Environmental Studies Program: Ongoing Study

Field	Study Information
Title	Characterization of Water Column Habitats to Understand Potential Impacts fro
Administered by	Pacific OCS Region
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Procurement Type(s)	Cooperative Agreement
Conducting Organization(s)	University of Alaska Fairbanks
Performance Period	FY 2024–2026
Final Report Due	July 31, 2027
Date Revised	April 14, 2025
Problem	Despite being the largest habitat type in the world, there are large knowledge gaps concerning water column biology and chemistry. Energy and mineral development could impact the water column and its biota through discharges, introduction of anthropogenic structures and noise, and changes in local hydrography. To inform environmental reviews, BOEM needs to first identify relevant water column parameters and catalog local biodiversity that could be affected by BOEM-approved projects.
Intervention	This study proposes to leverage planned research cruises for water column data collection. The addition of a water column component could add value in ways that are cost-effective and complementary to planned cruise plans and operations.
Comparison	Multiple water column samples (including for environmental DNA (eDNA) analysis) and underwater video will be collected within one or more regions of BOEM interest. The samples will describe a snapshot of water column structure that could provide insight on the variety and extent of deepwater habitats and inform future investigations that describe the ecosystem at finer scales should development proceed.
Outcome	Integration of water column data into environmental analyses could lead to more informed decision-making and more effective environmental protections.
Context	BOEM areas of interest with planned research cruises, such as Hawai‘i

BOEM Information Need(s): Existing knowledge gaps of water column habitats must be addressed for comprehensive environmental analyses, including of cumulative impacts and adequate mitigation measures. This study will provide data that characterize water column environments that could potentially be disrupted by BOEM-managed activities, which may manifest through seafloor or sea surface mechanisms. The resulting data could contribute to knowledge of pelagic systems that are highly dynamic and difficult to study. With industries moving into deeper waters further offshore, these water column data are necessary to understand environmental conditions and associated natural variation.

For example, current seabed mining technologies are expected to produce sediment plumes with unknown environmental impacts (Gollner et al. 2017, Gillard et al. 2019). BOEM needs data for these water column habitats to assess what those impacts are likely to be. This study is responsive to a FY 2024–2025 Stakeholder Input letter that emphasizes the need to collect water column data to help inform potential OCS development activities.

Background: Although the pelagic ocean is the largest ecosystem on earth, it remains poorly understood due to its vast size and three-dimensional, highly dynamic nature (e.g., Perelman et al. 2021). Very little of the water column, especially that deeper than the epipelagic (0–200 m), has been described in any detail (Netburn 2018). However, we know that important processes occur throughout the water column, such as the biological pump (Passow and Carlson 2012), diel vertical migration (Sutton 2013, Kelly et al. 2019), other mechanisms for connectivity (Sutton 2013), and food web dynamics (Choy et al. 2017). As industries move to deeper waters of the OCS, it is imperative to learn more about how these habitats may be potentially impacted, specifically sites of commercial interest.

Water column information can be collected by traditional oceanographic equipment, especially when supplemented by new techniques and technology. In addition to physical and chemical profiles of the water column, Conductivity-Temperature-Depth (CTD) rosette casts can collect water samples to evaluate the biological community through eDNA sampling. Cameras can also be integrated onto CTD rosettes to help image these pelagic environments; deeper habitats are rarely visualized. This study is intended to fund the integration of a complementary water column component into planned research cruises in locations of BOEM interest. One example is the planned Hawai‘i mineral resource evaluation cruise that is co-funded by BOEM’s Marine Minerals Program and Pacific OCS Region (currently scheduled for fall 2025).

This study could also contribute to national and international initiatives. The National Strategy on Ocean Mapping, Exploration, and Characterization (NOMEC) has identified the water column as one of its national strategic priorities, in particular improved characterization of water column biology, biogeochemistry, physical properties, and oceanographic trends (Interagency Working Group on Ocean Exploration and Characterization 2022). The Japanese government’s Strategic Innovation Promotion (SIP) Program has provided considerable funding to support research and development of low-cost and highly efficient technologies and procedures to assess the environmental impact of resource exploration and extraction, including in the midwater. BOEM should evaluate potential collaborations related to past and planned NOMEC and SIP activities.

Objectives: The purpose of this study is to collect water column data that address BOEM information needs for environmental analyses. Specific objectives include:

- Characterize water column habitats in areas of BOEM interest by collecting environmental data.
- Test water column techniques and technologies for integration into resource evaluation and environmental monitoring operations. Given limited days-at-sea, the development of a low-cost sampling and sensor instrumentation package/module that is easily integrated and deployed with standard operations would be ideal.

Methods: BOEM is partnering with the University of Alaska Fairbanks to collect environmental data, such as temperature, salinity, turbidity, oxygen, pH, carbon, and species presence/absence and distribution (via eDNA), from water column habitats on appropriate cruises of opportunity. Planning must occur well in advance to ensure that the midwater component is fully integrated in science

operations. We anticipate funding new or expanded water column components on approximately three cruises. The scope of water column operations on each cruise will be designed to address the highest priority BOEM information needs while taking into account any pre-existing science plans and available planning horizon. One potential opportunity is the Hawai‘i mineral resource evaluation expedition. Optical sensors (e.g., high-definition cameras, shadowgraphs) will be integrated onto a CTD rosette to survey the water column and water samples will be collected for eDNA analysis. Traditional plankton net sampling will complement the CTD operations; net-caught organisms will be provisionally identified morphologically before DNA barcoding to validate species identifications. Any imagery collected (e.g., via CTD rosette-mounted camera, remotely operated vehicle) will be analyzed.

Specific Research Question(s):

1. What water column features and anomalies exist that can be remotely imaged, e.g., via split-beam sonar?
2. What are the physical and chemical properties of the water column nearby prospective lease areas?
3. What pelagic biological communities live at what depths? Do they exhibit any behaviors of note?

Current Status: In progress – Fieldwork on the NOAA Ship Bell M. Shimada in northern California was completed in 2024 and data are being processed. Fall 2024 expedition in Hawai‘i postponed due to technical issues; rescheduled for fall 2025. Additional fieldwork opportunities for 2025 are currently being discussed.

Publications Completed: N/A

Affiliated WWW Sites: N/A

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