IODP³-NSF Expedition 501: New England Shelf Hydrogeology Project Summary

Expedition Location and Timing

This expedition seeks to core the sub-seafloor at 3 sites on the New England Shelf, approximately 20, 27 and 43 miles south and southwest of Nantucket Island (Figure 1, Table 1). Two boreholes spaced approximately 50m apart would be cored at each of the three sites, up to 550 metres below seafloor, with 6 boreholes in total. The expedition would start on approximately 1 May 2025, would continue for approximately 90-100 days, and would end before 8 August.

Expedition Objectives

This expedition aims to recover cores of sediment and groundwater samples from the sub-seafloor offshore New England. These cores and groundwater samples would provide data for understanding the geological evolution of the shelf, and the processes driving the emplacement of freshwater reservoirs offshore New England and elsewhere globally. This would offer a better understanding of biogeochemical and elemental cycling in this worldwide hydrogeological phenomenon, essential for the protection and sustainable management of offshore freshwater systems.

Equipment and Methods

During the proposed 3-month effort, we would use the liftboat *L/B Robert*[1] (Seacor, Houston) carrying a Boart Longyear LF160 Drill Rig[2] to core into the seafloor to collect sediment and water samples. The drilling contractor is Matrix Offshore Services, Tennessee. The *L/B Robert* would temporarily stand on the seabed at each of the 6 boreholes in turn, for up to 25 days (cored borehole for sediment samples), or up to 12 days (drilled borehole for groundwater samples). At two boreholes, a passive Simple Cabled Instrument for Measuring Parameters In Situ (SCIMPI) would be deployed in the borehole, and left behind for long term monitoring of groundwater pressure, temperature and resistivity. The SCIMPI would have a buoyant control module on a 2-4 m cabled 'tail' on the seabed, to allow data download by remotely operated vehicle in future.

Institutes and Agencies Involved

This multi-national scientific drilling project is International Ocean Drilling Programme[3] Expedition 501: New England Shelf Hydrogeology, which would be implemented by the European Consortium for Ocean Research Drilling[4]. The expedition is publicly co-funded by the US National Science Foundation and the research agencies of ECORD member governments (14 European countries plus Canada).

The British Geological Survey (BGS), leads the ECORD Science Operator collaboration, and is responsible for coordinating, managing and contracting for the expedition.

The Science Team includes 37 scientists representing 13 countries.

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[1] https://seacormarine.com/vessel/l-b-robert-335-class/

[2] https://boartlongyear.canto.com/direct/document/tsl8d10h4l4if9i134vq02163g/aIut5RSdGutRwL8zoWfmo8zFSKE/original?content-type=application%2Fpdf&name=LF160_DataSheet_Mar_2017_V4.pdf

[3] IODP³, https://iodp3.org/

[4] ECORD, https://www.ecord.org/

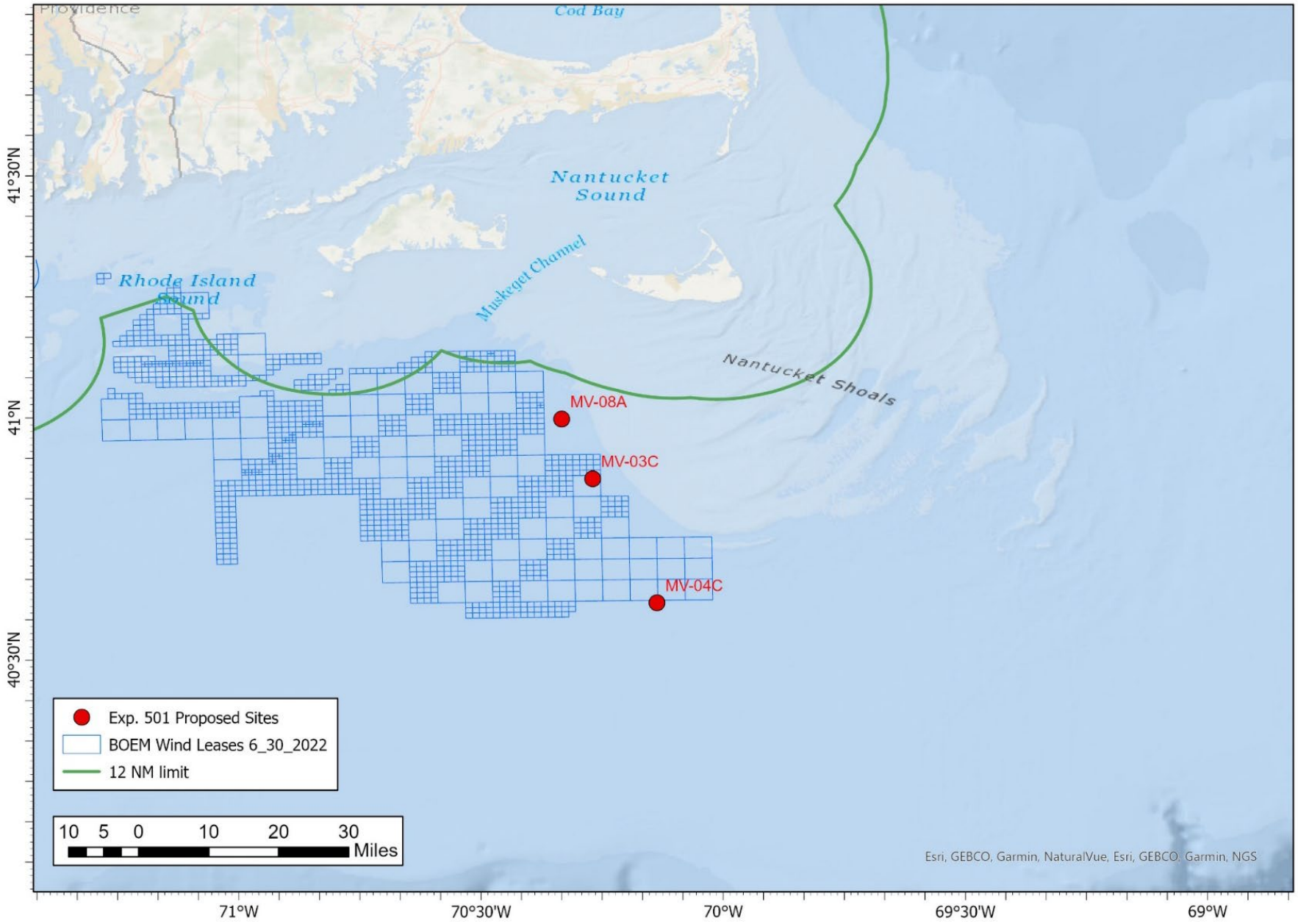

Figure 1. Overview location map of the Expedition 501 sites.

Site	Lat	Long	Water Depth (m)	Seabed Penetration (mbsf)	Borehole	Work plan
MV-08A	40.9976	-70.3334	41	550	A	Core borehole for sediment sampling
					B	Drill borehole for groundwater sampling
MV-03C	40.8746	-70.2697	42	550	A	Core borehole for sediment sampling
					B	Drill borehole for groundwater sampling
MV-04C	40.6185	-70.137	52	550	A	Core borehole for sediment sampling
					B	Drill borehole for groundwater sampling

Table 1. Expedition 501 proposed site coordinates.

How to follow the expedition, and main contacts

Regular updates will be provided on the expedition website at www.ecord.org and our blogsite https://expedition501.wordpress.com/.

Additionally, updates and information will be regularly posted on:
YouTube – https://www.youtube.com/@ECORDESO
Instagram – @ecord_iodp
Bluesky - @ecord.bsky.social

A daily report will be distributed from the ship. To sign up for this please visit https://www.jiscmail.ac.uk/cgi-bin/webadmin?SUBED1=ECORDSO&A=1
The list should be auto-selected as "ECORDSO Public Announcement list for the ECORD Science Operator", but please check first along with the other sign-up options.

Our science and operations teams would be happy to offer video calls directly with staff on the vessel for educational or informational purposes. Please contact our Outreach and Public Engagement officer (details below) to arrange this.

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Frequently Asked Questions

Under what regulations will this research be done?

The ECORD Science Operator, led by the British Geological Survey, is working with the US National Science Foundation (NSF), the US Department of State and the US Army Corps of Engineers (USACE) to ensure that all permissions are obtained before work commences.

As part of the permitting process, relevant stakeholders and interested parties were consulted (e.g., National Ocean Atmospheric Administration [NOAA], National Marine Fisheries Service [NMFS], Bureau of Ocean Energy Management [BOEM], Environmental Protection Agency [EPA], Department of Energy [DOE], Coastal Zone Management Offices, and Tribal Historic Preservation Officers). These interactions have raised awareness of the project and the proposed operations, and should ensure that all regulations are met and that best practices for environmental stewardship are followed.

Through the involvement of a federal agency in the project (NSF), a Draft Environmental Assessment was produced and is available online at the NSF Environmental Compliance website at https://www.nsf.gov/funding/environmental-compliance. Please scroll down to New England Shelf hydrogeology study, NW Atlantic, 2025. The Draft Environmental Assessment addresses the project's potential impacts, and the measures we will put in place to mitigate and remove those impacts.

Do these aquifers contain water that could be used as a source of drinking or irrigation water?

We are not evaluating if or how this fresh-to-freshened water could be used. Our goal is to characterize the salinity of the water in this offshore aquifer system. We anticipate sampling water that may have near-zero salinity as well as water that will have salinity similar to the ocean. In addition to directly measuring the salinity, we would establish the distribution of water with differing salinity and evaluate how that distribution was created through natural processes including sea-level change and glaciation, and how it is responding to modern sea-level change.

Is there a risk of contaminating the aquifers?

There would be minimal impact to the offshore freshened groundwater system. Our boreholes would be 5.5 inches in diameter and would only be open during drilling. Once drilling is complete, the boreholes would naturally collapse, which would seal the subsurface aquifers from the seawater above.

Will the drilling vessel be visible from shore?

Our three drill sites are approximately 20, 27 and 43 miles south and southwest of Nantucket Island. In general, a person can see approximately 2.8 miles (2.4 nautical miles) offshore, and an object elevated 66 feet above sea-level can be seen from approximately 9.9 miles (8.6 nautical miles), so operations are unlikely to be visible by a person standing on the shoreline. To see the liftboat from shore, a person would need to be standing 160 feet above sea level.

Is this project related to exploration for oil and gas?

Our research has no relation to oil and gas exploration, and safety evaluations of our drilling locations show no indication of oil or gas in the region. By intent, scientific ocean drilling avoids locations where oil and gas could be encountered.

Is this work related to wind farm activity?

Aside from geographic proximity and the use of specialized marine vessels for our drilling operations, this research has no relation to wind farm activity. Once we have completed our research there would be no visible evidence of our operations.

How will the expedition data be made available?

All data collected by the expedition will be freely available on the IODP³ website https://iodp3.org/ to anyone worldwide from early 2027.

Some initial results may be announced at the end of the offshore operation, but only a very small proportion of the analyses necessary would be possible at sea. The detailed scientific description would be carried out by the Science Team at a core analysis workshop that would be held in Bremen, Germany in early 2026. Here, the Science Team would undertake a detailed description of the cores and their properties.

After this Onshore Operation, the Science Team would have another 12 months to conduct in-depth research on the samples. This detailed scientific work would be published in scientific journals in the years after the expedition.

What are the origins of this project?

In the 1970's, the US Geological Survey conducted the Atlantic Margin Coring (AMCOR) Project[5] to understand the geological system of the US Atlantic Margin from Florida to New Hampshire. This included characterization of sediments, fluids in the sediments, and mineral resources along the margin. One surprising discovery was the presence of freshened/slightly saline water in seafloor sediments. Since this initial, anecdotal discovery, other studies have found similar phenomena around the globe (see Figure 1). To date, however, no dedicated, hydrogeological study of an offshore freshened groundwater system has been completed. This project will be the first dedicated study linking those early discoveries to the processes that created the freshened water. This will help us better understand the formation, evolution, and longevity of such systems globally.

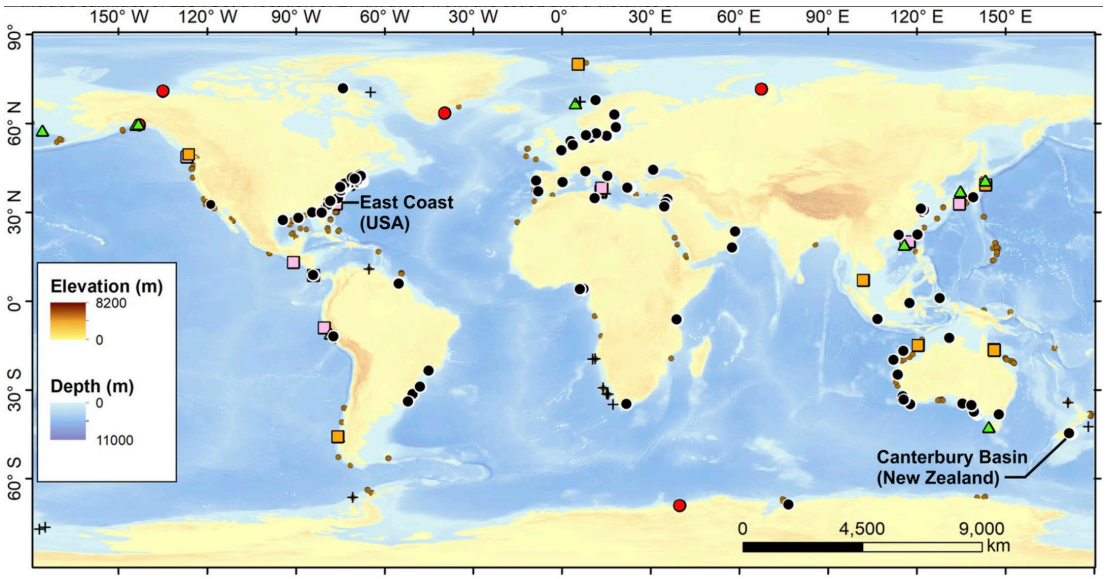

Figure 1: Locations of interpreted offshore freshened groundwater (symbols) around the world (image from Micallef et al., 2021).

[5] https://www.usgs.gov/publications/data-file-1976-atlantic-margin-coring-amcor-project-us-geological-survey

How can I learn about the detailed science of this project?

General Readings and News Pieces

- East Coast has a giant offshore freshwater aquifer – how did it get there? By Hannah Richter https://arstechnica.com/science/2024/05/what-put-huge-quantities-of-freshwater-under-the-seabed/
- Off Martha's Vineyard, a mysterious pool of freshwater beneath the sea floor by Eve Zuckoff https://www.capeandislands.org/local-news/2023-06-02/off-marthas-vineyard-a-mysterious-pool-of-freshwater-beneath-the-sea-floor
- Found: Giant Freshwater Deposits Hiding under the Sea by Rob L. Evans https://www.scientificamerican.com/article/found-giant-freshwater-deposits-hiding-under-the-sea/
- A massive freshwater reservoir at the bottom of the ocean could solve Cape Town's drought – but it's going untapped by Evan Lubofsky https://www.theverge.com/2018/2/15/17012678/cape-town-drought-water-solution
- Fresh Water below the Seafloor? By Evan Lubofsky https://www.marinetechnologynews.com/news/fresh-water-below-seafloor-548449
- Tapping the Freshwater Ocean Under the Sea by Evan Lubofsky https://hakaimagazine.com/news/tapping-freshwater-ocean-under-sea/

Podcasts

- Unconventional Freshwater Resources on Longitude Sound Bytes with Emory Mckenzie https://longitude.site/unconventional-freshwater-resources/
- Under the Sea: Hidden Freshwater Reserves on What About Water? With Jay Famiglietti https://podcasts.apple.com/us/podcast/under-the-sea-hidden-freshwater-reserves-with/id1485919205?i=1000583909840
- There's Water Under the Water on This Week in Water on H20 Radio https://exchange.prx.org/pieces/195913?m=false

Scientific Publications

- Micallef, A., Person, M., Berndt, C., Bertoni, C., Cohen, D., Dugan, B., Evans, R., Haroon, A., Hensen, C., Jegen, M., Key, K., Kooi, H., Liebetrau, V., Lofi, J., Mailloux, B.J., Martin-Nagel, R., Michael, H.A., Müller, T., Schmidt, M., Schwalenberg, K., Trembath-Reichert, E., Weymer, B., Zhang, Y., Thomas, A.T., 2021, Offshore freshened groundwater in continental margins, Reviews of Geophysics, 58, e2020RG000706, https://doi.org/10.1029/2020RG000706.
- Gustafson, C., Key, K., Evans, R.L., 2019, Aquifer systems extending far offshore on the U.S. Atlantic margin. Scientific Reports, 9(1), 8709, https://doi.org/10.1038/s41598-019-44611-7
- Siegel, J., Person, M., Dugan, B., Cohen, D., Lizarralde, D., Gable, C., 2014, Influence of Late Pleistocene Glaciations on the Hydrogeology of the Continental Shelf Offshore Massachusetts, USA, Geochemistry, Geophysics, Geosystems, 15, https://doi.org/10.1002/2014GC005569.
- Siegel, J., Dugan, B., Lizarralde, D., Person, M., *DeFoor, W., *Miller, N., 2012, Geophysical evidence of a late Pleistocene glaciation and paleo-ice stream on the Atlantic Continental Shelf, offshore Massachusetts, USA, Marine Geology, 303-306, 63-74, https://doi.org/10.1016/j.margeo.2012.01.007.