Frequently Asked Questions

IODP³-NSF Expedition 501
New England Shelf Hydrogeology
May – August 2025

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IODP³-NSF Expedition 501: New England Shelf Hydrogeology

The expediton briefly explained

In this expedition the scientific focus is exploring offshore groundwater systems. Offshore fresh, or freshened, groundwaters are considered an 'unconventional water resource' that could reveal a previously unknown immense reservoir of water potentially usable to face future water scarcity crises. These groundwater resources are known to exist, but they are extremely poorly known. Scientific investigation on the nature, extent, renewability and quality of this groundwater system is a mandatory step before any plan is made for their use.

What will you be doing and what are the goals of the project?

Our scientific drilling expedition, known as IODP³-NSF Expedition 501, aims to understand how groundwater systems under land are connected to sub-seafloor groundwater systems discovered in the past 50 years. The expedition also aims to understand the role that sea-level change and glaciation may have played over tens-to-hundreds of thousands of years in charging these offshore aquifers with freshened/slightly saline water. We hypothesize that freshened water may exist in confined aquifers extending to 30 miles (26.1 nautical miles) from the Cape and Islands. As part of this three-month effort, we will use a lift-boat platform to drill into the seafloor in three locations south of Martha's Vineyard to collect water and sediment samples to better understand these aquifers. During operations, we will collect small samples (less than 10 ounces) of water from sediment cores and larger volumes (less than 1000 gallons) pumped from the wells to assess the chemical composition and age of water in the offshore aquifers. Upon completion of our offshore operations, the wells we drilled will close naturally and reseal the aquifer. No additional water will be collected and no infrastructure for additional water sampling or pumping will be left on the seafloor or in the wells.

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 will be fresh having near-zero salinity as well as water that will have salinity similar to the ocean. In addition to directly measuring the salinity, we will 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 will be minimal impact to the offshore freshened groundwater system. Our wells will be 5.5 inches in diameter and will only be open during drilling. Once our drilling is complete, the wells will naturally collapse, which will seal the subsurface aquifers from the seawater above.

Under what regulations or guidelines will this research be done?

ECORD Science Operator (ESO) is working with the US National Science Foundation (NSF) and the US Department of State to ensure that all relevant stakeholders and

interested parties (e.g., National Ocean Atmospheric Administration [NOAA], National Marine Fisheries Service [NMFS], Bureau of Ocean Energy Management [BOEM]) are aware of the project and proposed operations, that all regulations are being met, and that best practices for environmental stewardship are being followed.

What are the origins of this project?

In the 1970's, the US Geological Survey conducted the Atlantic Margin Coring (AMCOR) [https://www.usgs.gov/publications/data-file-1976-atlantic-margin-coring-amcor-project-us-geological-survey] Project 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.

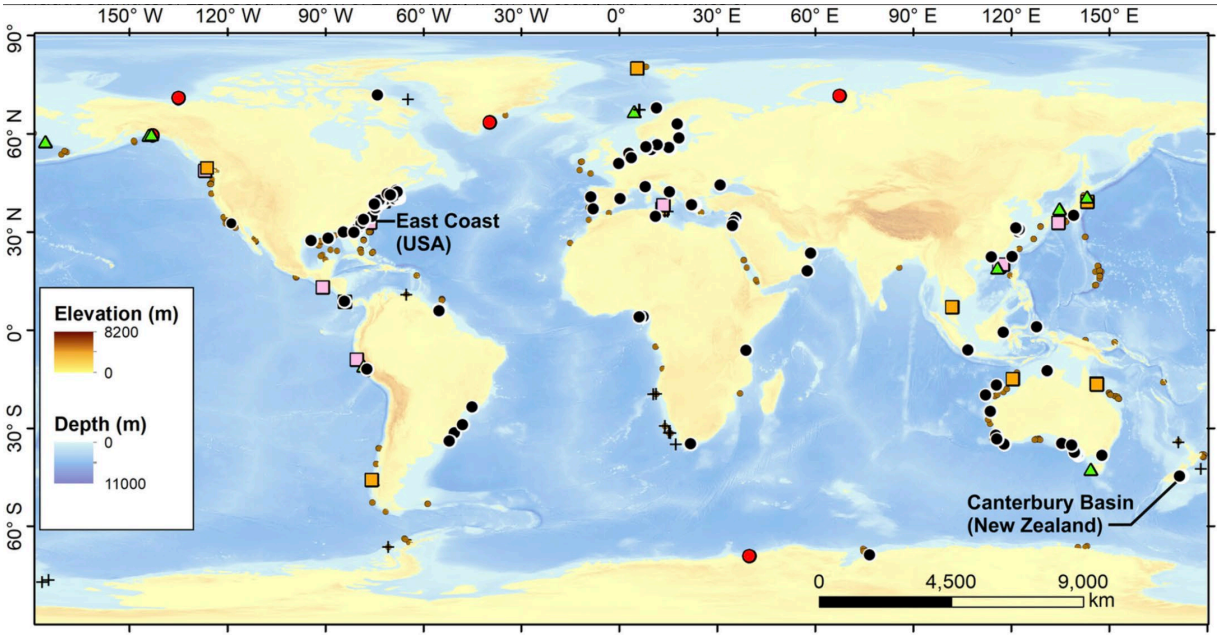

Figure 1: Locations of interpreted offshore freshened groundwater (symbols) around the world (image from Micallef et al., 2021).

Will the drilling vessel be visible from shore?

The L/B Robert's legs are 335 feet (102 meters) tall. At the site closest to shore (19.7 miles from Nantucket), the water depth is 41 meters meaning the top of the legs will be 61 meters above sea level. Using a distance-to-horizon formula that takes into account both the observer's and the object's height, we have calculated that the very top of the L/B Robert's legs will be visible from a distance of 20.4 miles. Therefore, it is geometrically possible to see the top of the legs from shore, if there are clear visibility conditions. In reality, the L/B Robert would be a speck on the horizon as seen from shore, and probably only visible through binoculars.

The main body of the platform will be much lower, approximately ~20 meters (66 feet) above sea level. A structure at this height would only be visible within 12.9 miles of the vessel, and would not be visible from shore."

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 location show no indication of oil or gas in the drilling region. By intent, scientific ocean drilling is not done in 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 will be no visible evidence of our operations.

Who is involved in the project?

This international scientific research project is funded by IODP³, an international marine research consortium, and the US National Science Foundation (NSF). The project currently includes 29 scientists representing 13 countries all of whom will contribute to the scientific objectives through sample collection, data analyses, and dissemination of results and interpretations.

How can I learn more about the project?

Technical Overview of Offshore Freshened Groundwater

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.

Expedition 501 Specific Readings

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.

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

Program and generic questions

What is IODP³?

The International Ocean Drilling Programme (IODP³) [Link: https://iodp3.org/]is an international marine research collaboration that explores Earth's history and dynamics using ocean-going research platforms to recover data recorded in seafloor sediments and rocks and to monitor subseafloor environments. IODP³ builds upon the earlier successes of the Deep Sea Drilling Project (DSDP) [Link: https://www.iodp.tamu.edu/publicinfo/glomar_challenger.html], Ocean Drilling Program (ODP) [Link: http://www-odp.tamu.edu/index.html], the Integrated Ocean Drilling Program (IODP) [Link: https://www.iodp.org/iodp-legacy/iodp-2003-2013-documents] and the International Ocean Discovery Program (IODP) [Link: IODP.org], which revolutionized our view of Earth's history and global processes through ocean basin exploration.
IODP³ depends on facilities funded by two platform providers with financial contributions from additional partner agencies. Together, these entities represent 16 nations whose scientists are selected to staff IODP³ research expeditions conducted throughout the world's oceans, and large-scale Scientific Projects using Ocean Drilling Archives (SPARCs).

What is ECORD?

ECORD stands for the European Consortium for Ocean Research Drilling [ecord.org], one of the two IODP³ platform providers. ECORD is a distributed infrastructure for scientific ocean drilling that supports scientists based in Europe and Canada, implements offshore expeditions, manages scientific ocean drilling legacy cores and data, promotes the submission of scientific proposals and implements education, communication and outreach activities.

Who will conduct the drilling operations?

The ECORD (European Consortium for Ocean Research Drilling) Science Operator (ESO) will manage and oversee the technical, drilling, and scientific operations. The British

Geological Survey (BGS) acts as the coordinator; the European Petrophysics Consortium (EPC) provide logging and petrophysical activities and MARUM, University of Bremen carries out all core curation and data management tasks. All ESO members provide a wide range of operational expertise and support from initial contracts to geochemists, drilling experts to media relations.

What are Mission Specific Platform Expeditions?

Mission Specific Platform Expeditions (MSPs) are unique in that they use a wide array of vessels and/or drilling and coring systems to carry out specific scientific drilling. The MSP concept allows to select the adequate technology to achieve scientific objectives and tailor expeditions to better adapt to the scientific needs.

How can I find out about the results of IODP³ mission-specific platform expeditions?

Because only a very small proportion of core analyses is possible at sea only some initial results may be published in scientific journals at the end of each offshore expedition. The detailed scientific description of cores and data will be carried out by a larger group of international scientists in the Bremen Core Repository at the MARUM – Center for Marine Environmental Sciences at the University of Bremen, Germany, in early 2026. Here, they will undertake a detailed description of the cores and their properties.

After this Onshore Operations phase, scientists will have another twelve months to go back to their own labs to do even more in-depth research on samples before the initial cruise information is published in the Expedition Proceedings [https://iodp3.org/publications/]. Detailed scientific work will be published in scientific journals.

Open access to the complete data set acquired during both offshore and onshore phases of the expedition will possible one year after the end of the meeting of the full Onshore Science Team in Bremen, free of charge, on the IODP³ website. In addition, any interested and suitably qualified scientist may sample the cores stored at the Bremen Core Repository for research purposes, again after the one year-moratorium period.

Who is paying for the expedition?

Operational costs are funded by contributions from government science funding organisations of 14 European nations and Canada, forming the European Consortium for Ocean Research Drilling (ECORD). ECORD's member countries and funders are currently: Austria, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.
Expedition 501 is co-funded by the US National Science Foundation (NSF) and is, therefore, an IODP³-NSF expedition.

What is the difference between drilling and coring?

Drilling is the process of penetrating the seabed with a set of rotating metal pipes led by a drill bit. Coring involves recovering the penetrated sediments or rocks in 10 m-long cylindrical samples (core) in a plastic tube that travel inside the pipes (wireline) back to the drilling vessel's deck. This can then be examined and analysed by scientists.

What is downhole logging?

Downhole logging operations involve the deployment of a variety tools down the hole on a wire after drilling in order to collect a range of in-situ data that complements the data collected in cores.

How can I follow the operation?

Regular updates will be provided on the expedition website at www.ecord.org and

https://expedition501.wordpress.com/

Additionally, updates and information will be regularly posted on:
Our Blogsite – https://expedition501.wordpress.com/
YouTube – https://www.youtube.com/@ECORDESO
Instagram – @ecord_iodp
Bluesky - @ecord.bsky.social

When and where will results of your research be available?

All data collected by the project will be freely available from the IODP³-website [https://iodp3.org/expedition/501/] to anyone worldwide one year after the onshore analyses, which will happen in early 2026.

Some initial results may be announced at the end of each offshore operation, but only a very small proportion of the analyses necessary will be possible at sea. The detailed scientific description will be carried out by a larger group of international scientists in the Bremen Core Repository at the MARUM at the University of Bremen, Germany. Here, they will undertake a detailed description of the cores and their properties.

After this Onshore Operations, scientists will have another 12 months to go back to their own labs to do even more in-depth research on the samples before the initial cruise information is published. Detailed scientific work will be published in scientific journals.

Will fishing and marine tourism be impacted by operations?

We will spend approximately 30 days drilling at each site and will not be mobile during each drilling period. Our location and lack of mobility will be updated and broadcast daily so recreational and commercial fishing boats and other marine vessels will be aware of our presence and lack of mobility. The minor impact on fishing and tourism will be confined to the fact that boats will have to move around our fixed location. Once operations are completed, there will be no impact on fishing or marine tourism.

Does drilling into the seabed affect the local environment?

The vessel hosting the drilling rig is operated according to international regulations for environmental protection. Similarly, the drilling operating platform conforms to all statutory regulations. All precautions are taken by the drilling rig operators to ensure that no solid or fluid materials are dispersed at sea from the platform during operations. All waste produced on the rig is returned to land for appropriate disposal. Residual chips of drilled sediment/rocks (cuttings) brought to the seabed surface by the seawater circulated in the hole are discharged to the sea bed.

All drilling sites are approved by a panel of international experts that formed the Environmental Protection and Safety Panel and its successor the Safety and Environment Advisory (SEA) Group in IODP³. In case of drilling in waters under national jurisdiction, national authorities release the authorization after reviewing safety regulations and ensuring that no obstacles are present at the seabed at the proposed drilling locations.

Do you carry out any activities that can affect the local wildlife?

Drilling expeditions are operated in line with established best practices and follow the authorization of the authorities of the nation with jurisdiction on the interested water and seabed. Any needs to implement mitigation measures for the impact on marine mammals are established during the authorization process.

Are you looking for oil or gas?

No, IODP³, like all past programs of scientific ocean drilling, drills into the seabed for science.

Oil and gas reservoirs would impede the collection of cores and data useful for scientific purposes, and would generate hazard for drilling: The geophysical data used to support drilling site locations are meticulously checked by world-wide experts to ensure that no hydrocarbons are present where the drilling is planned.

Contact:

ECORD – European Consortium for Ocean Research Drilling: www.ECORD.org
IODP³ – International Ocean Drilling Programme: www.iodp3.org

Co-Chief Scientists
Prof. Brandon Dugan
Colorado School Of Mines
Email: dugan@mines.edu

Prof. Karen Johannesson
University of Massachusetts Boston
Email: Karen.Johannesson@umb.edu

Expedition Project Manager
Jeremy Everest (lead), Margaret Stewart
British Geological Survey (BGS)
Email: jdev@bgs.ac.uk, mstewart@bgs.ac.uk

Outreach and Public Engagement
Ulrike Prange
MARUM – Center for Marine Environmental Sciences University of Bremen
Email: uprange@marum.de

ECORD
European Consortium for Ocean Research Drilling

IODP³
INTERNATIONAL OCEAN DRILLING PROGRAMME