DEEP SEARCH 2019: DEEP Sea Exploration to Advance Research on Coral/Canyon/Cold seep Habitats

Mission Plan

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Introduction

From April 9 to 30, 2019, NOAA and partners at the Bureau of Ocean Energy Management (BOEM) and the U.S. Geological Survey (USGS) will conduct a research expedition on NOAA Ship *Ronald H. Brown* to collect critical baseline information about deepwater habitats offshore the U.S. Mid- and South Atlantic coasts. This expedition is part of the 4.5-year BOEM-USGS-NOAA Deep Sea Exploration and Research of Coral/Canyon/Cold seep Habitats (DEEP SEARCH) interagency project sponsored by the National Oceanographic Partnership Program (NOPP), with TDI-Brooks International, Inc. as the prime contractor for BOEM, and scientists from USGS and nine academic institutions participating. During this 22-day expedition, remotely operated vehicle (ROV) *Jason* will be used to explore and sample seafloor environments, complemented by additional shipboard operations including multibeam mapping, multicore collections, and CTD casts.



From April 9 to April 30, the DEEP SEARCH team will be diving daily with ROV *Jason* at targets indicated by yellow stars. Bathymetry data shown in full color were collected by recent NOAA Ship *Okeanos Explorer* missions and by the 2018 R/V *Atlantis* DEEP SEARCH cruise. Bathymetry data shown in muted, transparent color represents the full extent of data in the region. *Map courtesy of the U.S. Geological Survey*. Download larger version (jpg, 9.1 MB).

Study Background

DEEP SEARCH's primary goal is to augment the ability to predict the location of seafloor communities off the coast of the Southeast United States that are potentially sensitive to disturbance. This area encompasses a variety of different habitat types, including submarine canyons, cold-water coral mounds and gardens, methane seeps, and soft sediments. We will explore and characterize the biological communities of the study area; examine their sensitivity to natural and human disturbance; and describe the oceanographic, geological, geochemical, and acoustic conditions associated with each habitat type.

Deep-sea ecosystems along the U.S. continental margin support enhanced biodiversity and sensitive biological communities, yet they remain poorly understood. The maintenance of biodiversity is critical to the function and sustainability of these deepwater ecosystems that provide numerous ecosystem services. Loss of deep-sea biodiversity could have long-term, damaging effects to large expanses of the deep seafloor, the overlying water column, and to human health. Thus, we need to better understand these systems so they can be effectively managed. Through this study, we will improve our understanding of the habitats and communities in offshore areas of the Atlantic Large Marine Ecosystem, which will augment the capacity to predict the distribution of sensitive areas with respect to the potential development of energy and marine mineral resources.



Homeported in Charleston, South Carolina, NOAA Ship *Ronald H. Brown* is a global-class oceanographic and atmospheric research platform and is the largest vessel in the NOAA fleet. With its highly advanced instruments, the ship travels worldwide supporting scientific studies to increase our understanding of climate and the ocean. *Image courtesy of DEEP SEARCH 2019 - BOEM, USGS, NOAA.* Download larger version (jpg, 1.5 MB).

Field Work to Date

This is the fifth research expedition associated with this project. The first was on NOAA Ship *Pisces* with the autonomous underwater vehicle (AUV) *Sentry* in September 2017. This cruise was heavily impacted by weather, but the team acquired some multibeam data and accomplished three *Sentry* dives in the study area. The second mission was originally scheduled on NOAA Ship *Nancy Foster*, but it was cancelled due to needed ship repairs. That mission was re-allocated to two cruises in 2018: multibeam mapping objectives were completed by during a cruise on NOAA Ship *Okeanos Explorer* in May 2018 and the sampling and lander component was conducted on the R/V *Brooks McCall* in October 2018.

The Okeanos Explorer cruise was highly successful and detailed bathymetry was acquired over the southern Lophelia coral portions of the study area. These locations were selected using a combination of prior coral observation data along with the results of our preliminary predictive habitat models. The subsequent Okeanos Explorer ROV mission, Windows to the Deep 2018, was co-led by DEEP SEARCH co-principal investigator Cheryl Morrison and included a number of exploratory dives to coral, canyon, and seep habitats in the DEEP SEARCH study area.

In August 2018, the DEEP SEARCH team completed a 15-day expedition on the Woods Hole Oceanographic Institution (WHOI) operated R/V *Atlantis* using human occupied vehicle (HOV) *Alvin*. Eleven dives were completed at three canyons, two seep sites, and four coral sites, ranging in depth from 403 to 2,169 meters (1,322 to 7,116 feet). Mapping data from the earlier *Okeanos Explorer* cruises were augmented with an additional 8,233 square kilometers (3,178 square miles) of data. Biological, geological, and chemical samples were collected by HOV *Alvin* and with CTD, monocore, and multicore instruments.



Human occupied vehicle (HOV) *Alvin* collecting a sample of live *Lophelia pertusa* on the DEEP SEARCH 2018 mission. On the third dive of the R/V *Atlantis* expedition, the DEEP SEARCH team explored thriving *Lophelia* reefs along pronounced linear mound features. These *Lophelia* reefs are among some of the deepest along the U.S. Atlantic coast. *Image courtesy of DEEP SEARCH 2018 - BOEM, USGS, NOAA, HOV* Alvin. *Copyright Woods Hole Oceanographic Institution.* Download larger version (jpg, 5.1 MB).



During the 2019 DEEP SEARCH mission, the team will again visit the North Carolina submarine canyons, including Pamlico Canyon seen here. In 2018, HOV *Alvin* explored Pamlico Canyon and observed stunning rock walls covered in a diversity of corals. *Image courtesy of DEEP SEARCH 2018 - BOEM, USGS, NOAA, HOV* Alvin. *Copyright Woods Hole Oceanographic Institution*. Download larger version (jpg, 4.3 MB).

Current Mission Objectives

The 2019 expedition on board NOAA Ship *Ronald H. Brown* with the ROV *Jason* builds upon all of this work and will allow the DEEP SEARCH team to build upon the successes of the *Atlantis* cruise. The primary objectives of the 2019 cruise are as follows:

- 1. Conduct daily ROV operations (>12 hours) to target canyon, seep, and deep-sea coral habitats and associated fauna with a depth range from 150-2,600 meters (492-8,530 feet).
- 2. Deploy one deep-sea instrumented lander, including a short-term deployment (~4 days) and recovery, with follow-up long-term deployment (~4 months to a year).
- 3. Collect multibeam bathymetry in areas lacking high-resolution bathymetric data.
- 4. Conduct CTD casts to collect sediment and water samples for various analyses.
- 5. Conduct replicate multicore sediment coring of the seafloor in areas of seeps, canyons, and adjacent to coral hardbottom communities.

During the 22-day voyage in and out of Charleston, South Carolina, the team has planned for daily dives (see sampling map), including canyons and seeps located offshore Virginia and North Carolina and coral mounds recently mapped by *Okeanos Explorer* near the Georgia-Florida line.

Recent Updates



Mission Summary

The 2019 DEEP SEARCH mission was a great success. We battled some stormy weather that forced us to run and adapt our plans, but the whole team worked together and did an exceptional job in pulling off this complex research expedition.

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Leg 2 Highlights

These are some of the highlights from the second leg of the DEEP SEARCH 2019 mission.

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Tubeworm Growing on a Carbonate Rock

A tubeworm growing on a carbonate rock with white chemosynthetic bacterial mat and anemones nearby at the Kitty Hawk Seep study site.

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DEEP SEARCH Leg 1 Highlights

These are some of the highlights from our first four dives of DEEP SEARCH 2019.

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