Mapping and Diving Go Together Like Peanut Butter and Jelly

Expedition: 2021 North Atlantic Stepping Stones

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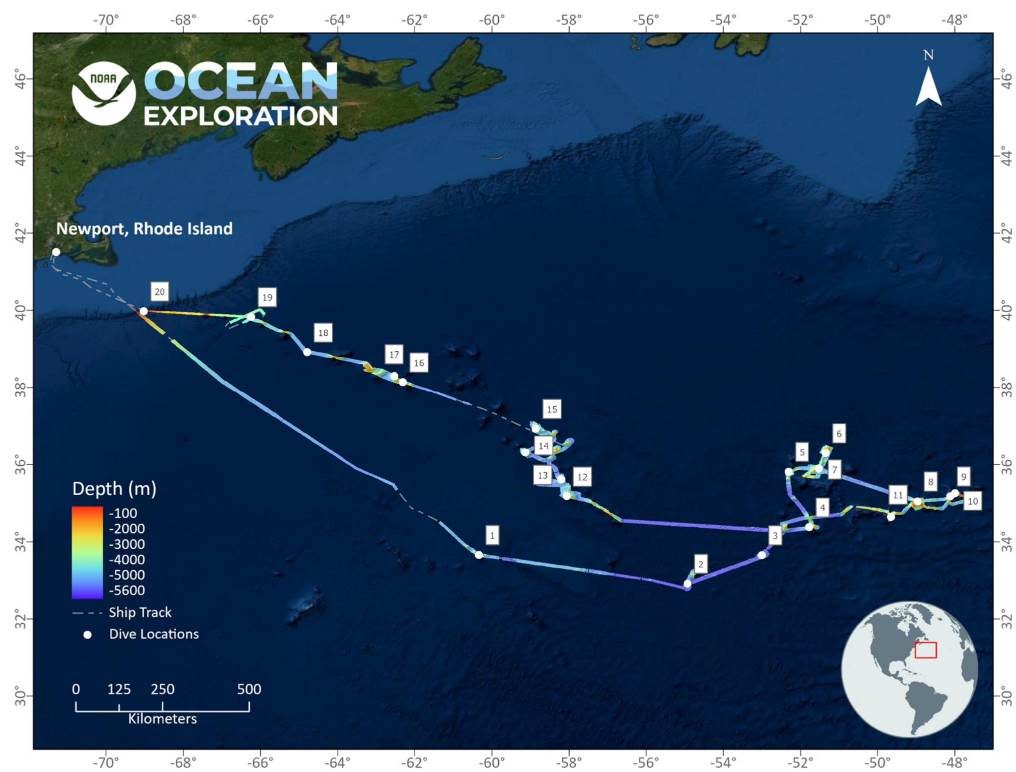
Complementary Components for Successful Ocean Exploration

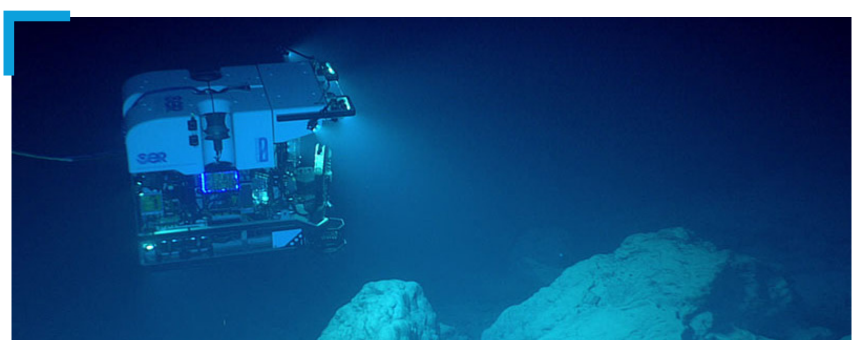
There are two main operations during remotely operated vehicle (ROV) expeditions on the NOAA Ship *Okeanos Explorer*: mapping and ROV dives. Acoustically (use of sound) mapping the seafloor using the ship's multibeam sonar happens overnight, while ROV dives take place during the day. Knowing the depth and shape of the seafloor is essential for safe and successful ROV operations. The two operations go together like peanut butter and jelly.

Ideally, seafloor mapping data is collected well before the ROV expedition, which allows for time to analyze the data and determine the best site for further ROV exploration. However, as is the nature with deepwater ocean exploration, other times we operate in remote areas where little previous acoustic mapping has occurred, requiring us to collect the critical seafloor data just before performing ROV operations.

This was the case for the 2021 North Atlantic Stepping Stones expedition which took place in deepwater areas off of the eastern U.S. coast and high seas. Little seafloor mapping data were available to us ahead of time, which required us to map the seafloor at night (or early morning) and determine the best site before the ROV dive scheduled for that day. The mapping team usually has only a few minutes in the morning to create the tools needed for exploration decision-making. We call this quick turn around of collecting seafloor data to investigation with the ROV a "map and dive."



2021 North Atlantic Stepping Stones: New England and Corner Rise Seamounts expedition map with dive sites. *Map courtesy of NOAA Ocean Exploration.*



ROV *Deep Discoverer* at work during the expedition. Its lights shine down on a rock outcrop. *Image courtesy of NOAA Ocean Exploration.*

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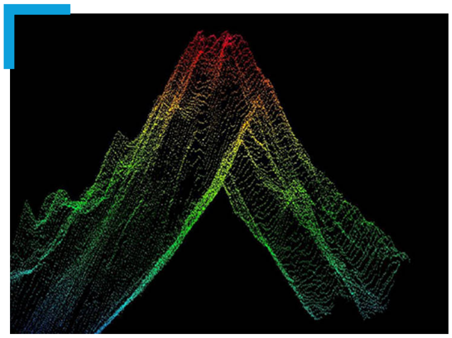
Order of Operations for ROV Deployment

Once we have collected seafloor data using multibeam sonar, we remove outlier data to produce a digital terrain model that can be viewed in 3D. The team then gathers to analyze the information and determine the best dive location based on scientific objectives and conditions that affect the ROV, such as the terrain and currents (both surface and deep). From the recently collected seafloor data, we use the morphology (shape), slope (steepness), and backscatter (relative hardness) of the seafloor to determine the ideal dive location.

These early morning meetings are some of the most intense parts of my day as a mapping lead. I thoroughly enjoy the speed with which we all must come together and provide our unique expertise to figure out where it is best to explore, given the data that my team worked hard overnight to collect and process.



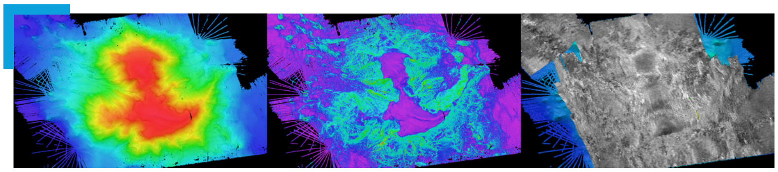
Computers are used to convert the data from the multibeam sonar into 3D point clouds of individual bathymetric soundings of the seafloor. *Image courtesy of NOAA Ocean Exploration.*

Advancements in Seafloor Mapping Technologies

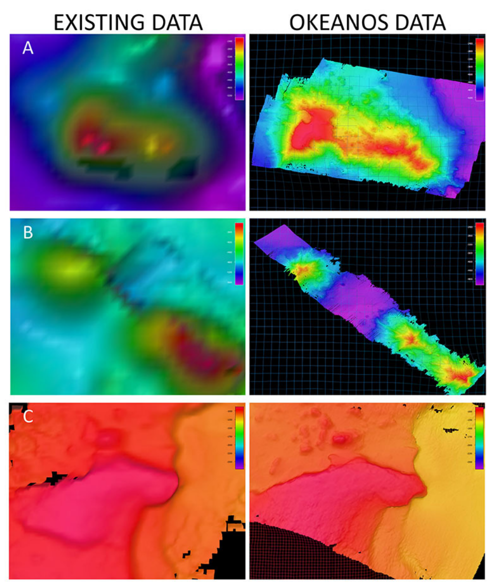
Fortunately, on this expedition we were not totally in the dark before mapping the area. We had some information about the seafloor from satellite altimetry (altitude/elevation measurements) and previous exploration. It is always fascinating to see the differences we uncover when remapping an area. This was especially true during this expedition because it was the first ROV mission using our new state-of-the art multibeam sonar technology.

With the multibeam sonar we discovered that satellite altimetry had estimated a feature to be two seamounts when it was actually one, and we found a new seamount not visible in satellite altimetry data! There was also a significant difference in the shape of a feature from what was mapped during a 2005 expedition.

One might think “Hey, 2005 wasn’t that long ago. Why is there such a difference?” While 2005 was only 16 years ago, that is actually a significant amount of time in terms of how long multibeam sonar technology has been around, which is approximately 40 years (so nearly half of its life). The difference observed between these two datasets is likely due to the increased resolution capable from rapid advancements in technology.



Three different images display different characteristics of Michael Seamount: seafloor depth (left), slope (middle), and backscatter - relative hardness of surfaces (right). *Image courtesy of NOAA Ocean Exploration.*



Maps on the left were created with satellite altimetry (A&B) and data collected with older mapping systems (C). New mapping technology used during this expedition created higher resolution maps of the seafloor (right). Rows A&B: Higher resolution maps provided an accurate count of the number of seamounts in the area. Row C: Improved technology, revealed more detail of area. *Image courtesy of NOAA Ocean Exploration.*

Throughout this expedition, we mapped about 40 seamounts, 20 of which had little to no preexisting data. We also performed 14 “map and dives.” In addition to creating maps to determine the best locations for ROV dives, the mapping data collected during this expedition fill gaps in our collective understanding of the North Atlantic seamount chains.

Original Expedition Feature: https://archive.oceanexplorer.noaa.gov/okeanos/explorations/ex2104/features/mapping/welcome.html
Expedition: https://oceanexplorer.noaa.gov/okeanos/explorations/ex2104/welcome.html
Explorer (bio): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/ex2104/explorers/welcome.html#hoy
Stepping Stones (map): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/ex2104/gallery/welcome.html#cbpi=/okeanos/explorations/ex2104/features/summary/media/summary-map.inc
ROV *Deep Discoverer* (image): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/ex2104/dives/dive05/media/d2-rocks-800.jpg
Multibeam Sonar (factsheet): https://oceanexplorer.noaa.gov/edu/materials/multibeam-sonar-fact-sheet.pdf
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Michael Seamount (image): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/ex2104/features/mapping/media/planning-hires.jpg
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NA seamount chains (webpage): https://oceanexplorer.noaa.gov/expedition/ex2104/#overview

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