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Seabed Mining in Areas Beyond National Jurisdiction: Issues for Congress

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SUMMARY

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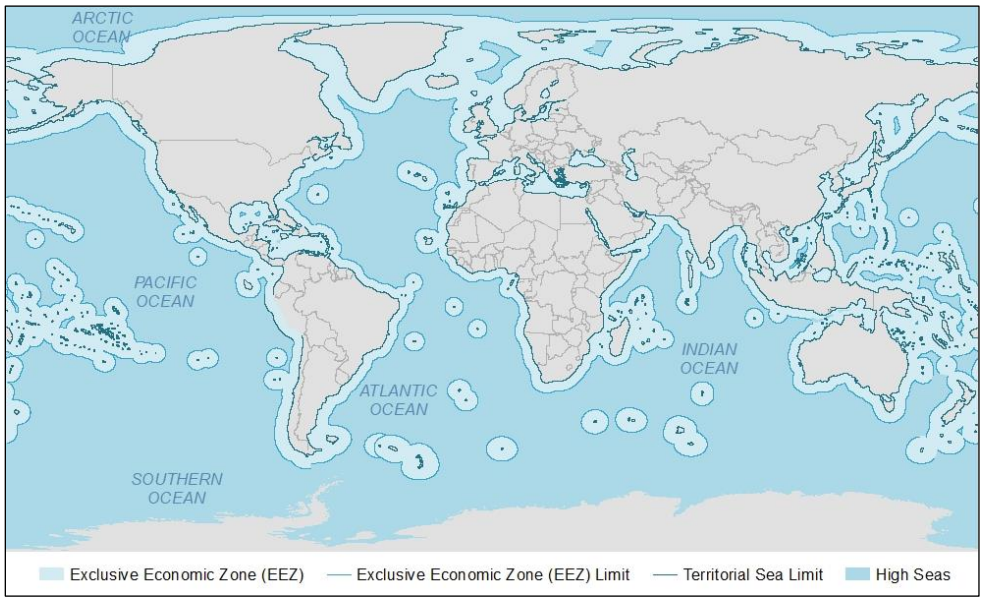
Seabed Mining in Areas Beyond National Jurisdiction: Issues for Congress

Some scientists estimate that certain mineral deposits, including those containing critical minerals, are more abundant on the seafloor than on land. This fact, coupled with the demand for critical minerals for rapid deployment of clean energy technologies, has increased interest in the recovery of minerals from areas beyond national jurisdiction (ABNJ, which are illustrated in the below figure). Minerals may be extracted through *seabed mining*, a process that involves the recovery of submerged minerals from the seafloor. Deep-seabed mining (i.e., mining activities taking place at water depths greater than 200 meters) in ABNJ has yet to occur, although some entities hold contracts to explore the seafloor for potential commercial recovery. The potential of seabed mining in ABJN raises several issues for Congress given the United States' demand for critical minerals and concerns about the potential marine environmental impacts.

Illustration of Areas Beyond National Jurisdiction (ABNJ)



Source: Created by CRS using the Sovereign Limits database (sovereignlimits.com). Data updated October 1, 2022.

Notes: Boundaries of coastal countries' national jurisdictions (i.e., exclusive economic zones, or EEZs) are illustrated in light blue. Areas beyond national jurisdiction (i.e., the *high seas*) are illustrated in dark blue. Figure is an illustration and is not for official purposes of identifying ABJNs, EEZs, or territorial sea limits.

International and U.S. Context for ABJN Mineral Exploration and Exploitation

The International Seabed Authority (ISA), established in 1994 under the 1982 United Nations Convention on the Law of the Sea (UNCLOS), is authorized as a United Nations organization to regulate party nations to UNCLOS conducting mineral-related activities occurring in ABNJ. Part of the ISA's mandate is to "ensure the effective protection of the marine environment from harmful effects that may arise from deep-seabed related activities." The ISA can issue contracts for exploration and exploitation of seabed mineral resources to party nations to UNCLOS. In 2021, the Republic of Nauru, a small island country located northeast of Australia in the Pacific Ocean, notified the ISA of its sponsorship of Nauru Ocean Resources and its intention to recover minerals from an ABJN in the Pacific Ocean, which triggered a provision that compels the ISA to establish by summer 2023 a mining code that would allow for seabed mining.

The United States has not ratified UNCLOS and therefore cannot sponsor companies seeking ISA contracts for exploration or exploitation of seabed mineral resources beyond the U.S. exclusive economic zone. However, the Deep Seabed Hard Mineral Resources Act (DSHMRA; P.L. 96-283), signed into law in 1980 prior to the establishment of the ISA, authorized the National Oceanic and Atmospheric Administration (NOAA) to regulate seabed mining activities (exploration and

commercial recovery) of U.S. citizens occurring in ABNJ. To date, NOAA has issued licenses to U.S.-based companies to explore the seafloor in ABNJ; it has not received applications for commercial recovery permits.

Issues for Congress: Access to ABJN Minerals and Environmental Impacts of Seabed Mining

Sourcing minerals from the deep sea may limit the U.S. dependency on importing land-based minerals and reduce potential supply disruptions. Unless the United States either ratifies UNCLOS, which would allow it to seek ISA contracts for seabed mining activities, or unilaterally authorizes seabed mining in ABNJ under domestic law, U.S. companies may not have a clear U.S. avenue to pursue seabed mining activities in ABNJ. Conversely, U.S. companies may establish subsidiaries in party nations to UNCLOS to pursue seabed mining activities under ISA authority.

Deposits of different minerals occur in in different ocean formations and locations (e.g., hydrothermal vents along seafloor spreading ridges, the abyssal plains, volcanically active regions). Although the primary concerns associated with seabed mining include deep-sea habitat disturbance and biodiversity loss, some mining-related environmental concerns may be specific to the habitat, species, or mining technologies and practices proposed for a specific mining location or operation. Congress may seek to improve understanding of the potential environmental impacts associated with seabed mining. In DSHMRA, Congress directed NOAA to study seabed mining impacts to the marine environment; legislation introduced in the 117th Congress would authorize NOAA to seek "an agreement with the National Academies to conduct a comprehensive assessment of the environmental impacts of deep seabed mining" (e.g., H.R. 3764, the Ocean-Based Climate Solutions Act of 2021). With an improved understanding of potential marine environmental impacts, Congress might consider amending DSHMRA or other laws to make seabed mining regulations more applicable to modern mining technologies and their potential impacts to the deep sea and its marine life.

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Introduction

Interest in mining the seabed in areas beyond national jurisdiction (ABNJ) for deposits that contain valuable minerals, such as critical minerals, has grown in recent years for a few reasons.[1] First, improved technology and increased resources dedicated to the exploration and mapping of the deep sea have advanced knowledge of seafloor deposits that contain minerals of interest.[2] Second, the development of technologies for systems to collect seabed minerals from the deep ocean and deliver them to ships or surface-based mining platforms has made mining the seafloor technically possible and more economically feasible.[3] Third, the growth in the production of clean energy technologies, many of which rely on elements contained in certain minerals, is increasing the demand for seabed minerals because some of these minerals are rare on land.[4]

Different types of clean energy technologies rely on elements found in specific seafloor deposits (e.g., nickel, cobalt, manganese).[5] Some scientists estimate these minerals of interest are more abundant in seafloor deposits than in land deposits.[6] For example, some rechargeable batteries—including those that power electric vehicles—commonly use nickel, cobalt, and manganese.[7] Critical minerals used in the magnets of wind turbines and the motors of electric vehicles also occur in seafloor deposits.[8]

This report focuses on seabed mining activities that could take place in ABNJ (**Figure 1**).[9] The report outlines the history of international agreements that establish guidelines and standards for seabed mining activities and provide protection to the marine environment in ABNJ. It also

[1] Section 7002 of the Energy Act of 2020 (Division Z, P.L. 116-260) codifies the methodology to be used by the Secretary of the Interior to determine the list of critical minerals.

[2] For example, the expeditions of the National Oceanic and Atmospheric Administration (NOAA) ship *Okeanos Explorer* are devoted to research to better understand biological, chemical, and physical characteristics of the ocean, which may inform environmental baselines, ocean energy and mineral resource decisions, and marine hazard assessments. NOAA, "NOAA Ship *Okeanos Explorer*: 2022 Expeditions Overview," at https://oceanexplorer.noaa.gov/okeanos/explorations/2022-overview/welcome.html.

[3] U.S. Government Accountability Office (GAO), *Science & Tech Spotlight: Deep-Sea Mining*, GAO-22-105507, December 15, 2021; Massachusetts Institute of Technology, "Deep Sea Mining," at https://web.mit.edu/12.000/www/m2016/finalwebsite/solutions/oceans.html; and Rosanna Carver et al., "A Critical Social Perspective on Deep Sea Mining: Lessons from the Emergent Industry in Japan," *Ocean and Coastal Management*, vol. 193 (August 2020) (hereinafter, Carver et al., "Critical Social Perspective").

[4] GAO, "Deep-Sea Mining Could Help Meet Demand for Critical Minerals, But Also Comes with Serious Obstacles," *WatchBlog*, December 16, 2021; GAO, *Science & Tech Spotlight: Deep-Sea Mining*, GAO-22-105507, December 15, 2021; Yasuhiro Kato et al., "Deep-Sea Mud in the Pacific Ocean as a Potential Resource for Rare-Earth Elements," *Nature Geoscience*, vol. 4 (2011), pp. 535-539 (hereinafter, Kato et al., "Deep-Sea Mud"); and International Energy Agency (IEA), *The Role of Critical Minerals in Clean Energy Transition*, 2022, p. 156 (hereinafter, IEA, *Role of Critical Minerals*).

[5] Minerals can be single elements (e.g., copper) or they can be compounds of elements (e.g., olivine). This report uses the term *mineral* for those composed of single elements or compounds of elements. Olive Heffernan, "Deep-Sea Dilemma," *Nature*, vol. 571 (2019), pp. 465-469; and Kato et al., "Deep-Sea Mud."

[6] Olive Heffernan, "Deep-Sea Dilemma," *Nature*, vol. 571 (2019), p. 467.

[7] IEA, *Role of Critical Minerals*, p. 5. For more information on critical minerals in electric vehicle batteries, see CRS Report R47227, *Critical Minerals in Electric Vehicle Batteries*, by Brandon S. Tracy.

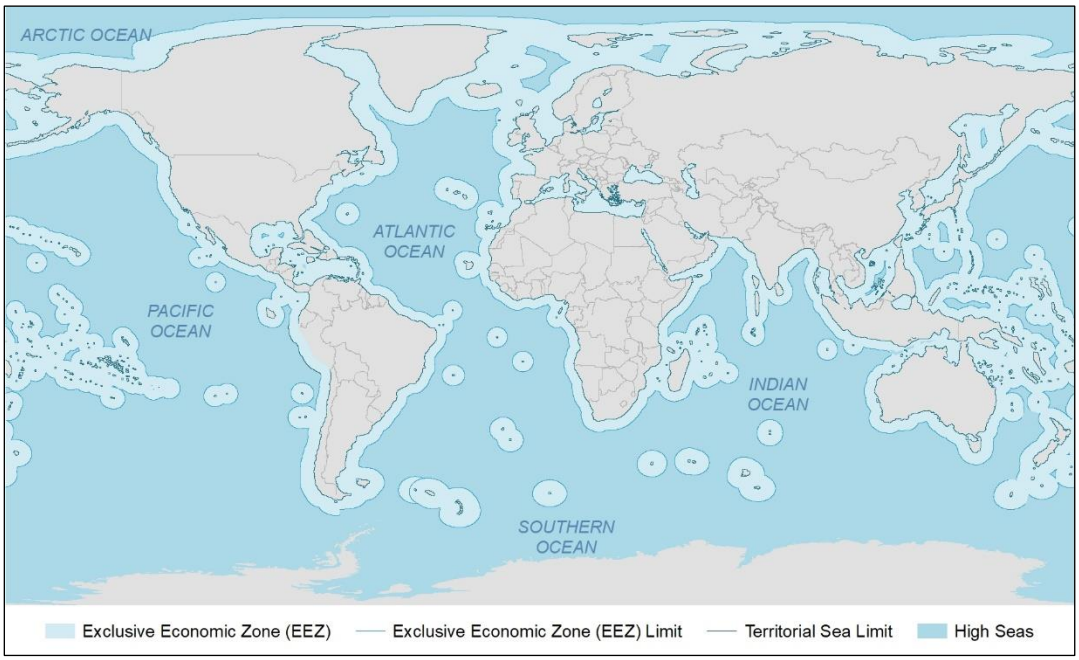
[8] Ibid.

[9] The United Nations Convention on the Law of the Sea (UNCLOS) established national boundaries for the party nations that extend to an adjacent *territorial sea*, which extends up to 12 nautical miles from the baseline of the coast of a nation. The territorial sea includes the *exclusive economic zone* (EEZ), which extends up to 200 nautical miles from the baseline of low sea level (usually near the coastline). Although the United States has not ratified UNCLOS, it generally has abided by the convention's terms, as dictated by Presidential Proclamation 5030. See "Proclamation 5030: Exclusive Economic Zone of the United States of America," 48 *Federal Register* 10605 (March 10, 1983).

outlines domestic regulations for U.S. interests pursuing seabed-mining activities in ABNJ. The report then discusses potential seabed mining impacts to ocean ecosystems. Finally, this report discusses issues for Congress, such as U.S. participation in international agreements regarding seabed mining, and possible tradeoffs about domestic versus foreign supplied minerals.

Figure 1. Illustration of High Seas and Exclusive Economic Zone Boundaries

High seas apply to areas beyond national jurisdiction (ABNJ)



Source: Illustration created by CRS using the Sovereign Limits database (sovereignlimits.com). Data are updated quarterly by the Sovereign Limits, and data used for this illustration were most recently updated on October 1, 2022.

Notes: Figure is an illustration and is not for official purposes of identifying ABJNs, exclusive economic zones (EEZs), or territorial sea limits. Boundaries of coastal countries' national jurisdictions (i.e., EEZs) are illustrated in light blue. Areas beyond national jurisdiction (i.e., the *high seas*) are illustrated in dark blue. As defined in the United Nations Convention on the Law of the Sea (UNCLOS), the territorial sea extends up to 12 nautical miles; the EEZ extends up to 200 nautical miles from the baseline of low sea level (usually near the coastline); and the high seas apply to "all parts of the sea that are not included in the [EEZ], in the territorial sea or in the internal waters of a State, or in the archipelagic waters of an archipelagic State" (see, UNCLOS Articles 3, 57, and 86). Peru claims a single maritime zone of 200 nautical miles, which it refers to as a *maritime domain*, not an EEZ; for the purposes of this figure, Peru is shown with an EEZ. Antarctica does not have a territorial sea or an EEZ because it is not a sovereign nation and its governance is carried by the Consultative Nations of the Antarctic Treaty.

Background on Seabed Mining

Seabed mining is a process of extracting sediment and mineral resources from the seafloor. In general, water depths less than 200 meters occur within nations' exclusive economic zones (EEZs), to which coastal nations may claim "sovereign rights" for the purpose of exploring and exploiting the natural resources of its continental shelf.[10] Seabed mining activities occurring

[10] UNCLOS Article 77.1.

within a nation's EEZ are regulated by that nation's domestic law.[11] In the United States, the seaward boundary of coastal states is generally three nautical miles offshore,[12] and certain states prohibit seabed mining within their state waters (e.g., California, Oregon, Washington).[13] In general, marine sediment and mineral resources of commercial interest occurring on the U.S. continental shelf include sand, gravel, and shell resources and may include minerals (e.g., titanium, tin, platinum, gold, silver, rare earth elements).[14] An emerging subset of seabed mining is *deep-seabed mining*, or *deep-sea mining*, which occurs at water depths of 200 meters or greater.[15] Water depths greater than 200 meters generally occur in areas beyond the EEZ. This report focuses on seabed minerals found beyond the outer continental shelf in ABNJ.

Deep-seabed mining was first explored in the 1960s, with commercial test mining for metal-rich nodules on the seabed starting in the 1970s.[16] In 1994, the International Seabed Authority (ISA) was created under the United Nations (U.N.) Convention on the Law of the Sea as a U.N. organization to regulate and control seabed mining activities taking place in ABNJ.[17] The ISA can issue exploration and exploitation (i.e., commercial recovery) contracts for three types of deep-seabed mineral deposits (**Table 1**).[18] The technologies and machinery to extract raw seabed material vary depending on the type of mineral deposit (**Table 1**).[19] Once the seabed material is extracted, the material would be transported to land for mineral processing.

[11] The Bureau of Ocean Energy Management (BOEM) is the federal agency authorized to oversee mineral leasing in the U.S. outer continental shelf. For information on BOEM's authority to lease marine minerals from the U.S. outer continental shelf, congressional clients may contact CRS Analyst Brandon Tracy.

[12] Submerged Lands Act (43 U.S.C. §§1301 et seq.).

[13] PEW, "New California Law Bars Seabed Mining in State Waters," September 19, 2022, at https://www.pewtrusts.org/en/research-and-analysis/articles/2022/09/19/new-california-law-bars-seabed-mining-in-state-waters.

[14] BOEM, "Offshore Critical Mineral Resources," at https://www.boem.gov/marine-minerals/offshore-critical-mineral-resources; Ocean Foundation, "Seabed Mining," at https://oceanfdn.org/seabed-mining/; and International Union for Conservation of Nature (IUCN), "Deep-Sea Mining," May 2022, at https://www.iucn.org/resources/issues-brief/deep-sea-mining (hereinafter, IUCN, "Deep-Sea Mining").

[15] For example, Ocean Foundation, "Seabed Mining," at https://oceanfdn.org/seabed-mining/; and IUCN, "Deep-Sea Mining."

[16] Helen Scales, *The Brilliant Abyss* (New York: Atlantic Monthly Press, 2021), p. 184.

[17] UNCLOS Article 156.

[18] International Seabed Authority (ISA), "Exploration Contracts," at https://www.isa.org.jm/exploration-contracts.

[19] Kathryn Miller et al., "An Overview of Seabed Mining Including the Current State of Development, Environmental Impacts, and Knowledge Gaps," *Frontiers in Marine Science*, vol. 4, (2018); and Helen Scales, *The Brilliant Abyss*, (New York: Atlantic Monthly Press, 2021), pp. 192-193.

Table 1. Types of Common Seabed Mineral Deposits and Proposed Mining Methods

Type of Seabed Mineral Deposit	Deposit Description	Minerals[a]	Occurrences	Proposed Mining Method
Polymetallic Nodules	Precipitate as thin layers onto small, hard fragments (e.g., shark tooth, whale ear bone) that have settled onto the abyssal plain. Over millions of years, the layers can accumulate to form potato-sized nodules (can be smaller or larger).	Cobalt, manganese, nickel, iron, copper, and molybdenum; metallic REEs.	Abyssal plains, such as the Clarion-Clipperton Fracture Zone (see **Figure 2**).	Remotely operated collector machines on caterpillar-like tracks that push a metal fork through the seafloor sediment to scrape and remove nodules or machines fixed with vacuum devices that suck nodules from the sediment.
Polymetallic Sulfides or Seafloor Massive Sulfide	Form at hydrothermal vents along seafloor spreading ridges.	Iron, copper, zinc, lead, barium, silver, and gold.	Mid-Atlantic Ridge, Red Sea, East Pacific Rise, Galapagos Rift, and Juan de Fuca and Gorda Ridges (located off the Pacific Northwest coast of North America).	Remotely operated collector machines that cut and drill into the hard substrate of the hydrothermal vent chimney to extract internal minerals.
Ferromanganese Crusts	Precipitate as crusts onto hard surfaces (e.g., rocks) from seawater rich in dissolved metals occurring in volcanically active regions, such as seamounts and ridges.	Cobalt, manganese, nickel, iron, copper, and platinum; metallic REEs.	All ocean basins. Also occur at shallower depths within countries' exclusive economic zones.	Remotely operated machines that scrape across the surfaces of seafloor geologic features to remove surficial mineral crusts.

Sources: International Seabed Authority (ISA), "Minerals: Polymetallic Nodules," at https://www.isa.org.jm/exploration-contracts/polymetallic-nodules; ISA, "Minerals: Polymetallic Sulphides," at https://www.isa.org.jm/index.php/exploration-contracts/polymetallic-sulphides; ISA, "Minerals: Cobalt-Rich Ferromanganese Crusts," at https://www.isa.org.jm/index.php/exploration-contracts/cobalt-rich-ferromanganese; International Energy Agency, *The Role of Critical Minerals in Clean Energy Transition*, 2022, p. 156; United Nations, "The International Seabed Authority and Deep Seabed Mining," May 2017, at https://www.un.org/en/chronicle/article/international-seabed-authority-and-deep-seabed-mining; Olive Heffernan, "Deep-Sea Dilemma," *Nature*, vol. 571 (2019), p. 466; Lisa Levin et al., "Defining 'Serious Harm' to the Marine Environment in the Context of Deep-Seabed Mining," *Marine Policy*, vol. 74 (2016), pp. 245-259; and Helen Scales, *The Brilliant Abyss*, (New York: Atlantic Monthly Press, 2021), pp. 185, 192, and 193.

Notes: These three types of seabed mineral deposits are of commercial interest for critical minerals. The mined seabed material would be pumped to the surface of the ocean by a riser pipe system and transported to a surface support vessel. At the ocean surface, seabed material would be separated from the seawater and seafloor sediment and transported to a processing plant on land. REEs = rare earth elements.

a. The list of minerals is not exhaustive and includes common minerals of commercial interest. Minerals may not all occur simultaneously in an ocean deposit, and deposits may vary geographically across the global ocean.

Regulations for Seabed Mining in Areas Beyond National Jurisdiction

Several international bodies and agreements address seabed mining activities that could occur in ABNJ. Some of these regulate international exploration and exploitation of seabed minerals or provide guidance to prevent harm to the marine environment. The following sections describe the international bodies and agreements that regulate seabed mining in ABNJ, as well as relevant U.S. domestic laws.

United Nations Convention on the Law of the Sea and the 1994 Agreement

In 1982, the U.N. Convention on the Law of the Sea (UNCLOS) established a framework governing activities on, over, and under the world's ocean.[20] A reoccurring theme throughout UNCLOS is the "protection and preservation of the marine environment."[21] UNCLOS specifies that necessary measures be taken to protect the marine environment with respect to certain activities. For example, Article 145 states,

> Necessary measures shall be taken in accordance with this Convention with respect to activities in the Area to ensure effective protection for the marine environment from harmful effects which may arise from such activities. To this end the Authority shall adopt appropriate rules, regulations and procedures for *inter alia*:
>
> (a) the prevention, reduction and control of pollution and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment, particular attention being paid to the need for protection from harmful effects of such activities as drilling, dredging, excavation, disposal of waste, construction and operation or maintenance of installations, pipelines and other devices related to such activities;
>
> (b) the protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment.

In 1982, the United States and some other industrialized countries did not sign the convention or announced they could not ratify it without important changes to Part XI of UNCLOS, which deals with deep-seabed resources in ABNJ.[22] UNCLOS refers to resources recovered from ABNJ as *minerals*, which includes all solid, liquid, or gaseous mineral resources as well as polymetallic nodules at or beneath the seabed.[23] UNCLOS also considers deep-sea minerals collected from ABNJ as common heritage of mankind, meaning seabed resources are available for everyone's use and benefit, including Small Island Developing States, Landlocked Developing Countries, and Least Developed Countries.[24] The United States was not comfortable with these provisions.

In 1994, the U.N. General Assembly adopted a resolution opening the Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea (the *1994*

[20] Text of UNCLOS is available at http://www.un.org/depts/los/convention_agreements/texts/unclos/closindxAgree.htm. CRS Specialist in Foreign Policy Legislation Matthew Weed contributed to this section.

[21] For example, see UNCLOS's Preamble and Part XII: "Protection and Preservation of the Marine Environment."

[22] Bernard Gwertzman, "U.S. Will Not Sign Sea Law Treaty," *New York Times*, July 10, 1982, p. 5.

[23] UNCLOS Article 133.

[24] UNCLOS Articles 136, 140, and 141.

Agreement), which amended UNCLOS Part XI by removing many of the provisions objectionable to industrialized nations. Following the adoption of the 1994 Agreement, UNCLOS entered into force. In October 1994, President Clinton submitted UNCLOS and the 1994 Agreement as a package to the Senate for advice and consent to ratification. To date, the Senate has not ratified UNCLOS or the 1994 Agreement, but members of the executive branch have stated that some (but not all) portions of UNCLOS reflect customary international law.[25] For example, Presidential Proclamation 5030 established the EEZ of the United States in accordance with UNCLOS and "assert[ed] the sovereign rights and jurisdiction of the United States in its EEZ and confirm[ed] the rights and freedoms of all states, as provided under international law."[26]

In 1980, Congress enacted the Deep Seabed Hard Mineral Resources Act (DSHMRA; P.L. 96-283) as an interim measure to allow U.S. citizens to proceed with seabed mineral exploration and recovery until an international regime was in place (i.e., UNCLOS).[27] In the United States, the DSHMRA authorized the National Oceanic and Atmospheric Administration (NOAA) to regulate seabed mining activities taking place in ABNJ by U.S. citizens.[28] The DSHMRA is discussed further below in "Deep Seabed Hard Mineral Resources Act and Other Applicable U.S. Laws."

International Seabed Authority

The 1994 Agreement established the International Seabed Authority (ISA), which regulates and controls all mineral-related activities in ABNJ as an autonomous organization under UNCLOS.[29] Part of the ISA's mandate is to "ensure the effective protection of the marine environment from harmful effects that may arise from deep-seabed related activities."[30] Deep-seabed activities include both exploration of the seabed and exploitation of seabed mineral resources.

The party nations to UNCLOS are ipso facto members of the ISA. As of December 2022, the ISA had 167 member states plus the European Union (a total of 186 members).

The ISA has yet to develop a regulatory regime for extraction of seabed minerals and therefore has not issued exploitation contracts. The issuance of exploitation contracts would include information about mining operations and actions to minimize harm to marine habitats and species at the proposed site.[31] In 2014, the ISA began to draft standards and guidelines for exploitation of seabed minerals in ABNJ and initially set a self-imposed deadline of 2020 for the release of its "Mining Code," which was delayed due to the Coronavirus Disease 2019 pandemic.[32] As a U.N. member nation, the United States has an observer delegate status for the ISA.[33] According to the

[25] In the past, some members of Congress have expressed concerns regarding the ability of an international organization to regulate a commercial activity (i.e., seabed mining) and distribute revenues from such activity.

[26] "Proclamation 5030: Exclusive Economic Zone of the United States of America," 48 *Federal Register* 10605 (March 10, 1983).

[27] 30 U.S.C. §1401(b)(3). The Deep Seabed Hard Mineral Resources Act (P.L. 96-283) refers to UNCLOS as the *Law of the Sea Treaty*.

[28] 30 U.S.C. §1401-1473.

[29] ISA, "About ISA," at https://www.isa.org.jm/about-isa.

[30] Ibid.

[31] United Nations, *U.N. Chronical*, "The International Seabed Authority and Deep Seabed Mining," March 2017, at https://www.un.org/en/chronicle/article/international-seabed-authority-and-deep-seabed-mining.

[32] Ibid; and Helen Scales, *The Brilliant Abyss*, (New York: Atlantic Monthly Press, 2021), p. 187.

[33] The U.S. delegation to the ISA includes representatives from the Department of State's Bureau of Oceans and International Environmental and Scientific Affairs, NOAA, BOEM, and the U.S. Geological Survey.

U.S. State Department, United States' input has been respected and accepted in the drafting of the ISA's exploitation regulations.[34]

However, because the United States is not a party nation to UNCLOS, the United States cannot sponsor companies interested in seeking ISA contracts for exploration or exploitation of seabed mineral resources through the ISA system. Under domestic law, the United States has authorized exploration licenses to U.S.-based companies (e.g., the Lockheed Martin Corporation) and could authorize commercial recovery permits in ABNJ (see "Deep Seabed Hard Mineral Resources Act and Other Applicable U.S. Laws").

As of December 2022, the ISA had issued 31 exploration contracts to both public and private mining enterprises for seabed mineral resources.[35] In June 2021, the Republic of Nauru, a small island country located northeast of Australia in the Pacific Ocean, notified the ISA of its sponsorship of Nauru Ocean Resources (a subsidiary of the Metals Company, a Canadian firm) and its intention to mine the Clarion-Clipperton Fracture Zone (CCZ; **Figure 2**).[36] The CCZ is estimated to contain more copper, cobalt, nickel, and manganese than all known land deposits combined.[37] The Republic of Nauru claimed its efforts to mine the seabed would support the global transition to clean energy technologies and would help reduce carbon emissions.[38] The Republic of Nauru's application triggered a legal provision within UNCLOS that compels the ISA to establish standards and guidelines for mining deep-sea resources while minimizing environmental risks.[39] According to the provision, commonly referred to as the *two-year rule*, the ISA must finalize its seabed mining regulations within two years (i.e., by summer 2023).[40]

[34] Telephone conversation between CRS and Gregory O'Brien, Foreign Affairs Officer at the U.S. Department of State, Bureau of Oceans and International Environmental and Scientific Affairs, Office of Ocean and Polar Affairs, October 17, 2022.

[35] ISA, "Exploration Contracts," at https://www.isa.org.jm/exploration-contracts.

[36] ISA, "Letter Dated 30 June 2021 from the President of the Council of the International Seabed Authority Addressed to Members of the Council," ISBA/26/C/38, July 1 2021; and The Metals Company, "Sponsoring States," at https://metals.co/sponsoring-states/.

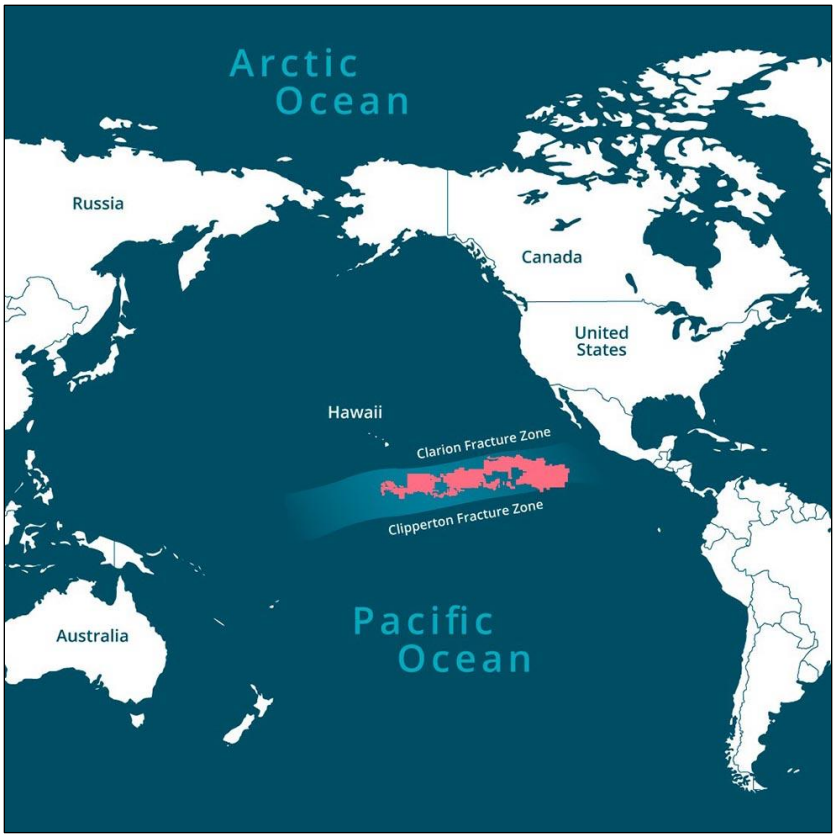
[37] Olive Heffernan, "Deep-Sea Dilemma," *Nature*, vol. 571 (2019), p. 467.

[38] As a small Pacific island country, the Republic of Nauru is threatened by rising sea levels exacerbated by anthropogenic climate change. See World Bank, "Climate Change Knowledge Portal: Nauru," at https://climateknowledgeportal.worldbank.org/country/nauru/impacts-sea-level-rise; The Metals Company, "Sponsoring States," at https://metals.co/sponsoring-states/; and ISA, "Letter Dated 30 June 2021 from the President of the Council of the International Seabed Authority Addressed to Members of the Council," ISBA/26/C/38, July 1 2021.

[39] 1994 Agreement Relating to the Implementation of Part XI of UNCLOS, July 28, 1994.

[40] Pradeep Singh, "The Two-Year Deadline to Complete the International Seabed Authority's Mining Code: Key Outstanding Matters That Still Need to Be Resolved," *Marine Policy*, vol. 134, no. 104804 (2021).

Figure 2. Clarion-Clipperton Fracture Zone



Source: Tom Cassauwers, "Deep-Sea Mining: Is It an Environmental Curse or Could It Save Us?," *Horizon: The EU Research & Innovation Magazine*, August 12, 2021.

Notes: Most commercial interest in deep-seabed mining focuses on the Clarion-Clipperton Fracture Zone (CCZ). The CCZ is approximately 1.7 million square miles (up to 3.4 miles beneath the ocean's surface), spanning an area as wide as the continental United States on the Pacific seafloor. The International Seabed Authority has awarded 17 exploration contracts for the CCZ and has one pending application for an exploitation contract for the CCZ.

Some environmental advocates and international organizations have called for the implementation of environmental safeguards before ISA permits deep-sea exploitation activities.[41] Some technological companies and automakers have announced support for a moratorium on seabed minerals being used in electrical vehicle batteries and other clean energy technologies until seabed mining activities can be performed in a way that protects the marine environment.[42] Outstanding matters to be considered within the ISA's regulations for exploitation of seabed minerals could include the following, for example:

[41] For example, IUCN, "Deep-Sea Mining"; and Deep Sea Conservation Coalition, "DSCC Position Statements on Deep Seabed Mining," July 2019, at https://www.savethehighseas.org/wp-content/uploads/2019/08/DSCC-Position-Statement-on-Deep-Seabed-Mining_July2019.pdf.

[42] For example, see IEA, *Role of Critical Minerals*, p. 156; Frank Jordans, "Automakers BMW, Volvo Back Moratorium on Deep Seabed Mining," Associated Press News, March 31, 2021, at https://apnews.com/article/technology-oceans-environment-overfishing-europe-3359dff680e15606dc9d069e1992e0bf.

- Threshold of environmental harm to apply when assessing applications, including knowledge of environmental baseline data
- Processes relating to the preparation and evaluation of environmental plans
- Monitoring programs
- Environmental performance guarantees
- Environmental compensation fund
- Adjacent coastal states and transboundary harm[43]

The London Convention

The principal international agreements that address marine pollution are the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, known as the *London Convention*,[44] and the 1996 Protocol to the London Convention, known as the *London Protocol*.[45] The United States is a party nation to the London Convention and is not a party nation to the London Protocol. Under Article XII of the London Convention, parties pledge to take measures to protect the marine environment against pollution. Included among the list of pollution sources are "wastes or other matter directly arising from, or related to the exploration, exploitation and associated off-shore processing of sea-bed mineral resources."

Deep Seabed Hard Mineral Resources Act and Other Applicable U.S. Laws

In 1980, Congress enacted DSHMRA as an interim measure to allow U.S. citizens to proceed with seabed mineral exploration and recovery until an international regime was in place (i.e., UNCLOS).[46] The 96th Congress stated among the findings of DSHMRA that "the nations of the world, including the United States, will benefit if the hard mineral resources [, including nickel, copper, cobalt, and manganese,] of the deep seabed beyond limits of national jurisdiction can be developed and made available for their use."[47] Further, the 96th Congress stated the purposes of DSHMRA are to "encourage the successful conclusion of a comprehensive [UNCLOS],"[48] and to "assure that such exploration and recovery activities are conducted in a manner which will encourage the conservation of such resources, protect the quality of the environment, and promote the safety of life and property at sea,"[49] among others. For example, the act directed NOAA to "expand and accelerate a program assessing the effect on the environment from exploration and commercial recovery activities," including the long- and short-term effects on deep-seabed species in ocean areas where seabed mining activities likely would occur.[50]

[43] Ibid.

[44] Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention), London, December 29, 1972, in force August 30, 1975, 1046 UNTS 138.

[45] 1996 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Protocol), November 7, 1996, in force March 24, 2006, 36 ILM 1.

[46] 30 U.S.C. §1401(b)(3).

[47] 30 U.S.C. §1401(a).

[48] 30 U.S.C. §1401(b)(1).

[49] 30 U.S.C. §1401(b)(4).

[50] 30 U.S.C. §1419(a).

DSHMRA establishes a framework for authorizing U.S. citizens to explore for and recover minerals from the seabed in ABNJ. Congress authorized NOAA to issue exploration licenses and commercial recovery permits for seabed mining activities.[51] After NOAA receives an application by an entity seeking an exploration license or commercial recovery permit and before it issues the license or permit, NOAA is required to prepare and publish an environmental impact statement for its issuance of the license or permit.[52] The National Environmental Policy Act (42 U.S.C. §§4321-4347) is the source of the substantive requirements for preparing an environmental impact statement.

The lack of accession by the United States to UNCLOS does not preclude NOAA from issuing exploration licenses or commercial recovery permits pursuant to DSHMRA.[53] NOAA issued two exploration licenses to the Lockheed Martin Corporation in 1984 under the authorities of DSHMRA, predating the establishment of the ISA in 1994.[54] To date, NOAA has not issued commercial recovery permits under DSHMRA, and such activity is not anticipated in the near future.[55] Commercial recovery permits issued by NOAA may not be recognized by nation parties to UNCLOS, and it is possible the ISA could issue exploitation contracts to a company sponsored by a party nation to UNCLOS in the same area.[56] Without the United States being a party nation to UNCLOS, U.S. citizens issued licenses or permits by NOAA would have no legal resource to protect their claim to explore and/or recover seabed minerals in ANBJ.

U.S. companies pursuing seabed mining activities in ABNJ may be subjected to other U.S. federal laws, including the Marine Mammal Protection Act (16 U.S.C. §§1361-1423h). In addition, Section 109(e) of DSHMRA provides that any discharge of a pollutant from a vessel or other floating craft subject to DSHMRA is subject to the provisions of the Clean Water Act (33 U.S.C. §§1251-1387).[57]

Potential Marine Environmental Impacts of Seabed Mining

Seabed mining impacts in the marine environment are incompletely understood. This is in part because seabed mining in ABNJ has yet to occur. Different types of mineral deposits occur in in different parts of the ocean (e.g., hydrothermal vents along seafloor spreading ridges, the abyssal plains, volcanically active regions; see **Table 1**), which means it may be challenging to extrapolate understanding of marine environmental impacts from one area of the ocean to another.

Some species inhabiting the deep sea live under cold conditions without sunlight and survive on little food.[58] To be successful under such conditions, deep-sea species have low metabolic rates—

[51] 30 U.S.C. §1412. 15 C.F.R. Part 970 and 15 C.F.R. Part 971 at https://www.ecfr.gov/current/title-15/subtitle-B/chapter-IX/subchapter-D/part-970; https://www.ecfr.gov/current/title-15/subtitle-B/chapter-IX/subchapter-D/part-971.

[52] 30 U.S.C. §1419(d).

[53] Email correspondence between CRS and Melanie Jackson, Congressional Affairs Specialist at NOAA Office of Legislative and Intergovernmental Affairs, November 23, 2022 (hereinafter, CRS correspondence with NOAA).

[54] NOAA, "Deep Seabed Mining: Approval of Exploration License Extensions," 87 *Federal Register* 52743, August 29, 2022.

[55] CRS correspondence with NOAA; and NOAA, "Deep Seabed Hard Mineral Resources Act," at https://www.gc.noaa.gov/documents/gcil_dshmra_summary.pdf.

[56] CRS correspondence with NOAA.

[57] 30 U.S.C. §1419(e).

[58] NOAA, "What Conditions Exist for Life in the Deep Ocean?," at https://oceanexplorer.noaa.gov/facts/deep-

they move slowly, live for a long time, and take many years to reproduce.[59] In general, these traits mean species may be slow to recover from disturbances, making them potentially vulnerable to deep-sea exploitation activities, such as seabed mining, and making the deep-sea environment potentially susceptible to biodiversity loss.[60]

Sediment dispersal by seabed mining machinery disturbing seafloor deposits has the potential to impact environments immediate and adjacent to the mined area.[61] The distance to which sediment disperses through the water column primarily depends on the presence of ocean currents and, if near the surface of the ocean, wave energy. Suspended sediment in the water column could reduce water quality and clarity. The dispersion of seafloor sediment may threaten certain groups of benthic (i.e., living on or within the seafloor) invertebrate organisms in specific ways:

- *Deposit feeders*, organisms that feed on organic matter that settled onto the seafloor, may be impacted by sediment diluting or burying their food resources.[62]
- *Suspension feeders* (also known as *filter feeders*), organisms that filter small food particles directly from the water, may be affected by suspended sediment clogging the water column.[63]

An additional concern for benthic organisms is that seabed mining machinery could crush, smother, or disperse them while disturbing their habitats.[64]

The removal of nodules and other hard mineral resources from the seabed also may impact species living or depending on these resources.[65] For example, some organisms require a hard surface, such as a mineral nodule, to attach their bodies to in order to live and grow. Some species of sponges and some microbes live on seabed nodules,[66] and a species of deep-sea octopus lays its eggs on sponges attached to seabed nodules.[67] Because deep-sea nodules form over millions of

habitat.html.

[59] Craig R. McClain et al., "Energetics of Life on the Deep Seafloor," *Proceedings of the National Academy of Sciences*, vol. 109, no. 38 (2012), pp. 15366-15371; and Robert Danovaro, "The Deep-Sea Under Global Change," *Current Biol*ogy, vol. 27, no. 11 (2017), pp. R461-R465.

[60] Holly Niner et al., "Deep-Sea Mining with No Net Loss of Biodiversity—An Impossible Aim," *Frontiers in Marine Science*, vol. 5 (2018) (hereinafter, Niner et al., "Impossible Aim"); and Daniel Jones et al., "Biological Responses to Disturbance from Simulated Deep-Sea Polymetallic Nodule Mining," *PLOS One*, vol. 12, no. 2 (2017) (hereinafter, Jones et al., "Biological Responses").

[61] Rahul Sharma, "Environmental Issues of Deep-Sea Mining," *Procedia Earth and Planetary Science*, vol. 11 (2015), pp. 204-211 (hereinafter, Sharma, "Environmental Issues"); Diva Amon et al., "Assessment of Scientific Gaps Related to the Effective Environmental Management of Deep-Sea Mining," *Marine Policy*, vol. 138 (2022), pp. 1-22 (hereinafter, Amon et al., "Assessment of Scientific Gaps"); Niner et al., "Impossible Aim"; and NOAA 1995 Report to Congress, p. 12.

[62] Sharma, "Environmental Issues."

[63] Ibid.

[64] Niner et al., "Impossible Aim"; and Sharma, "Environmental Issues."

[65] Levin et al., "Defining 'Serious Harm.'"

[66] Amon et al., "Assessment of Scientific Gaps."

[67] Autun Purser et al., "Association of Deep-Sea Incirrate Octopods with Manganese Crusts and Nodule Fields in the Pacific Ocean," *Current Biology*, vol. 26 (2016), pp. R1268-R1269.

years,[68] their removal in an area of the seafloor would equate to the permanent loss of a part of the marine habitat that some deep-sea species depend on for their survival.[69]

Noise and vibration associated with seabed mining operations may affect the behaviors of marine mammals and other animals living near the ocean's surface.[70] Sound waves travel through the ocean approximately four times faster than they can travel through air and could increase the ambient background noise level in areas up to 500 kilometers away from the mining site, potentially impacting animals in that radius.[71] Noise pollution from mining operations may mask communication and echolocation sounds of cetaceans (whales, porpoises, and dolphins), affecting their abilities to detect and avoid predators and to find food and mates.[72] It also may cause temporary or permanent hearing loss in some marine mammals and may increase their stress levels.[73]

The processing of recovered seabed material at the ocean surface and its transport to land may have impacts near or at the ocean surface. For example, seabed material may be processed on mining vessels or surface-based mining platforms and seafloor sediment discarded back into the ocean may cloud the near surface water column, potentially inhibiting photosynthesis in some plankton.[74] In addition, ship traffic associated with seabed mining operations may pose a threat to animals living near the ocean's surface. The increased potential for a vessel strike is one concern;[75] for example, one of the leading causes of deaths for right whales is vessel strikes.[76] Another concern would be the discharge of ballast water and other wastes, including marine debris, from mining vessels.[77]

Proponents of seabed mining that is "properly managed with appropriate governance safeguards" argue that sourcing minerals from the deep sea has the potential to have less pollution (e.g., tailings, waste), impacts on freshwater sources, and social impacts (e.g., human fatalities, injuries, health effects) compared with traditional land-based open-pit and underground mining.[78] Instances of terrestrial mining have been associated with drinking water contamination, air pollution, and alteration of landscapes, among other impacts.[79] The potential primary impacts of

[68] NOAA, "What's in a Nodule?," at https://oceanexplorer.noaa.gov/okeanos/explorations/ex2104/features/nodule/welcome.html.

[69] Helen Scales, *The Brilliant Abyss*, (New York: Atlantic Monthly Press, 2021), p. 192.

[70] NOAA, "Ocean Noise," at https://www.fisheries.noaa.gov/national/science-data/ocean-noise; and Christine Erbe et al., "The Effects of Ship Noise on Marine Mammals—A Review," *Frontiers in Marine Science*, vol. 6 (2019).

[71] Rob Williams et al., "Noise from Deep-Sea Mining May Span Vast Ocean Areas," *Science*, vol. 377 (2022), pp. 157-158.

[72] NOAA, "Ocean Noise," at https://www.fisheries.noaa.gov/national/science-data/ocean-noise.

[73] Ibid.

[74] Sharma, "Environmental Issues."

[75] NOAA, "Understanding Vessel Strikes," at https://www.fisheries.noaa.gov/insight/understanding-vessel-strikes.

[76] NOAA, "North Pacific Right Whales," at https://www.fisheries.noaa.gov/species/north-pacific-right-whale; and NOAA, "North Atlantic Right Whales," at https://www.fisheries.noaa.gov/species/north-atlantic-right-whale.

[77] For example, PEW, "Vessel Waste a Growing Challenge in the Northern Bering Sea and Bering Strait," October 10, 2018, at https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2018/10/vessel-waste-a-growing-challenge—in-the-northern-bering-sea-and—bering-strait.

[78] For example, Daina Paulikas et al., "Life Cycle Climate Change Impacts of Producing Battery Metals from Land Ores versus Deep-Sea Polymetallic Nodules," *Journal of Cleaner Production*, vol. 275 (2020), p.17.

[79] For example, Aboka Yaw Emmanuel et al., "Review of Environmental and Health Impacts of Mining in Ghana," *Journal of Health and Pollution*, vol. 8 (2018), pp. 43-52.

seabed mining would be on the marine organisms, which could have secondary effects on humans.

Issues for Congress

Congress may be interested in how seabed mining in ABNJ may impact deep-sea habitats and their species as well as demand for and U.S. importation of land-based minerals. Congress may consider the potential implications of the United States not being a party nation to UNCLOS or the potential benefits, or consequences, of the U.S. ratification of UNCLOS.

U.S. Importation of Land-Based Minerals and Seabed Mining Exploration Efforts by Selected Foreign Governments

Because critical minerals, including rare earth elements, can be found in land and ocean deposits, Congress could consider weighing the potential marine environmental impacts of deep-seabed mining alongside the potential environmental impacts associated with terrestrial mining. Some may argue seabed mining could reduce U.S. dependency on importing certain land-based minerals.[80] For example, currently China produces 80% of the world's supply of cobalt—a critical mineral used in clean energy technologies—and most of it comes from Chinese-owned or financed mines in the Democratic Republic of the Congo, some of which have been associated with unsafe working conditions and forced labor.[81] Dependence on foreign sources of minerals may lead to U.S. uncertainties in supply ranging from cost instability to supply disruptions. Some stakeholders also may look to seabed mining to reduce dependence on sources with weak protective labor and environmental standards and practices.[82]

The deep sea's supply of cobalt may be able to meet or exceed the global demand for cobalt currently derived from terrestrial mines. The ISA has issued 31 exploration contracts to both public and private mining enterprises for seabed mineral resources.[83] Of these ISA exploration contracts, China currently holds three contracts for polymetallic nodules, two of which are for the CCZ; one contract for polymetallic sulfides; and one contract for cobalt-rich ferromanganese crusts. The Russian Federation currently holds two ISA exploration contracts for polymetallic nodules located in the CCZ, one of which is a joint contract between six member nations of the ISA; one ISA exploration contract for polymetallic sulfides; and one ISA exploration contract for cobalt-rich ferromanganese crusts.

[80] For example, United States Institute of Peace, "The Geopolitics of Deep-Sea Mining and Green Technologies," November 3, 2022, at https://www.usip.org/publications/2022/11/geopolitics-deep-sea-mining-and-green-technologies.

[81] Andrew L. Gulley, Erin A. McCullough, and Kim B. Shedd, "China's Domestic and Foreign Influence in the Global Cobalt Supply Chain," *Resources Policy*, vol. 62 (August 2019), pp. 317-323; and Eric Lipton and Dionne Searcey, "Chinese Company Removed as Operator of Cobalt Mine in Congo," *New York Times*, February 28, 2002, at https://www.nytimes.com/2022/02/28/world/congo-cobalt-mining-china.html (hereinafter, Lipton and Searcey, "Chinese Company Removed").

[82] NOAA 1995 Report to Congress, p. 2.

[83] ISA, "Exploration Contracts," at https://www.isa.org.jm/exploration-contracts.

Seabed Mining in Areas Beyond National Jurisdiction in the Arctic Ocean

The continued decline of Arctic sea ice cover may lead to increased accessibility to marine natural resources, including seabed minerals. However, severe weather and extreme conditions in the Arctic would pose challenges to the recovery of seabed minerals in the deep ocean. Seabed mining activities taking place in areas beyond national jurisdiction (ABNJ) in the Arctic Ocean may be pursued by any member nation to the International Seabed Authority (ISA). As of December 2022, the ISA has not issued exploration or exploitation contracts in the Arctic Ocean.

Some coastal Arctic nations have made submissions, supported by scientific data, to the Commission on the Limits of the Continental Shelf (CLCS), an expert body established under the United Nations Convention on the Law of the Sea, requesting an extended continental shelf beyond the 200-nautical mile limit from their shore. Many of the submissions from Arctic nations to the CLCS request the inclusion of an ocean ridge. An extended continental shelf would expand a coastal nation's sovereign rights and jurisdiction over the exploration and exploitation, among other activities, of non-living resources of the seabed and subsoil of the continental shelf, such as seabed minerals.

Mineral deposits often occur at ocean ridges where volcanic activity (e.g., hydrothermal vents) concentrates dissolved metals in the seawater. Minerals may precipitate onto the seafloor and geologic features in areas with high dissolved metal concentrations. Seabed mining interests in the Arctic Ocean may focus exploration efforts along the Arctic seafloor's major ocean ridges (i.e., Alpha-Mendeleev Ridge, the Lomonosov Ridge, and the Gakkel Ridge). Polymetallic sulfide deposits have been found at both active (i.e., slow or fast spreading) and inactive ocean ridges and may contain critical minerals. Scientists also have identified ferromanganese crusts and nodules collected from the abyssal plains of the Arctic Ocean, providing another potential source for critical minerals.

Sources: For more information about natural resources in the Arctic, see CRS Report R41153, *Changes in the Arctic: Background and Issues for Congress*, coordinated by Ronald O'Rourke. ISA, "Exploration Contracts," at https://www.isa.org.jm/exploration-contracts; Department of State, "Frequently Asked Questions," at https://www.state.gov/frequently-asked-questions-u-s-extended-continental-shelf-project/; ISA, "Minerals: Polymetallic Sulphides," at https://www.isa.org.jm/index.php/exploration-contracts/polymetallic-sulphides; International Energy Agency, "The Role of Critical Minerals in Clean Energy Transition" (2022), p. 156; and James Hein et al., "Arctic Deep Water Ferromanganese-Oxide Deposits Reflect the Unique Characteristics of the Arctic Ocean," *Geochemistry, Geophysics, Geosystems*, vol. 18, (2017) pp. 3771-3800.

U.S. Ratification of United Nations Convention on the Law of the Sea

The U.S. Senate might consider the ratification of UNCLOS.[84] Because it is not a party nation to UNCLOS, the United States cannot sponsor companies seeking ISA contracts. By ratifying UNCLOS, the United States would become a member of the ISA. Conversely, U.S. companies may establish a subsidiary in a party nation to UNCLOS to seek ISA contracts, which could potentially reduce U.S. federal corporate tax revenues. For example, the United Kingdom (UK) arm of the Lockheed Martin Corporation established UK Seabed Resources; through sponsorship of the UK of Great Britain and Northern Ireland, it holds ISA contracts to explore an estimated 133,000 square kilometers of the CCZ for polymetallic nodules.[85] However, the lack of accession by the United States to UNCLOS has not precluded NOAA from extending two DSHMRA exploration licenses to the Lockheed Martin Corporation through 2027.[86] Recently, the ISA established an Area of Particular Environmental Interest that partially overlaps with one of the

[84] To date, UNCLOS and the 1994 Agreement has been considered by Senate Committee on Foreign Relations three times (1994, 2003, and 2007).

[85] Lockheed Martin Corporation, "UK Seabed Resources," at https://www.lockheedmartin.com/en-gb/products/uk-seabed-resources.html; and ISA, "Minerals: Polymetallic Nodules," at https://www.isa.org.jm/exploration-contracts/polymetallic-nodules.

[86] NOAA, "Deep Seabed Mining: Approval of Exploration License Extensions," 87 *Federal Register* 52743, August 29, 2022.

Lockheed Martin Corporation's DSHMRA exploration licenses.[87] Conflicting claims between DSHMRA exploration licenses and ISA contracts could potentially deter financiers from backing U.S.-authorized deep-seabed mining projects.[88] Some recent legislative proposals have included a sense of Congress that the United States should become a party nation to UNCLOS; examples include Section 233 of S. 4629 (116th Congress) and Section 30004(b) of H.R. 4521 (117th Congress), as passed by the House. These provisions have not been enacted.

U.S. Federal Research to Study Seabed Mining Impacts

NOAA's 1975-1980 Deep Ocean Mining Environmental Studies Project and subsequent projects through the 1990s as directed by Congress under DSHMRA were limited to the biological effects of increased sedimentation on the seafloor.[89] Some scientists point to the lack of environmental baseline data for deep-sea habitats as one reason to delay or ban seabed mining in ABNJ.[90] Exploration of deep-sea habitats can provide baselines for understanding whether—and to what degree—these habitats and their species are vulnerable or resilient to disturbance or change. For example, Congress may consider directing NOAA and appropriating more funding to conduct additional NOAA exploration campaigns designed to better document and characterize deep-sea habitats and life.[91] Members proposed legislation in the 117th Congress that could improve understanding of seabed mining impacts. For example, H.R. 3764, the Ocean-Based Climate Solutions Act of 2021, would call on the NOAA Administrator to seek "an agreement with the National Academies to conduct a comprehensive assessment of the environmental impacts of deep seabed mining." With an improved understanding of these marine environmental impacts, Congress might consider how amending DSHMRA or other laws could ameliorate some of the potential negative effects on the ocean of U.S. licensed or permitted seabed mining activities. Congress also might consider how mining technologies for the recovery of seabed minerals has evolved in the 40-plus years since DSHMRA was enacted and amend relevant aspects of the law to better reflect the potential impacts these technologies could have on deep-sea habitats and life.[92]

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[87] Ibid.

[88] CRS correspondence with NOAA.

[89] The Deep Ocean Mining Environmental Study conducted by NOAA as directed by Congress under DSHMRA (30 U.S.C. §1419(a)) focused primarily on determining the biological effects of increased sedimentation on the seafloor that would result from seabed mining operations. See, NOAA 1995 Report to Congress, p. 12.

[90] Levin et al., "Defining 'Serious Harm'"; and Amon et al., "Assessment of Scientific Gaps."

[91] For example, the research campaigns of the NOAA ship *Okeanos Explorer*. NOAA, "NOAA Ship *Okeanos Explorer*: 2022 Expeditions Overview," at https://oceanexplorer.noaa.gov/okeanos/explorations/2022-overview/welcome.html.

[92] For example, the 96th Congress stated among the purposes of DSHMRA "to encourage the continued development of technology necessary to recover the hard mineral resources of the deep seabed", see 30 U.S.C. §1401(b)(5).

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