov/okeanos/explorations/ex1905/welcome.html](https://OceanExplorer.NOAA.gov/okeanos/explorations/ex1905/welcome.html)



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