COMMITTEE ON
SCIENCE, SPACE AND TECHNOLOGY
CHAIRMAN BRIAN BABIN

SUBCOMMITTEE ON ENVIRONMENT
HEARING CHARTER

"Beneath the Waves: The Science and Technology of Deep-Sea Mining"
Thursday, March 26, 2026
10:00 a.m.
2318 Rayburn House Office Building

Purpose

The purpose of this hearing is to examine ocean exploration, science, and technology, including efforts to enable deep-sea mining for critical materials. The Committee will examine how the role of sea floor mapping, surveying, advancements in research, and the development of new technologies are supporting the expansion of this burgeoning enterprise. The hearing will also review policy options to ensure U.S. leadership.

Witnesses

- **Mr. Gerard Barron, Chief Executive Officer & Chairman, The Metals Company**
- **Mr. Brian Connon, Vice President for Ocean Mapping, Saildrone**
- **Dr. Robert D. Ballard, Ph.D., Chief Executive Officer, Ocean Exploration Trust**
- **Dr. Astrid Leitner, Assistant Professor of Oceanography, Oregon State University**

Background

Deep-seabed mining is the extraction of critical mineral resources from the ocean floor. The deep seabed contains valuable resources such as manganese, nickel, cobalt, copper, and rare earth elements. Critical minerals are used in everything from defense systems and batteries to smartphones and medical devices. Access to these minerals is a key factor in the resilience of U.S. supply chains.[1]

This hearing will include testimony from individuals in oceanographic communities to enhance sustainability and advance public-private partnerships within this critical industry. As the Committee looks toward its role in bolstering deep-sea mining technologies, the hearing will include insights into what data is currently accessible; how stakeholders —including the energy industry, the Army Corps of Engineers, and the general public — understand and use the data; and what technological gaps need to be addressed in the short and long term.

Ocean Resources

Oceans cover approximately 70% of the Earth's surface,[2] however, only 27.3% of the ocean floor has been mapped with modern, high-resolution technology.[3] U.S. oceans, coasts, and Great Lakes waters comprise the largest area of national seafloor and lake floor mapping responsibility in the world, totaling approximately 3.9 million square nautical miles.[4] Almost 54% of the seafloor beneath U.S. waters has been mapped to these modern standards.[5] Globally, more than 90% of the ocean is deeper than 200 meters.[6] The depth of the oceans presents a unique challenge when attempting to map, characterize, and mine resources on the ocean floor.

[1] US Department of Commerce, NOAA (2025, May 15). *Deep Seabed Hard Minerals Mining*. NOAA's National Ocean Service. https://oceanservice.noaa.gov/deep-seabed-mineral-resources/deep-seabed-mining/

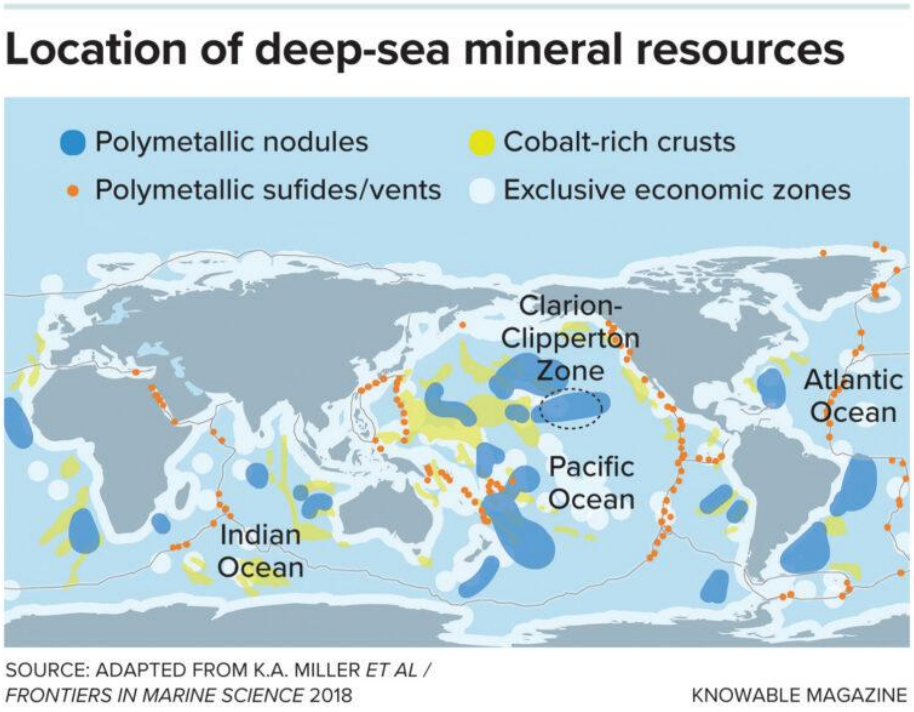
[2] *How Much of the Ocean Has Been Explored?*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., https://oceanexplorer.noaa.gov/ocean-fact/explored/ (last visited Mar. 24, 2026).

[3] *Seabed 2030 Announces Millions of Square Kilometers of New Seafloor Data On World Hydrography Day*, Seabed 2030 (June 21, 2025), https://seabed2030.org/2025/06/21/seabed-2030-announces-millions-of-square-kilometers-of-new-seafloor-data-on-world-hydrography-day/.

[4] *Status of Seafloor Mapping Within U.S. Waters*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., https://iocm.noaa.gov/seabed-2030-status.html (last visited Mar. 24, 2026).

[5] *How Much of the Ocean Has Been Explored?*, *supra* note 2.

[6] Mayer L, Jakobsson M, Allen G, Dorschel B, Falconer R, Ferrini V, Lamarche G, Snaith H, Weatherall P. The Nippon Foundation—GEBCO Seabed 2030 Project: The Quest to See the World's Oceans Completely Mapped by 2030. Geosciences. 2018; 8(2):63. https://doi.org/10.3390/geosciences8020063



[7]

Critical minerals are found in every ocean, within the exclusive economic zones (EEZ) of coastal nations, and in international waters (see side image). These minerals are generally found in three types of formations: polymetallic nodules, also called manganese nodules, which lie on the seabed; sulfide deposits around hydrothermal vents; and ferromanganese crusts, which are rich in cobalt and manganese and line the sides of ridges and seamounts.[8]

Deep-Sea Mining Governance

NOAA's Office of Ocean Exploration and Research (OER) is the primary federal entity responsible for the exploration of deep waters and the waters of the U.S. EEZ. This is accomplished through partnerships with federal and state agencies, academic institutions, nonprofit organizations, and private industry to leverage complementary expertise and develop innovations in exploration tools and capabilities. By working with institutions that bring a range of experience, expertise, and creativity, OER can enhance the potential for significant new advances in discovery, understanding, and application.[9]

Since its commissioning in 2008, the *Okeanos Explorer*, NOAA's primary exploration vessel, has mapped over one million square kilometers of the seafloor at high resolution.[10] Data collected from ocean exploration expeditions has been critical for science-based decision-making on issues such as deepwater fisheries management, potential oil and gas development, deep-sea mining, marine protected area establishment and management, determination of the U.S. Extended Continental Shelf, and nautical charting.

---

[7] Natasha Gilbert, *Mining the Deep Ocean*, ARS TECHNICA (Mar. 22, 2026), https://arstechnica.com/science/2026/03/mining-the-deep-ocean/.
[8] *Science & Tech Spotlight: Deep-Sea Mining*, U.S. GOV'T ACCOUNTABILITY OFFICE (Dec. 15, 2021), https://www.gao.gov/products/gao-22-105507.
[9] *About NOAA Ocean Exploration*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., https://oceanexplorer.noaa.gov/about/ (last visited Mar. 24, 2026).
[10] *NOAA Ship Okeanos Explorer: Technology: Vessels: NOAA Office of Ocean Exploration and Research*. (n.d.). https://oceanexplorer.noaa.gov/technology/vessels/okeanos/okeanos.html

For ocean floor areas within U.S. national jurisdiction, the primary legal authority for offshore mining activities is the Outer Continental Shelf Lands Act, which is administered by the Department of the Interior's Bureau of Ocean Energy Management.

The International Seabed Authority (ISA) regulates deep seabed mining in areas beyond national jurisdiction for countries that are parties to the Law of the Sea Convention (LOSC). The U.S. is not a party to the LOSC. In 1980, Congress passed the Deep Sea Hard Mineral Resources Act (DSHMRA), 30 U.S.C. 1401 et seq, to provide the U.S. with a regulatory framework to proceed with seabed mining activities in areas beyond national jurisdiction.[11] Under DSHMRA, the U.S. may issue exploration licenses and commercial recovery permits to U.S. companies in areas beyond national jurisdiction, provided all statutory and regulatory requirements are met.

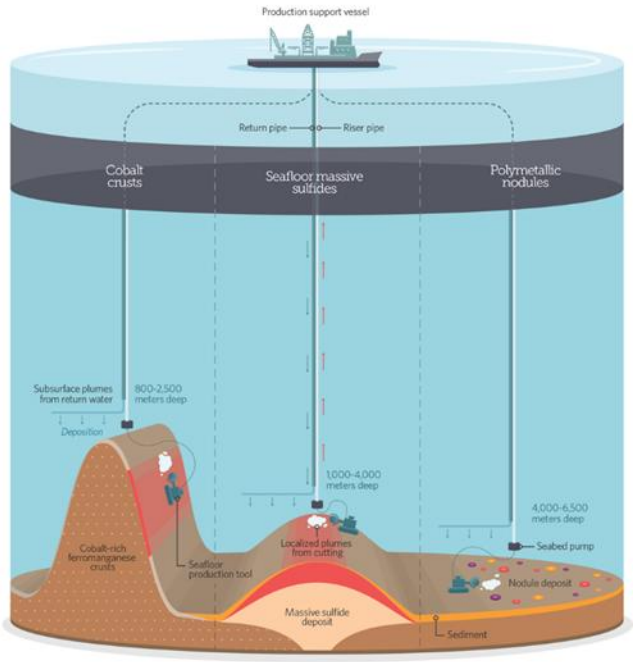
On April 24, 2025, the President signed Executive Order 14285, establishing policies to advance U.S. leadership in seabed mineral exploration and responsible commercial recovery.[12]

Science and Technology

Government entities, academic institutions, and private companies have developed a range of technologies and system designs for both exploration and the transport of extracted material to ships or surface-based mining platforms.[13] For example, underwater remotely operated vehicles (ROVs) can be used to locate prime extraction sites and collect samples from the seabed.[14] Technological advancements include autonomous underwater vehicles hosting sophisticated multibeam sonar which can map the ocean floor to a 1-meter resolution. This far surpasses the accuracy of surface multibeam sonars, although still in use, can only get to a 100-meter resolution.[15]

[11] Caitlin Keating-Bitonti, *U.S. Interest in Seabed Mining in Areas Beyond National Jurisdiction: Brief Background and Recent Developments*, CONG. RESEARCH SERV. (Feb. 18, 2026), https://www.congress.gov/crs-product/IF12608.
[12] US Department of Commerce, N. O. and A. A. (2025, May 15). *Deep Seabed Hard Minerals Mining*. NOAA's National Ocean Service. https://oceanservice.noaa.gov/deep-seabed-mineral-resources/deep-seabed-mining/
[13] *Science & Tech Spotlight: Deep-Sea Mining*, *supra* note 8.
[14] *Id*.
[15] Ryu P, Brown D, Arsenault K, Cho B, March A, Ali WH, Charous A, Lermusiaux PFJ. A Wide-Area Deep Ocean Floor Mapping System: Design and Sea Tests. *Geomatics*. 2023; 3(1):290-311. https://doi.org/10.3390/geomatics3010016

Figure 1
Types of Deep Sea Mining



Source: New Zealand Environment Guide

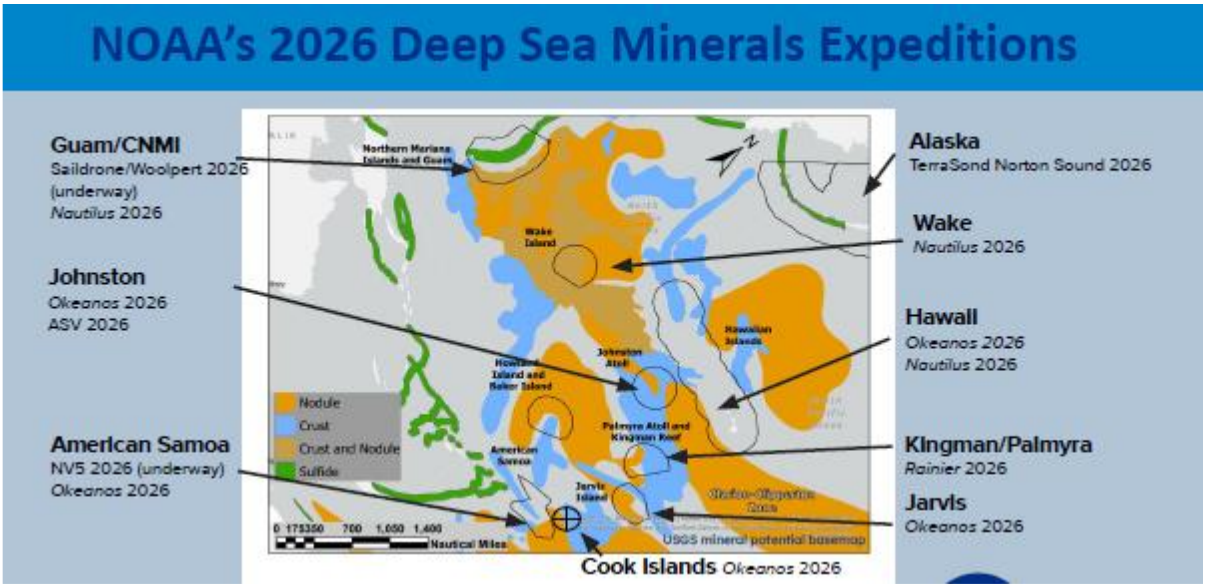
Companies are also developing technologies to collect materials from the seabed. Polymetallic nodules are the easiest type of subsea mineral to collect, as they lie on the seabed and can be retrieved by robotic collectors.[16] A variety of subsea collectors have been developed and tested to gather nodules from the seafloor. These systems typically use robotic arms to select individual nodules or hydraulic systems to collect nodules from the seafloor.[17] The most promising technology identified so far to get the nodules to the surface is the pipeline lift mining system which includes a surface support vessel, a hoisting system, and a deep sea mining vessel.[18]

Mining of critical minerals requires extensive mapping and surveying of the seafloor. There are ambitious efforts underway to map the seafloor of all U.S. coastal, ocean, and Great Lakes waters to the boundaries of the U.S. Exclusive Economic Zone (EEZ) and Extended Continental Shelf (ECS), a task that will require coordinated efforts between federal agencies and private-sector partners. U.S. federal mapping efforts are coordinated by the Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM), which operates under the National Science and Technology Council (NSTC) Subcommittee on Ocean Science and Technology (SOST).[19]

The coordination needed to implement these strategies is multifaceted and benefits from intra- and interagency collaboration, as well as engagement with national and international initiatives, to promote the principle of "map once, use many times"[20] The United States is also participating in Seabed 2030, an international project launched in 2017 to produce the definitive map of the world's ocean floor by 2030.[21] Supplementing NOAA's mission is an extensive network of academic institutions and private-sector companies operating through NOAA-issued grants and contracts. In 2026 alone, NOAA is working with its partners on 9 different mapping and characterization missions to further facilitate deep sea mining.

---

[16] Phillip Gales, *Mining Subsea Minerals – How It Works*, DEEP SEA MINING, https://deepseamining.ac/how_it_works#gsc.tab=0 (last visited Mar. 24, 2026).
[17] *Id*.
[18] Zhang, X., Zuo, Y., Wei, J., Sha, F., Yuan, Z., Liu, X., Xi, M., & Xu, J. (2024). A Review on Underwater Collection and Transportation Equipment of Polymetallic Nodules in Deep-Sea Mining. Journal of Marine Science and Engineering, 12(5), 788. https://doi.org/10.3390/jmse12050788
[19] NOMEC strategy and Implementation Plan | National Oceanic and Atmospheric Administration. (n.d.). https://www.noaa.gov/ocean-science-and-technology-subcommittee/national-ocean-mapping-exploration-and-characterization-nomec-council/nomec-strategy-and-implementation-plan
[20] *Integrated Ocean & Coastal Mapping*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., https://iocm.noaa.gov/ (last visited Mar. 24, 2026).
[21] *Seabed 2030*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN. (June 29, 2022), https://oceanservice.noaa.gov/news/jun22/seabed-2030.html.



[22]

In addition to advancing mapping and extraction technologies, science to understand the potential environmental impacts on ocean ecosystems continues to evolve. NOAA's National Centers for Coastal Ocean Science is leading the federal government effort to model and characterize the effects of deep sea mining. This includes the use of imagery and AI for nodule detection, assessing sediment contaminants and biotoxicity to establish permitting baselines and modeling the extent of dewatering plumes.[23]

[22] NOAA Briefing March 24, 2026.

[23] Spearman, J., Taylor, J., Crossouard, N., Cooper, A., Turnbull, M., Manning, A., ... & Murton, B. (2020). Measurement and modelling of deep sea sediment plumes and implications for deep sea mining. *Scientific reports*, *10*(1), 5075.