

Environmental Studies Program: Ongoing Study

Field	Study Information
Title	Developing a Critical Minerals Environmental Assessment Framework (CMEAF) for Critical Minerals Activities (MM-24-01)
Administered by	Marine Minerals Program
BOEM Contact(s)	Jennifer Le (jennifer.le@boem.gov), Mark Mueller (mark.mueller@boem.gov), Paul O. Knorr (paul.knorr@boem.gov), Jessica Bravo (jessica.bravo@boem.gov)
Procurement Type(s)	Contract (IDIQ Task Order)
Conducting Organization(s)	National Academies of Science, Engineering, and Medicine (NASEM)
Total BOEM Cost	\$600,000 (ESP \$300,000; MMP \$300,000)
Performance Period	FY 2025–2027
Final Report Due	January 2027
Date Revised	April 8, 2025
Problem	The Outer Continental Shelf (OCS) contains many of the critical mineral (CM) resources needed to help meet domestic supply chain demand and reduce dependence on foreign sourcing. To develop the information needed to meet various statutes and Administration directives, BOEM needs objective scientific information about these resources and environments to sufficiently prepare for potential management of CM resource development.
Intervention	BOEM will engage the NASEM who will recruit and manage expert research scientists using their long-established processes. The resulting deliverables will inform BOEM's CMEAF .
Comparison	This study will assist BOEM in the development of mission-critical, statutorily required geological, environmental, and economic analyses, for this relatively nascent but nationally strategic program area where key information is currently lacking. Without such information, obtained from this highly credible, authoritative source, BOEM and DOI will be hindered in future program development and appropriate management efforts.
Outcome	This study will provide essential information for environmental analysts and resource managers when evaluating and permitting exploratory prospecting requests, lease sale requests, lease sales, and monitoring of extractive activities. With highly accurate information, operational mitigations can be precisely tailored and BOEM's dual mission mandate can be achieved.
Context	All OCS areas that may contain CM resources, including the Extended Continental Shelf.

BOEM Information Need(s): Available information needed by analysts related to the habitats where marine critical minerals (CM) occur (e.g., baseline conditions of the surrounding environment, relevant parameters, potential impacts of exploration and recovery activities, and mitigation options) is sparse. Documentation of prospecting, extraction, monitoring and mitigation methods, data, and references are disparate, found in scientific journals, governmental publications, and industry literature. In the event of

an unsolicited request for a lease sale (30 CFR 581.11), BOEM must inform the applicant within 45 days whether the steps leading to a lease sale will be initiated. BOEM staff need recent, focused, and reliable references and guidelines to expeditiously evaluate the initial request and support the continuing in-depth environmental analyses following the initial 45-day request response period. This project will develop a Critical Minerals Environmental Analyses Framework (CMEAF), consisting of references, BOEM-management specific guidelines, and expert synthesis of baseline information that is necessary for effective stewardship of OCS resources and environments. The results of this study will also help BOEM to identify and prioritize information needs that need to be addressed by future CM studies.

Background: The U.S. is lagging other nations in domestic CM planning and investments, including scientific research throughout the U.S. Outer Continental Shelf. The International Seabed Authority—which has jurisdiction over deep-sea mining in international waters—has issued 31 contracts for exploration and exploitation of deep-sea minerals, primarily polymetallic nodules in the Clarion-Clipperton Fracture Zone (CCZ), which covers about 1,700,000 square miles between Hawai'i and Mexico (Sharma, 2017). Although work related to environmental assessment and baseline data collection has been performed in the CCZ, those analyses do not provide sufficient information for BOEM to comply with U.S. statutory requirements including accurate descriptions of the Affected Environment and Impact levels under the National Environmental Policy Act (NEPA), Coastal Zone Management Act, and other relevant laws and regulations, including BOEM's Marine Minerals Program (MMP) regulation for competitive mineral prospecting (30 CFR 580), leasing (30 CFR 581), and operations (30 CFR 582). A series of recent Executive Orders (i.e., EO 13817, EO 13953, EO 14017, EO 14154, EO 14156) have recognized the national security and economic importance of this issue and directed federal agencies to take actions to bolster development of domestic CM resources.

CM are found as polymetallic nodules (“nodules”) on abyssal plains, ferromanganese crusts (“crusts”) on the flanks of seamounts, seafloor massive sulphides (SMS) associated with hydrothermal vents (e.g., “black smokers”), phosphorites, and nearshore placer deposits (“placers”). Nodules, which contain manganese, cobalt, nickel, and other minerals, accrete on the abyssal seabed, have attracted the most interest from industry and will likely be the first type of deep-sea mineral to be mined (Mizell et al., 2022). Nodule recovery is expected to have fewer environmental impacts compared to mining crusts and SMS deposits and is the primary, but not exclusive, focus of this study.

During 2021, BOEM received inquiries about Bureau regulations governing CM leasing and the type of environmental information needed to support such decisions in the BOEM regions. In 2022, BOEM's jurisdiction was changed to include portions of the territorial EEZ where nodules are thought to occur. In light of potential impending requests to develop OCS CM resources, BOEM needs this CMEAF project to inform environmental assessment guidance related to prospecting, leasing, and developing offshore CM, culminating in a comprehensive document that addresses the CM affected environment, the impact of CM recovery, transport, and refining processes, baseline data needed to assess these systems, and the environmental impacts associated with various prospecting and operational methods.

Multiple CMEAF related projects, funded by the MMP, have either been completed or are being planned along with this study. These cover CM resource evaluation/prospecting, mining, economics, and the novel extraction technologies that may be used operationally. Collectively, these reviews will document the mineral resources, associated environments, and economic considerations needed to evaluate CM activity requests and assist analysts in developing clear, understandable information for decision-makers. The study proposed here will most directly inform required environmental analyses.

The CMEAF study will also benefit other BOEM initiatives, including the Status of the Outer Continental Shelf project, and the National Offshore Critical Minerals Inventory, hosted within the existing Marine Minerals Information System (MMIS). The baseline data requirements identified by the CMEAF will inform the development of the MMIS as it expands to contain CM data.

Objectives: This study will improve BOEM environmental analyses by developing a series of CMEAF documents.

- The focus of this study is to identify information needs, determine which baseline environmental parameters should be gathered, and collect and collate existing information.
- The CMEAF should identify, describe, and prioritize information gaps that can be addressed by future CM environmental studies, including studies related to:
 - Identifying the environmental analyses information needed and data gaps associated primarily with nodules, while crusts, SMS, phosphorites, and placers will collectively receive less attention.
 - Identifying assessment needs specific to CM prospecting, leasing, and operations (i.e., testing, mining, decommissioning), culminating in a comprehensive document, which will describe: habitats where CM are found; the surrounding ecosystem; environmental impacts, including cumulative effects, associated with CM prospecting and operations actions; potential mitigations to reduce the impacts of CM actions; broader impacts of the associated CM transport and refining processes (e.g., vessel traffic, emissions, climate impact); and baseline data needed to assess these systems.
- All CMEAF documents will be accompanied by copies of referenced materials for MMP analyst use in developing further environmental assessment protocols. Development of specific standards, sampling methods, and detailed implementation guidelines are not anticipated to be part of this project.

Methods: BOEM will work with NASEM to develop a literature synthesis and expert recommendations. Existing pertinent information from similar efforts (e.g., sand and gravel, renewable energy studies, oil and gas studies, terrestrial resource studies, the International Seabed Authority's draft environmental guidelines) can be provided to NASEM as a starting point for this effort. The Academies will follow its regular processes, culminating in BOEM-relevant synthesized information presented in a detailed written report and webinar presentation.

Specific Research Question(s):

1. What are the technological feasibility and economic potential of extracting seabed minerals, including geologic resource potential of different types of deposits and the global state of industry practices?
2. What information is required to establish the baseline environment associated with deep-sea CM resources?
3. What are the potential impacts (physical, chemical, biological, geological, social, cultural, economic) associated with deep-sea CM prospecting and operations activities?
4. What are potential mitigations that can be applied to-deep sea CM prospecting and operations activities?

5. What type and scale (temporal, spatial) of monitoring is required to measure potential impacts and effectiveness of mitigations?

Current Status: Study awarded to NASEM in April 2025 with anticipated consensus report in January 2027.

Publications Completed: None

Affiliated WWW Sites: None

References:

Mizell K, Hein JR, Au M, Gartman A. 2022. Estimates of metals contained in abyssal manganese nodules and ferromanganese crusts in the global ocean based on regional variations and genetic types of nodules. In: Sharma R, editor. Perspectives on deep-Sea mining. Cham (Switzerland): Springer Cham. p. 53–80.

Sharma R. 2017. Deep-sea mining: current status and future considerations. In: Sharma R, editor. Perspectives on deep-Sea mining. Cham (Switzerland): Springer Cham. p. 3–21.