



INTERNATIONAL OCEAN DRILLING PROGRAMME

SECOND CALL FOR PARTICIPATION

IODP³-NSF Expedition 501:
New England Shelf Hydrogeology
Deadline: 13 November 2026

Second Call for Participation in IODP³-NSF Expedition 501: New England Shelf Hydrogeology



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Introduction

Offshore freshened groundwater (OFG) systems, defined as subseafloor environments with porewater that has salinity less than seawater salinity, have been documented worldwide, yet the hydrogeological, geochemical, and microbiological evolution and dynamics of these systems have not been directly evaluated (e.g., [Post et al., 2005](#); [Micallef et al., 2020](#)). Prior ocean drilling data have documented OFG beneath the Atlantic continental shelf off New England, with further investigation of extent and emplacement mechanisms using marine electromagnetic surveys, and hydrogeological models (e.g., [Cohen et al., 2010](#); [Hathaway et al., 1979](#); [Gustafson et al., 2019](#); [Mountain et al., 2009](#); [Person et al., 2025](#); [Siegel et al., 2014](#)). IODP³-NSF Expedition 501 was developed and implemented to collect sediment, fluid, and microbiological samples that will help us evaluate the dynamics of the OFG system south of Martha's Vineyard and Nantucket, Massachusetts, USA. Expedition 501 specifically aimed to understand the geological evolution of the aquifer and aquitard system within the continental shelf, the timing and driving mechanism(s) of OFG system emplacement, the abundance and activity of the microbiological ecosystem in the OFG system, and the role of groundwater in biogeochemical cycling within shelf sediments ([Dugan et al., 2025](#)). This dedicated hydrogeological expedition provided data and samples to better constrain the local OFG system within the US Atlantic continental shelf and will also improve our understanding of OFG systems around the world.

Nature and extent of core materials recovered

Expedition 501 drilled Sites M0112, M0111, and M0113 along NNW-SSE transect on the southern New England continental shelf offshore Martha's Vineyard and Nantucket. Water depths at the sites ranged from 41 to 54 m and drilling was completed at 339.82 mbsf (Site M0112), 392.93 mbsf (Site M0111), and 325 mbsf (Site M0113). In addition to standard IODP³ measurements, a removable packer system was deployed to allow fluid sampling from aquifer units through pumping tests at each site, and long-term observatories were installed at Sites M0112 and M0113 to collect formation temperature, resistivity, and pressure data. Observatory data recovery is

planned for summer 2027. Core recovery for the expedition was 71% and 10,500 litres of water was sampled during pumping tests for post-expedition geochemical, noble gas, and microbiological analyses. In addition to sediment and fluid samples, all three sites were logged with natural gamma radiation, magnetic susceptibility, electrical resistivity, and nuclear magnetic resonance wireline tools. Initial offshore and onshore analyses document an unconsolidated sedimentary package consisting predominantly of alternating layers of sand and mud that spanned from present to late Cretaceous in age and document marine and terrestrial depositional environments. Interstitial water and pumped groundwater from the nearshore Sites M0112 and M0111 confirm a transition from seawater salinity to less than 10% of seawater salinity within the upper 125 mbsf. Furthest offshore at Site M0113, two freshened zones with salinity that is 50-60% of seawater salinity exist above 300 mbsf. The OFG system spans the marine and terrestrial depositional environments. Aquifers and aquitards have similar salinity in the freshened zones, consistent with interpretations of marine-based electromagnetic surveys previously collected. Noble gas and groundwater collected during the pumping tests were preserved for water age analyses.

Analyses already being conducted by the Science Team

During offshore and onshore operations, and continuing during post-expedition research the Expedition 501 is actively working on the following scientific measurements and assessments of the OFG system:

- Lithostratigraphy – visual core description, smear slide description, bulk powder XRD and XRF analyses, XRF scanning, CT scanning, grain-size distribution measurements, natural gamma radiation (wireline, MSCL), and core-log-seismic integration;
- Geochemistry – alkalinity, pH, ammonium, salinity, chloride, bromide, sulphate, major and minor element analysis, hydrogen sulfide, total carbon, total inorganic carbon, total organic carbon, radiocarbon, nitrogen isotopes, sulphur isotopes, oxygen isotopes, hydrogen isotopes, and chlorine isotopes;
- Noble gases of pumped groundwater – radon, oxygen, argon, helium, and krypton;
- Hydrogeology – water level drawdown data, permeability, storativity, and groundwater and solute transport modeling;
- Biostratigraphy – calcareous nannofossils, planktonic foraminifera, and palynology;
- Petrophysics and physical properties – moisture and density, porosity, magnetic susceptibility, natural gamma radiation, nuclear magnetic resonance (porosity, T2

relaxation), electrical resistivity, formation factor, undrained shear strength, and cation exchange capacity;

- Microbiology – abundance, community structure and function, rRNA, eDNA, metabolomics, and lipids.

Potential new approaches identified by the Science Team

Based on the completed offshore and onshore operations and initial analyses of samples and data collected during Expedition 501, the Science Team identified potential research opportunities that will help expand the knowledge base of OFG systems and expand the impact of the geological evolution of the active OFG system within the US Atlantic continental shelf:

- **Glacial sedimentology and geomorphology** for assessing depositional and erosive evolution of the margin and connectivity of aquifers and aquitards as well as estimates of glacial extent and thickness on the margin;
- **Onshore-offshore stratigraphic correlation** for improved characterization of linkages between onshore and offshore aquifer systems;
- **Terrestrial basin analysis** for deciphering the depositional processes in the late Cretaceous and character of ancient aquifer systems;
- **Terrestrial paleoclimate proxy analysis** for evaluation of early hydrogeological, biogeochemical, and microbiological systems before the system became a passive, marine margin; and
- **Novel geochronological tools** that can help extend our transect evaluation to a margin-wide context especially in the context of paleoenvironment.

Applications are welcomed from scientists in **IODP³ Core and Associate Member nations and the US** proposing to either: (a) adopt these or any other approaches to address the original objectives of the expedition without duplicating the plans of the original Science Team; or (b) use core samples recovered during the expedition to address new objectives and deliver new science not envisaged by the original expedition proposal ([Dugan et al., 2025](#)).

How to Apply

Applications from scientists based in **IODP³ Core and Associate Member nations and the US** must be submitted to the IODP³ Science Office by the deadline of **23:59 BST on Friday 13 November 2026** using the **IODP³ Gateway** system, accessed via “Apply to Participate” on the **IODP³ website**.

Information on the content required in applications to this call is available in the IODP³ [Guide for Applicants](#) (Note that the applicant role for this call is **Sample Request**; see Section 4.1 in the guide)

Applications received by the deadline will be evaluated by the appropriate Programme Member Office and shortlisted candidates will be considered for selection by ESO and the Co-Chief Scientists.

- For further expedition details from ESO, please contact:
Margaret Stewart, Expedition Project Manager, mstewart@bgs.ac.uk
- For further scientific details, please contact:
Brandon Dugan, Expedition 501 Co-Chief Scientist, dugan@mines.edu
Rebecca Robinson, Expedition 501 Co-Chief Scientist, rebecca_r@uri.edu
- For enquiries about the application process and IODP³ Gateway, please contact:
Jodie Fisher, IODP³ Science Office, applications@iodp3.org