| Field | Study Information |
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| Title | Characterization of Water Column Habitats to Understand Potential Impacts from Deepwater Energy and Mineral Development (PC-24-03) |
| Administered by | Pacific OCS Region |
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| Procurement Type(s) | Cooperative Agreement, Interagency Agreement(s) |
| Performance Period | FY 2024–2026 |
| Final Report Due | TBD |
| Date Revised | April 27, 2023 |
| 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 associated with lease area identification and NEPA documents, BOEM needs to first identify relevant water column parameters and catalog local biodiversity that could be affected by BOEM-approved projects, such as offshore renewable energy development, marine minerals operations, and conventional energy development. |
| 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 prospective for leasing offshore Hawai'i. 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 | Hawai'i EEZ and other areas of BOEM interest with planned research cruises. |

BOEM Information Need(s): Existing knowledge gaps of water column habitats are relatively broad and include foundational themes such as what lives in the water column and where, how the water column is structured, natural variability, anthropogenic influences, and likely unknown unknowns (Netburn 2018, Interagency Working Group on Ocean Exploration and Characterization 2022). This study will generate data to 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 will contribute to baseline 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, baseline environmental data can improve understanding of environmental risks and potential impacts of floating offshore wind, such as changes in organism behavior and displacement (Maxwell et al. 2022). Additionally, current seabed mining technologies are expected to produce sediment plumes with unknown environmental impacts (Gollner et al. 2017, Gillard et al. 2019). BOEM needs baseline data for these water column habitats to identify which resources may be impacted and 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 characterized and 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 potential impacts to these habitats, 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 marine mineral and offshore wind-related research cruises in locations of BOEM interest. Some examples are surveys for floating offshore wind projects and the planned Hawai'i Crescent resource evaluation cruise that is co-funded by BOEM's Marine Minerals Program and Pacific OCS Region.

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 support BOEM information needs in conducting environmental analyses. Specific objectives include:

- Characterize water column habitats in areas of BOEM interest by collecting baseline 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.

Intended study outcomes are data products (e.g., species inventories, habitat maps, physical and biogeochemical profiles) that synthesize and summarize findings for BOEM use, such as in describing the affected environment, assessing potential impacts, and developing adequate mitigation measures.

Methods: BOEM anticipates partnering with an academic institution to collect environmental data, such as temperature, salinity, turbidity, oxygen, pH, carbon, and species presence/absence and distribution (via active acoustics, such as side-scan sonar, and 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 Crescent 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. Tow 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: N/A

Publications Completed: N/A

Affiliated WWW Sites: N/A

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