

**EXPLORING THE POTENTIAL OF
DEEP-SEA MINING TO EXPAND
AMERICAN MINERAL PRODUCTION**

OVERSIGHT HEARING

BEFORE THE

SUBCOMMITTEE ON OVERSIGHT AND
INVESTIGATIONS

OF THE

COMMITTEE ON NATURAL RESOURCES

U.S. HOUSE OF REPRESENTATIVES

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HOUSE COMMITTEE ON
NATURAL RESOURCES
CHAIRMAN BRUCE WESTERMAN

To: House Committee on Natural Resources Republican Members
From: Natural Resources Subcommittee on Oversight and Investigations Staff,
Michelle Lane (Michelle.Lane@mail.house.gov) x6-4137 and Lucas Drill
(Lucas.Drill@mail.house.gov) x5-0500
Date: April 28, 2025
Subject: Oversight Hearing titled *“Exploring the Potential of Deep-Sea Mining to
Expand American Mineral Production”*

The Subcommittee on Oversight and Investigations will hold an oversight hearing titled **“Exploring the Potential of Deep-Sea Mining to Expand American Mineral Production”** on **Tuesday, April 29, 2025, at 10:15 a.m. in 1324 Longworth House Office Building.**

Member offices are requested to notify Jace McNaught (Jace.McNaught@mail.house.gov) by 4:30 p.m. on April 28, if their Member intends to participate in the hearing.

I. KEY MESSAGES

- Minerals, particularly critical minerals, are essential to contemporary life. The House Committee on Natural Resources Majority has repeatedly emphasized the importance of critical minerals and securing American mineral supply chains.
- Republican Members of Congress and the Trump Administration have championed an all-of-the-above approach to mineral exploration and extraction to counter longstanding foreign influence, particularly by China, and secure domestic mineral supply chains.
- The sea floor is lined with critical and other hardrock minerals, often found in the form of polymetallic nodules, which are similar in size to golf balls. While the technology and research to mine in the deep-sea has existed for decades, global supply chains, increased reliance on adversarial foreign nations for critical minerals, and an uptick in general demand for these minerals have increased interest in deep-sea mining.
- American seabed mining companies are leading the global race to explore deep-sea mineral deposits and develop technology enabling efficient mineral harvesting from the sea floor.
- Now is the time to reform permitting processes to unleash crucial terrestrial mining projects and embolden seabed mining operations, which together will secure American mineral supply chains.

II. WITNESSES

- **Mr. Gerard Barron**, CEO and Chairman, The Metals Company and The Metals Company USA, Raleigh, NC
- **Mr. Oliver Gunasekara**, CEO and Co-Founder, Impossible Metals, San Jose, CA

- **Dr. Thomas Peacock**, Professor of Mechanical Engineering and Director, Environmental Dynamics Laboratory, Massachusetts Institute of Technology, Cambridge, MA
- **Mr. Duncan Currie**, Legal Advisor, Deep Sea Conservation Coalition, Christchurch, New Zealand (*Minority witness*)

III. BACKGROUND

Minerals are Essential to Contemporary Life



An assortment of critical minerals.¹

Minerals, particularly those identified by the U.S. Department of the Interior's (DOI) U.S. Geological Survey (USGS) as critical to America's national security, economy, or energy infrastructure, are essential to contemporary life. The House Committee on Natural Resources has repeatedly emphasized the importance of minerals and securing American mineral supply chains.² The Committee has highlighted the countless applications of hardrock minerals and the exponentially rising global mineral demand. In addition, the Committee continues to speak to the rapidly increasing difficulty of meeting mineral demand due to permitting delays, legislative restrictions, and America's near-total mineral dependence on foreign nations like China.³

Spurred by this battered current state of domestic mineral supply chains,⁴ Republican Members of Congress⁵ and the Trump Administration⁶ have championed an all-of-the-above approach to mineral exploration and extraction policy, which includes not only streamlining permitting for terrestrial mining projects and encouraging American companies to continue investing in space mining technologies,⁷ but also diving deep to harvest minerals lining the sea floor.

Recognizing this need, on April 24, 2025, President Trump issued an Executive Order, *Unleashing America's Offshore Critical Minerals and Resources*, that made clear that the United States must immediately "accelerate the responsible development of seabed mineral resources," invest in deep sea mapping and technology to "quantify the Nation's endowment of seabed minerals," and "ensure secure supply chains for our defense, infrastructure, and energy sectors" through seabed mining.⁸

Seabed Mining

Seabed mining is the process of "extracting sediment and mineral resources from the seafloor."⁹ These mineral resources prominently include three types of deposits:

The first, polymetallic nodules, typically exist on abyssal plains, look like potato-shaped rocks, and contain cobalt, copper, manganese, nickel, and other metallic rare earth elements (REEs) that are essential to the production of batteries, electronics, and steel.¹⁰ The nodules develop over millions of years as minerals create thin concentric layers around small hard fragments like shells or shark teeth.¹¹ The nodules can vary greatly in size, from about 2 to 20 centimeters, and are estimated to exist worldwide in numbers as abundant as 210 trillion dry tons.¹²



Polymetallic nodules, each containing multiple valuable, including critical, minerals are seen here covering the sea floor in the Pacific Ocean.¹³

Polymetallic nodules are the most prominent form of seabed minerals targeted for extraction, with several methods for harvesting having been proposed. These include:

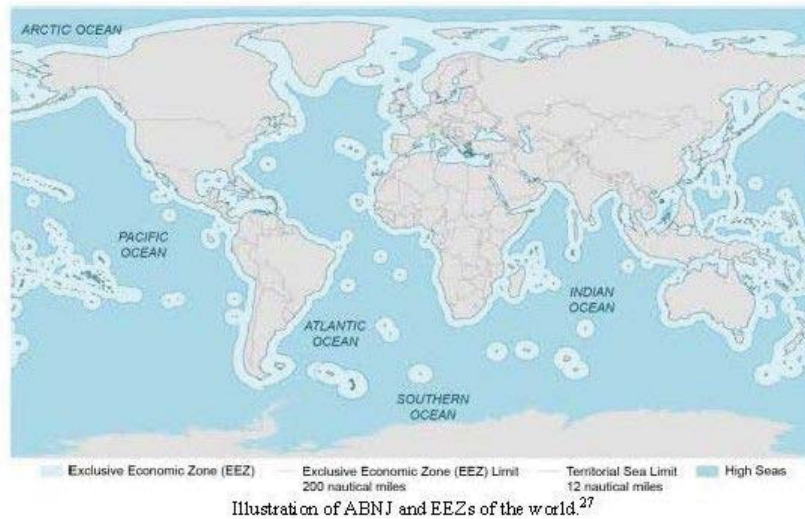
1. A “remotely operated collector vehicle fitted with caterpillar-like tracks that uses a water stream aimed at nodules laying on the seafloor to create a pressure drop and suction effect to lift sediment with nodules into a collector system.”¹⁴ This method functions as a vacuum-like system for harvesting polymetallic nodules.
2. An “autonomous underwater vehicle that hovers over the seafloor and uses robotic arms with a vision system to pick individual nodules from the seafloor.”¹⁵ This method is empowered by artificial intelligence to avoid picking up objects other than nodules.¹⁶

Nodules were discovered as early as the 1870s during the HMS Challenger expedition,¹⁷ but extraction and processing methods were not adequately explored until the 1970s.¹⁸

The second type of deposit, polymetallic sulfides, is usually found on sea ridges and “precipitate from hydrothermal fluids at hydrothermal vent sites.”¹⁹ These sulfides often contain copper, gold, iron, lead, silver, and zinc.²⁰ To mine sulfides, a “[r]emotely operated mining machine that cuts and/or drills into the hard substrate of the hydrothermal vent chimney to extract internal minerals” is required.²¹

The third, ferromanganese or cobalt-rich crusts, are typically found across ocean basins and shallower exclusive economic zones (EEZs) in volcanically active regions.²² These crusts form on hard surfaces like rocks “from seawater rich in dissolved metals,” and contain cobalt, manganese, nickel, platinum, and other metallic REEs.²³ To mine crusts, a “[r]emotely operated mining machine that scrapes across the surfaces of geologic features to remove surficial mineral crusts” is most effective.²⁴

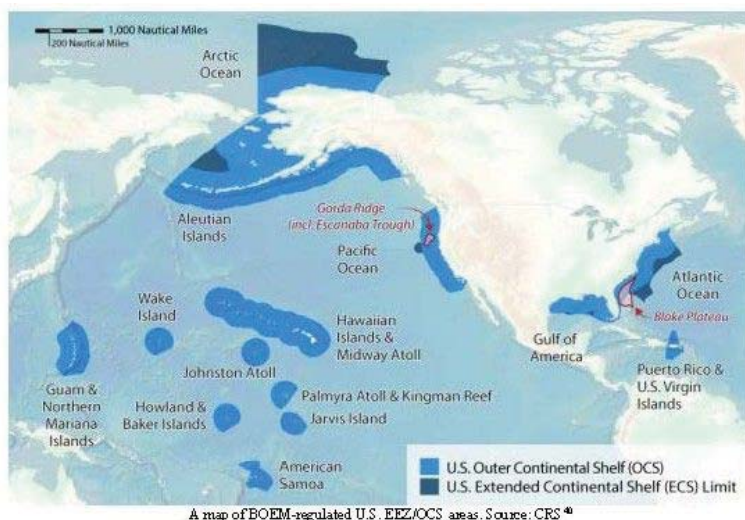
Two other types of mineral deposits, placers (heavy mineral sands) and phosphorites (sedimentary rocks), both occur in shallow waters close to shore. They contain relatively low concentrations of minerals and are, therefore, of little interest to commercial seabed mining operations.²⁵ Additionally, seabed mining techniques have been historically used to extract diamonds from the waters of South Africa and Namibia.²⁶



Seabed mining can occur within two distinct geographic areas:

1. *Exclusive Economic Zones (EEZs)*: Areas to which coastal nations “may claim sovereign rights for the purpose of exploring and exploiting the natural resources of its continental shelf.”²⁸ A nation’s domestic laws regulate seabed mining activities within EEZs.²⁹ EEZs typically extend up to 200 nautical miles from shore and usually feature waters less than 200 meters (approximately 656 feet) deep.³⁰ In the United States, the EEZ encompasses the U.S. Outer Continental Shelf (OCS), which extends from about 3 nautical miles from shore,³¹ where state-controlled waters end,³² to about 200 nautical miles.³³ Seabed mining in the U.S. EEZ is regulated by DOI’s Bureau of Ocean Energy Management (BOEM).³⁴
2. *Areas Beyond National Jurisdiction (ABNJ)*: Areas beyond EEZs, also known as the high seas or international waters, include all areas beyond approximately 200 nautical miles from the shores of coastal nations.³⁵ ABNJ commonly feature depths beyond 200 meters, at which seabed mining is also called deep-sea mining.³⁶ ABNJ seabed mining is generally regulated by the United Nations Convention on the Law of the Sea (UNCLOS) and its established International Seabed Authority (ISA).³⁷ In the United States, which is not a party to UNCLOS, ABNJ seabed mining is regulated by the U.S. Department of Commerce’s (DOC) National Oceanic and Atmospheric Administration (NOAA).³⁸ The most prominent hotspot of ABNJ seabed mining interest is known as the Clarion-Clipperton zone (CCZ) in the Pacific Ocean.³⁹

Domestic (EEZ) Governance Framework for Seabed Mining



Seabed mining within the United States EEZ is regulated by BOEM, which has two primary functions related to seabed mining and critical minerals: 1) evaluating the U.S. OCS for mineral resources; and 2) leasing submerged lands for critical mineral exploration and development.⁴¹ BOEM's administration of OCS leases, pursuant to the Outer Continental Shelf Lands Act of 1953,⁴² most directly impact the seabed mining industry. While BOEM's Marine Minerals Program has "supported work to evaluate critical mineral resources on the OCS" to meet its first mission,⁴³ BOEM has not "held any lease sales for critical minerals on the OCS or issued any critical mineral leases" to meet its second, more essential, mission to secure domestic mineral supply chains.⁴⁴

The failure to lease areas within the U.S. EEZ is due largely to a fatal flaw in BOEM's regulatory scheme that poses a heavy economic burden coupled with unnecessary risk on aspiring American seabed mining operations.⁴⁵ BOEM's scheme is a two-step process. First, an entity interested in exploring U.S. seabed mineral deposits for later commercial purposes must apply to BOEM for a prospecting permit.⁴⁶ Data collected by the permit holder must then be shared with BOEM. Crucially and problematically, "a prospecting permit is separate from a lease to develop minerals in an area, and the prospecting permit does not convey any preferential right to a lease."⁴⁷ Put simply, a company that expends considerable resources prospecting for seabed minerals under a BOEM prospecting permit must then begin the leasing process from scratch and compete with other seabed mining entities for the right to extract the minerals it located and studied.

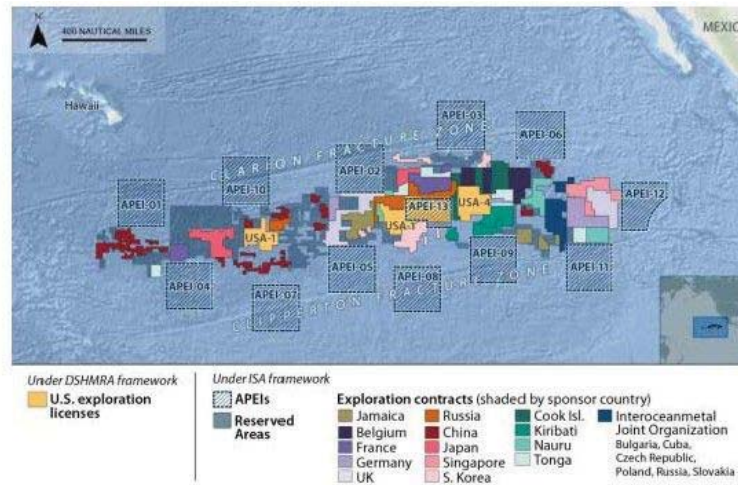
The BOEM leasing process itself is also burdensome. The leasing process can start with an unsolicited request for a lease sale to BOEM or can be initiated by BOEM.⁴⁸ Regardless, BOEM must publish a request for interest detailing the mineral lease sale in the Federal Register.⁴⁹ BOEM lease sales must be awarded through competitive cash auctions.⁵⁰ Then, once a lease is awarded, BOEM must approve three plans before any seabed mining activities may start: 1) a delineation plan describing how the lessee will locate and characterize the minerals to be extracted; 2) a testing plan describing pilot mining and equipment testing activities; and 3) a mining plan that includes "comprehensive detailed descriptions, illustrations, and explanations of the proposed OCS mineral development, production, and processing activities, as well as plans to address environmental impacts and plans to clear the lease area when mining activities end."⁵¹ Each of these approved plans must then be strictly adhered to during all seabed mining operations.⁵² Pursuant to the Inflation Reduction Act of 2022, BOEM's regulations and processes also apply to "submerged lands offshore of U.S. territories as part of the OCS."⁵³

Despite the burdens of BOEM's regulatory scheme, at least one American company, Impossible Metals, "has submitted a request to commence a leasing process for exploration and potential mining of critical minerals in the deep sea off

the coast of American Samoa.”⁵⁴ This first-of-its-kind request from Impossible Metals to BOEM may facilitate increased interest in seabed mining in the U.S. EEZ.

Additionally, President Trump’s April 2025 Executive Order aimed at revitalizing American seabed mining dominance directs DOI, through BOEM, to “establish an expedited process for reviewing and approving permits for prospecting and granting leases for exploration, development, and production of seabed mineral resources” found in the OCS.⁵⁵ This new expedited process “should ensure efficiency, predictability, and competitiveness for American companies” as BOEM’s regulatory scheme is reviewed and streamlined.⁵⁶

International (ABNJ) Governance Frameworks for Seabed Mining



The CCZ, a polymetallic nodule-rich area in the Pacific Ocean.⁵⁹

There are two major international entities that regulate ABNJ seabed mining. In addition, the United States has also established its own international regulatory scheme:

1. *UNCLOS*. In 1982, the United Nations (UN) “established a framework governing activities on, over, and under the world’s ocean.”⁵⁸ UNCLOS “considers 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.”⁵⁹ UNCLOS entered into force in 1994. The United States did not ratify UNCLOS and is not a party to the convention.⁶⁰ The U.S. does, however, recognize that some portions of UNCLOS reflect customary international law.⁶¹
2. *ISA*. UNCLOS established the International Seabed Authority (ISA) as “an autonomous organization that regulates and controls mineral-related activities in ABNJ for parties to UNCLOS.”⁶² Because the U.S. is a member of the UN, it holds observer delegate status at the ISA despite not being party to UNCLOS.⁶³ The ISA has issued 31 exploration contracts to public and private seabed mining companies, including 17 for polymetallic nodules in the CCZ, which contains “more copper, cobalt, nickel, and manganese than all known land deposits combined.”⁶⁴ The ISA “has yet to develop a regulatory regime for the extraction of seabed minerals and therefore has not issued exploitation contracts” for the extraction of deep-sea minerals.⁶⁵ The ISA’s deadline to establish this regulatory regime is 2025. Notably, China and Russia are both parties to UNCLOS and hold exploration contracts issued by the ISA in the CCZ. China, in particular, has actively sought “seabed mining partnerships far beyond its shores,” which presents security concerns to the United States as China’s seabed exploration activities generate data that can be used for future deep-sea mineral harvesting and military purposes.⁶⁶

3. *U.S. Law and NOAA*. NOAA regulates U.S. seabed mining activity beyond the boundary of the U.S. EEZ. In 1980, Congress passed the Deep Seabed Hard Mineral Resources Act (DSHMRA) that established a framework for “authorizing U.S. citizens to explore for and recover minerals from the seabed in ABNJ” by enabling NOAA “to issue exploration licenses and commercial recovery permits to U.S. citizens for deep-seabed mining activities.”⁶⁷ NOAA must “prepare and publish an environmental impact statement for its issuance” of an exploration license or commercial recovery following National Environmental Policy Act (NEPA) processes.⁶⁸ To be clear, “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.”⁶⁹ In fact, in 1984, “NOAA issued exploration licenses for four sites located in the CCZ.”⁷⁰ Two of these exploration licenses, USA-1 and USA-4, were renewed in 2022 and are still held by Lockheed Martin.⁷¹ However, these licenses were originally issued prior to UNCLOS entering into force and before the establishment of the ISA.⁷² Today, it is unclear whether new NOAA recovery permits would be recognized as legitimate by UNCLOS parties, and it is possible that the ISA could attempt to issue permits to other companies from UNCLOS party nations in the same areas as U.S. companies permitted by NOAA.⁷³

Nevertheless, leading American scholars claim that the NOAA regulatory scheme is sufficient to allow American companies to mine the deep sea without the U.S. ratifying UNCLOS.⁷⁴ Because of this confidence, at least one American company, The Metals Company USA, has “initiated a process” with NOAA “to apply for exploration licenses and commercial recovery permits under existing U.S. legislation.”⁷⁵ Moreover, President Trump’s April 2025 seabed mining Executive Order directs DOC, through NOAA, to “expedite the process for reviewing and issuing seabed mineral exploration licenses and commercial recovery permits in areas beyond national jurisdiction.”⁷⁶ This expedited process seeks to explicitly reinvigorate NOAA’s ABNJ regulatory authority, which gives U.S. companies like The Metals Company USA the conviction, predictability, and competitiveness necessary to lead the world in seabed mineral exploration, identification, and collection.⁷⁷

Regulatory and Permitting Reform is Essential for Successful Seabed Mining Operations

Navigating domestic and international regulatory frameworks to harvest minerals from the sea floor presents unique challenges for seabed mining stakeholders. Additionally, efficiently processing and refining these minerals once recovered is a vital consideration for mining operators without a clear solution, barring permitting reform. Today, although some foreign mineral processing facilities can extract some minerals from polymetallic nodules, no such facilities exist in the United States. Further, no purpose-built facility exists to effectively extract all the valuable minerals found in each nodule brought up from the sea floor.⁷⁸ According to experts, one purpose-built facility could not only unleash polymetallic nodule processing capabilities but also create approximately 1,500 direct and 10,000 indirect jobs.⁷⁹ Yet, until more processing facilities are constructed, particularly in the United States, reaping all the benefits of an all-of-the-above approach to securing domestic critical mineral supply chains, which includes seabed mining, remains a moving target.

Seabed mining efforts by U.S. entities, in the U.S. EEZ and in ABNJ, collectively represent a willingness to dive deep and use natural resources found in our waters effectively. As technology progresses at a rapid pace, costs are further reduced and collaboration in the seabed mining industry continues, the U.S. could not only develop the ability to harness vast mineral resources, but also apply these technologies to mining operations on land and in space to secure U.S. mineral supply chains.

Like most sectors, new and innovative technology has historically driven the mining industry. Today, promising new technologies in withstanding pressure, artificial intelligence, mapping, data, processing, and refining efficiencies promise to upend the industry just as updates in machinery, robotics, and basic safety equipment did in years past.⁸⁰ The time is now to embrace permitting reform for seabed and land-based mining as the United States seeks to secure its domestic supply chain. This is crucial not only for developing emerging technologies and strengthening our economy, but also for ensuring national security.

- ¹ *Critical Minerals*, Stanford University (2025), <https://asei.stanford.edu/critical-minerals>.
- ² See, e.g., *Now Ore Never: The Importance of Domestic Mining for U.S. National Security*, Oversight Hearing before the Subcomm. on Energy and Mineral Resources of the H. Comm. on Natural Resources, 119th Cong. (Feb. 6, 2025) (hearing memorandum), <https://naturalresources.house.gov/uploadedfiles/hlrg-119-006-20250206-sd002.pdf>; *Contrasting Momentum in the Space Mining Economy to the Terrestrial Mining Regulatory Morass*, Oversight Hearing before the Subcomm. on Oversight and Investigations of the H. Comm. on Natural Resources, 119th Cong. (Feb. 25, 2025) (hearing memorandum), https://naturalresources.house.gov/uploadedfiles/hearing_memo_-_sub_on_ov_hrg_on_space_mining_02_25_25.pdf; *Unleashing the Golden Age of American Energy Dominance*, Oversight Hearing before the Subcomm. on Oversight and Investigations of the H. Comm. on Natural Resources, 119th Cong. (Apr. 2, 2025) (hearing memorandum), https://naturalresources.house.gov/uploadedfiles/hearing_memo_-_sub_on_ov_hrg_on_energy_dominance_04_02_25.pdf.
- ³ See *Id.* (referring to all three previously cited Committee hearing memoranda). See also, Climate Smart Mining Facility, *Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition*, THE WORLD BANK (2020), <https://pubdocs.worldbank.org/en/96171188875536384/Minerals-for-Clean-Energy-Transition-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf>; James Marshall, *Insufficient minerals threaten energy transition—report*, E&E NEWS (May 5, 2021), <https://www.eenews.net/greenwire/stories/1063731805>; Wilson Center, Duncan Wood, et al., *The Mosaic Approach: a Multidimensional Strategy for Strengthening America's Critical Minerals Supply Chain*, https://www.wilsoncenter.org/sites/default/files/media/analyses/documents/critical_minerals_supply_report.pdf; Bonakdarpour et al., *Mine development times: The US in perspective*, S&P Global (June 2024), https://cdn.themarket.com/www/pdf/0724/SPGlobal_NMA_DevelopmentTimesUSinPerspective_June_2024.pdf; *Mineral Commodity Summaries 2024*, USGS, <https://pubs.usgs.gov/periodicals/mcs2024/mcs2024.pdf>; Ernest Scheyder, *China set to control rare earth supply for years due to processing dominance*, REUTERS (May 29, 2019), <https://www.reuters.com/article/us-china-usa-rareearth-refining/china-set-to-control-rare-earth-supply-for-years-due-to-processing-dominance-idUSKCN1T004I>.
- ⁴ For example, China has repeatedly restricted or banned exports of critical and other hardrock minerals to the United States. Earlier this month, China imposed new export restrictions on minerals crucial to U.S. defense, energy, and automotive industries. See, e.g., Gracelin Baskaran and Meredith Schwartz, *The Consequences of China's New Rare Earths Export Restrictions*, CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES (Apr. 14, 2025), <https://www.csis.org/analysis/consequences-chinas-new-rare-earth-export-restrictions>.
- ⁵ See, e.g., Caitlin Keating-Bitonti and Jared G. Tupuola, *Seabed Mining Interests Across the Pacific Islands*, CONG. RESEARCH SERVICE (Apr. 17, 2025), <https://www.crs.gov/Reports/RF12974>.
- ⁶ See, e.g., *Unleashing America's Offshore Critical Minerals and Resources*, THE WHITE HOUSE (Apr. 24, 2025), <https://www.whitehouse.gov/presidential-actions/2025/04/unleashing-americas-offshore-critical-minerals-and-resources/>; *Immediate Measures to Increase American Mineral Production*, THE WHITE HOUSE (Mar. 20, 2025), <https://www.whitehouse.gov/presidential-actions/2025/03/immediate-measures-to-increase-american-mineral-production/>; *Ensuring National Security and Economic Resilience Through Section 232 Actions on Processed Critical Minerals and Derivative Products*, THE WHITE HOUSE (Apr. 15, 2025), <https://www.whitehouse.gov/presidential-actions/2025/04/ensuring-national-security-and-economic-resilience-through-section-232-actions-on-processed-critical-minerals-and-derivative-products/>; *Trump Administration Advances First Wave of Critical Mineral Production Projects*, THE WHITE HOUSE (Apr. 18, 2025), <https://www.whitehouse.gov/articles/2025/04/trump-administration-advances-first-wave-of-critical-mineral-production-projects/>.
- ⁷ See *Contrasting Momentum in the Space Mining Economy to the Terrestrial Mining Regulatory Morass*, Oversight Hearing before the Subcomm. on Oversight and Investigations of the H. Comm. on Natural Resources, 119th Cong. (Feb. 25, 2025) (hearing memorandum), https://naturalresources.house.gov/uploadedfiles/hearing_memo_-_sub_on_ov_hrg_on_space_mining_02_25_25.pdf.
- ⁸ *Unleashing America's Offshore Critical Minerals and Resources*, THE WHITE HOUSE (Apr. 24, 2025), <https://www.whitehouse.gov/presidential-actions/2025/04/unleashing-americas-offshore-critical-minerals-and-resources/>.
- ⁹ Caitlin Keating-Bitonti, *Seabed Mining in Areas Beyond National Jurisdiction: Issues for Congress*, CONG. RESEARCH SERVICE (Nov. 22, 2024), <https://www.crs.gov/Reports/R47324>.
- ¹⁰ *Id.*
- ¹¹ *Id.*
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- ¹⁷ Shane Scarminch, *Diving into the History of Seabed Mining*, EDGE EFFECTS (Oct. 12, 2019), <https://edgeseffects.net/seabed-mining/>.
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<http://wilsoncenter.org/sites/default/files/media/uploads/documents/Polymetallic%20Nodules%20and%20The%20Critical%20Minerals%20Supply%20Chain.pdf>

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²⁰ *Id.*

²¹ *Id.*

²² *Id.*

²³ *Id.*

²⁴ *Id.*

²⁵ Caitlin Keating-Bitonti and Laura B. Comay, *Critical Minerals on the U.S. Outer Continental Shelf: The Bureau of Ocean Energy Management's Role and Issues for Congress*, CONG. RESEARCH SERVICE (Apr. 9, 2025), <https://www.crs.gov/Reports/R48302>.

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⁴¹ *Id.*

⁴² 43 U.S.C. §§ 1331 *et seq.*

⁴³ BOEM's analysis suggests that 37 of 50 minerals identified by USGS as critical occur on the sea floor within the U.S. EEZ, some in greater quantities than found on land. BOEM has not formally evaluated the commercial viability of harvesting these critical minerals from the U.S. OCS. See Caitlin Keating-Bitonti and Laura B. Comay, *Critical Minerals on the U.S. Outer Continental Shelf: The Bureau of Ocean Energy Management's Role and Issues for Congress*, CONG. RESEARCH SERVICE (Apr. 9, 2025), <https://www.crs.gov/Reports/R48302>.

⁴⁴ Caitlin Keating-Bitonti and Laura B. Comay, *Critical Minerals on the U.S. Outer Continental Shelf: The Bureau of Ocean Energy Management's Role and Issues for Congress*, CONG. RESEARCH SERVICE (Apr. 9, 2025), <https://www.crs.gov/Reports/R48302>.

⁴⁵ See *Id.*

⁴⁶ *Id.*; see also 30 C.F.R. §§ 580.24, 580.40 – 580.52, 580.70 – 580.73.

⁴⁷ Caitlin Keating-Bitonti and Laura B. Comay, *Critical Minerals on the U.S. Outer Continental Shelf: The Bureau of Ocean Energy Management's Role and Issues for Congress*, CONG. RESEARCH SERVICE (Apr. 9, 2025), <https://www.crs.gov/Reports/R48302>.

⁴⁸ *Id.*; see also 30 C.F.R. §§ 581.11 – 581.12.

⁴⁹ Caitlin Keating-Bitonti and Laura B. Comay, *Critical Minerals on the U.S. Outer Continental Shelf: The Bureau of Ocean Energy Management's Role and Issues for Congress*, CONG. RESEARCH SERVICE (Apr. 9, 2025), <https://www.crs.gov/Reports/R48302>; see also 30 C.F.R. §§ 581.12.

⁵⁰ 30 C.F.R. §§ 581.18 – 581.21.

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⁵⁷ Caitlin Keating-Bitonti, *Seabed Mining in Areas Beyond National Jurisdiction: Issues for Congress*, CONG. RESEARCH SERVICE (Nov. 22, 2024), <https://www.crs.gov/Reports/R47324>.

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⁶⁶ Caitlin Keating-Bitonti and Jared G. Tupuola, *Seabed Mining Interests Across the Pacific Islands*, CONG. RESEARCH SERVICE (Apr. 17, 2025), <https://www.crs.gov/Reports/R472974>.

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⁶⁸ Caitlin Keating-Bitonti, *Seabed Mining in Areas Beyond National Jurisdiction: Issues for Congress*, CONG. RESEARCH SERVICE (Nov. 22, 2024), <https://www.crs.gov/Reports/R47324>; see also 30 U.S.C. § 1419(d).

⁶⁹ Caitlin Keating-Bitonti, *Seabed Mining in Areas Beyond National Jurisdiction: Issues for Congress*, CONG. RESEARCH SERVICE (Nov. 22, 2024), <https://www.crs.gov/Reports/R47324>.

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⁷¹ *Id.*

⁷² *Id.*

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**OVERSIGHT HEARING ON EXPLORING THE
POTENTIAL OF DEEP-SEA MINING TO
EXPAND AMERICAN MINERAL PRODUCTION**

**Tuesday, April 29, 2025
U.S. House of Representatives
Subcommittee on Oversight and Investigations
Committee on Natural Resources
Washington, D.C.**

The Subcommittee met, pursuant to notice, at 10:15 a.m. in Room 1324, Longworth House Office Building, Hon. Paul Gosar [Chairman of the Subcommittee] presiding.

Present: Representatives Gosar, Westerman; Dexter, and Huffman.

Also present: Representatives Hunt, Webster; and Case.

Dr. GOSAR. The Subcommittee on Oversight and Investigations will come to order.

Without objection, the Chair is authorized to declare a recess of the Subcommittee at any time.

The Subcommittee is meeting today to hear testimony on exploring the potential of deep-sea mining to expand American mineral production.

Under Committee Rule 4(f), any oral opening statements at the hearing are limited to the Chairman and the Ranking Member, as well as the Ranking Member and the Chairman of the Full Committee. I therefore ask unanimous consent that all other Members' statements be made part of the hearing record if they are submitted in accordance with Committee Rule 3(o).

Without objection, so ordered.

I ask unanimous consent that the following Members be allowed to sit and participate in today's hearing: the gentleman from Florida, Mr. Webster; the gentleman from Texas, Mr. Hunt; and the gentleman from Hawaii, Mr. Case.

Without objection, so ordered.

I recognize the Full Committee Chair, Mr. Westerman.

I will now open with my opening statement.

**STATEMENT OF THE HON. PAUL GOSAR, A REPRESENTATIVE
IN CONGRESS FROM THE STATE OF ARIZONA**

Dr. GOSAR. Good morning, everyone. Thank you to our witnesses who came today to testify on this important issue: exploring the potential of deep-sea mining to expand American mineral production.

From the moment President Trump began his second term, the House Committee on Natural Resources majority and the Trump administration have worked tirelessly to unleash America's natural resources and restore our Nation's energy and mineral dominance. Doing so has meant not only leading an effort to reform

burdensome regulations and permitting processes to unlock key resources within America's land borders, but also looking to other areas like the sea floor of the U.S., the Outer Continental Shelf, and the deep, high seas that are rich with critical mineral deposits.

Under former misguided Democratic leadership, the U.S. abandoned our ability to explore, extract, and process critical minerals that are foundational to nearly all modern technologies and amenities. Nothing pleased our foreign adversaries like China more than America's surrender to radical preservationist NGOs and their foreign-funded donors who waged lawfare against sound, multiple-use resource management policies.

Seizing the opportunities left behind by America's absence, China has completely dominated global critical mineral supply chains. Right now, China controls approximately 60 percent of the worldwide critical mineral production, 90 percent of the processing, and 75 percent of the manufacturing. This outsized global influence has allowed China to cripple America's access to critical minerals at a whim.

Harvesting the minerals found in abundance on the sea floor, both in the U.S.-controlled and international waters, can significantly help America buck the supply chain yoke placed on us by China and reestablish mineral independence. Current estimates place a value of up to \$16 trillion on sea floor critical minerals around the world. Estimates of seabed minerals in U.S. waters alone suggest that seabed mining could add over \$300 billion to America's GDP over the next decade and create more than 100,000 jobs. And as our mineral identification capabilities increase through additional seabed exploration, these estimates are more likely to increase.

Recognizing this reality, last Thursday, April 24, President Trump issued an executive order intended to invigorate American seabed mining dominance by accelerating the process for reviewing and approving permits for exploration and extraction under long-standing U.S. law.

Unsurprisingly, the very next day the same Chinese authorities who have flouted nearly every humanitarian, labor, and environmental law on the books in their quest to control global mineral mining, including on the sea floor, accused President Trump of the United States of violating international law and harming the overall interests of the international community. *Deja vu*. This Chinese reaction only highlights that President Trump and the Republicans in Congress are charging ahead in the right direction.

I challenge my colleagues in this room to think about the widespread economic, energy, technology, and national security implications of seabed mining and about our duty to ensure that the United States, with its world-best environmental, humanitarian, and labor standards, leads the charge to harvest sea floor critical minerals. Together we must work to secure America's mineral supply chains and champion an all-of-the-above approach to mineral and energy development.

Thank you. I now recognize the Ranking Member, Ms. Dexter, for her opening statements.

STATEMENT OF THE HON. MAXINE DEXTER, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF OREGON

Dr. DEXTER. Thank you, Mr. Chair, and thank you to our witnesses for joining us today. I appreciate the opportunity to educate ourselves on an issue of profound environmental and economic consequence: deep-sea mining. It is unfortunate, indeed, that our President has already issued an executive order on this topic, even knowing that we had this hearing forthcoming, showing his disregard for transparency and public input.

Let me be clear from the outset. Deep-sea mining is a high-risk, low-reward endeavor. It carries grave risks to our oceans and communities with no credible evidence of return on investment. Supporters of deep-sea mining argue it will meet an urgent demand for minerals like cobalt, nickel, copper, and manganese, currently essential for electric vehicles and renewable energy. But the math simply does not add up.

The industry's financial models are based on wildly optimistic assumptions and fail to reflect the volatility and reality of global mineral markets. Between 2016 and 2023, electric vehicle production skyrocketed by 2,000 percent. Yet over that same period nickel prices only rose 28 percent, copper 21 percent, and cobalt prices fell by 10 percent. If prices remain stagnant or even dropped during the most significant boom in EV production to date, it is a stretch to assume prices will spike in the future to support a new, highly capital-intensive mining operation in one of the most hostile environments on Earth.

It is important to note that China, the world's largest producer of electric vehicles and responsible for 61 percent of global rare Earth mineral production, has already moved away from using cobalt in EV batteries. If cobalt were truly essential to the future of clean energy, they wouldn't be leaving it behind.

We also need to be honest about what is actually in the seabed. Polymetallic nodules contain only four commercially viable metals. Claims that deep-sea mining will solve supply chain needs for rare Earth elements or national security critical materials are exaggerated and grossly misleading. These minerals are not found in significant quantities on the ocean floor, and extracting them from nodules is inefficient and environmentally devastating.

And let's talk about cost. Deep-sea mining is no different than other high-risk industrial endeavors. It demands massive upfront capital investment. The record shows that two-thirds of large-scale industrial extractive projects go over budget, often by 50 percent or more. There is no reason to believe deep-sea mining will fare any better, especially given the extreme challenges of working at depths of 13,000 feet, where intense pressure, freezing temperatures, and corrosive conditions make operations both technically and financially risky.

We have already seen what this risk looks like in practice. The company leading the charge, The Metals Company, projected it could extract 12 million tons of material per year. But in 2022, after a 2-month test, it recovered just 3,000 tons, less than 1 percent of its target. That is not a proof of concept; it is a red flag.

And now that these startups are running out of cash, they are looking to the Trump administration for a bailout. President

Trump's executive order to fast-track deep-sea mining permits in international waters allows companies like The Metals Company to bypass the International Seabed Authority. Such a move would violate international law, strain relations with Pacific communities, and set a dangerous precedent for unilateral exploitation, opening the door for adversaries like China and Russia to justify expanding their own maritime activities.

The industry itself seems to recognize the writing is on the wall. Major corporations like Google, BMW, Samsung, and Volkswagen have pledged not to source minerals from deep sea. Financial institutions including Lloyds and Standard Chartered are refusing to back deep-sea mining. Even longtime backers like Maersk and Lockheed Martin have pulled their support.

The deep-sea mining industry lacks not just a social license to operate, it lacks a business case. Meanwhile, viable alternatives are emerging. Battery innovation is reducing the need for cobalt and nickel, and investment in recycling the circular economy technologies is growing rapidly. By 2050 nearly half of all cobalt and nickel needs could be met through recycling alone.

We do not need to bulldoze the bottom of the ocean to power our clean energy future. The economic argument is a mirage, the financial risk is immense, and the consequences to ecosystems, to fisheries, to Indigenous communities, and to our global climate are too great to ignore.

I urge my colleagues to reject deep-sea mining as a viable path forward, and instead invest in the sustainable, science-based alternatives that truly support our clean energy and conservation goals.

Thank you, Mr. Chair, I yield back.

Dr. GOSAR. I thank the gentlewoman. I now recognize the Full Committee's Ranking Member, Mr. Huffman from California, for his 5 minutes.

STATEMENT OF THE HON. JARED HUFFMAN, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mr. HUFFMAN. Thank you, Mr. Chairman. Mr. Chairman, I think we agree on something: this country needs an effective and comprehensive strategy to meet our mineral needs to transition to a clean energy economy. We might not agree on that last part, but we agree on the need for a mineral strategy.

Unfortunately, that is not what we are talking about here today. Deep-sea mining is a dirty, destructive, and unproven industry threatening to decimate one of the last untouched ecosystems on Earth. And despite what proponents claim, it is not the great silver bullet that solves our critical minerals problem. It is much more likely that it will create a whole new class of problems, especially if it is pursued in the reckless cowboy manner reflected in President Trump's imperial edict.

At its core, deep-sea mining involves deploying massive industrial machinery to scrape the ocean floor, sucking up the top few inches of sediment and the unique life that resides in it in search of metal-rich nodules. That sediment, crushed marine life and nodules, are all pumped to the surface where the minerals are extracted and the waste is simply dumped back in the ocean. On

a commercial scale, this would unleash a chain reaction of destruction. We can't even fully measure it, let alone fully mitigate it.

What we do know is this: the deep sea plays a crucial role in regulating carbon; it is home to an extraordinary wealth of biodiversity; and it provides habitat for species that we are only now beginning to understand and to discover. A single seabed mining operation could affect an area the size of a small country. Toxic plumes could travel hundreds, even thousands of miles, disrupting entire mid-water food webs, including tuna, whales, and other species that support our economy.

And the damage would be permanent. There is one deep-sea mining test that shows visible damage and a fourfold decrease in foundational microbial activity 26 years after the early test run.

And look, say what you will about land-based mining, but at least we can require remediation, cleanup. We can even have mining companies sometimes leave parks and other nice things when they are done. You can't do that with deep-sea mining. You simply wreck it and move on.

And here is the kicker. For all that destruction, deep-sea mining doesn't even pencil out. The industry has very questionable market prospects because battery technology is rapidly changing. Anyone remember nickel cadmium batteries? They are essentially obsolete now. Today EV markets are already moving away from the nickel, cobalt, copper, and manganese found in deep sea nodules towards other minerals. Folks who want to make money on this are skating to where the puck is or was, not skating to where the puck is going to be. I will mention Tesla, for example, just to make my friends across the aisle happy. It already builds half of its EVs without nickel and cobalt.

Part of the poor economic outlook is the sheer engineering and technical challenge of this, as well, operating in a harsh environment, machinery that has to survive crushing pressures three to four miles below the surface, freezing temperatures, enduring extreme salinity and corrosion, and somehow you got to repair all of that machinery without easy access to infrastructure.

Trials to date have been riddled with failure. No one has demonstrated that deep-sea mining can work at scale or even turn a profit.

Making matters worse, deep-sea mining is not an alternative to land-based mining, as its supporters claim. There is no reason to think any country would scale back land mining, even if seabed mining were to defy gravity and become reality. The minerals from deep-sea mining are likely to be significantly more expensive than those from terrestrial mining so we could end up doubling down on environmental harm, getting all the land-based mining and wrecking the ocean. That is not progress. It is subsidized plunder.

Fortunately, the global community, including banks, insurers, and businesses, are not buying it. Two dozen countries have already called for a moratorium, including countries where mining exploration has been tried. The Global Tuna Alliance and other seafood industry groups have called for a halt to deep-sea mining because of the risk that it poses to disrupting feeding, breeding, and migration patterns for tuna. Indigenous leaders across the

Pacific have also raised powerful objections. Their spiritual, cultural, and economic connection to the ocean is deep and enduring, and mining threatens to sever that connection forever.

Instead of pursuing this reckless fantasy, we should be scaling up on solutions we know are effective: battery innovation, recycling infrastructure, product redesign, building a true circular economy that keeps materials in use and ecosystems intact. We have Federal laws, the Inflation Reduction Act, and the IIJA, that have started us in that direction. Let's work together down that path, instead of chasing the folly of deep-sea mining.

Thank you, Mr. Chairman, I yield back.

Dr. GOSAR. I thank the gentleman from California. We will allow the Chairman of the Full Committee to speak when he comes in, but now we are going to introduce our witnesses.

Mr. Gerard Barron, CEO and Chairman of The Metals Company and The Metals Company USA, Raleigh, North Carolina; Mr. Oliver Gunasekara, did I say it right, Gunasekara?, CEO and Co-Founder, Impossible Metals, San Jose, California; Mr. Duncan Currie, Legal Advisor, Deep Sea Conservation Coalition, Christchurch, New Zealand; and Mr. Thomas Peacock, Professor of Mechanical Engineering and Director, Environmental Dynamics Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Let me remind the witness that under Committee Rules, you must limit your oral statements to about 5 minutes. You are going to see a little timer in front of you. When it goes green, you get going. When you start to see yellow, start wrapping it up. And when it is red, stop. OK? There are going to be a lot of questions coming your way this day.

I have the pleasure to see your full statement when we are done. So after that, I now recognize Mr. Barron for his first 5 minutes.

STATEMENT OF GERARD BARRON, CEO AND CHAIRMAN, THE METALS COMPANY, RALEIGH, NORTH CAROLINA

Mr. BARRON. Committee Chairman Westerman, Ranking Member Huffman, Subcommittee Chairman Gosar, Ranking Member Dexter, and distinguished members of the Committee, thank you for the opportunity to share my views on the potential of deep-sea mining to American critical mineral production.

And as a veteran of the deep sea minerals industry and the Chairman and CEO of The Metals Company, I can say with certainty that this industry is at an inflection point where America can take the lead. I intend to make this case across three key points.

First, America's mineral dependence is reversible. And from the 1880s to the 1970s, America was a mining and processing powerhouse. And since domestic production sank, leaving America dangerously dependent on adversaries. And we can change this without sacrificing American landscapes or communities.

Four days' sailing from San Diego lies the Clarion-Clipperton Zone, where polymetallic nodules sit 2.5 miles deep on the sea floor. And they are rich in nickel and cobalt and manganese and copper. And these nodules hold more of these four minerals than all known land-based reserves combined. And just 1 billion tons of

the 21 billion tons of nodules in the CCZ could supply over 450 years of the United States manganese needs, 150 years of cobalt needs, and 80 years of nickel needs. Developed over 20 years, a billion tons could create more than 100,000 jobs, generate \$300 billion in GDP, and revitalize shipyards, offshore industries, and manufacturing.

And second, the U.S. pioneered this industry, the technology, and the robust regulations. And over 60 years ago, American consortia successfully developed and tested nodule mining technologies, and they developed U.S. regulations that spanned five administrations. And NOAA led the world in deep-sea mining mineral governance, building a full framework pioneering environmental science through the deep ocean mining environmental study, and delivering a decade of rigorous impact studies and reports to Congress. It set the global standard for responsible seabed development long before international negotiations began. And by 1989, America had a regulatory regime for seabed mining that was environmentally responsible, commercially viable, and consistent with international law.

And the same cannot be said for the efforts at the United Nations, where a 1982 Law of the Sea Treaty's seabed mining provisions were so unworkable that industrialized nations, including the United States, refused to ratify it and still have not.

And after finalizing exploration regulations in 2000, the ISA took 14 years just to begin drafting a mining code, and has missed adoption deadlines in 2020, 2023, and likely again in 2025. This is not incompetence; this is a deliberate strategy by activists, land mining nations, and green coalition governments to stall by any means necessary. Meanwhile, China has become the largest holder of ISA mineral rights, pushing draft regulations that ban U.S.-flagged vessels and ports while favoring state-backed enterprises. And while TMC and western explorers lead offshore technology, China is close behind. And with its dominance in land-based processing, it is clear why deep-sea mining is one of China's core resource strategies.

And third, the real-world data has debunked every major activist claim against deep sea nodule collection. Onshore the benefits are clear: 100 percent of the nodule is used, with near zero solid waste, no toxic tailings, and far lower life cycle impacts than land-based mining. Offshore the facts are just as strong, and I direct the Committee to my written submission for a detailed rebuttal of the common environmental myths used to confuse the public.

And in closing, with seabed minerals America can end critical mineral dependence; reclaim leadership in offshore innovation; inspire generations of American engineers, scientists, and mariners; and create over 100,000 American jobs and generate hundreds of billions in GDP. And as evidenced by President Trump's executive order signed last week, this Administration recognizes the ability for seabed mineral resources to expand American mineral production and ensure the Nation's energy security and industrial competitiveness for generations.

Thank you for your attention and your commitment to securing America's mineral future.

[The prepared statement of Mr. Barron follows:]

PREPARED STATEMENT OF GERARD BARRON, CHAIRMAN & CEO, THE METALS COMPANY

Committee Chairman Westerman, Ranking Member Huffman, Subcommittee Chairman Gosar, Ranking Member Dexter, and distinguished Members of the Committee, thank you for the opportunity to share my views on the potential of deep-sea mining to expand American production. Deep-sea mining in the high seas is an industry that has been sixty years in the making and is now at an inflection point where it can enable America, the original pioneer of this industry, to reclaim its leadership of the industry and transform its dangerous mineral dependence on foreign adversaries into dominance in a matter of years. My views have been shaped by 25 years of experience in deep-sea minerals, with the last 7 years as Chairman & CEO of The Metals Company, a Nasdaq-listed explorer of polymetallic nodules in the East Pacific Ocean off the western seaboard of the United States.

To appreciate the potential of this industry, the maturity of the regulatory regime and the state of knowledge about its risks, we must rise above the noise of campaign slogans that are disconnected from history, disconnected from the reality of terrestrial mines and processing plants and disinterested in the trade-offs involved in the making of the physical world around us. This testimony is structured around five key messages:

1. America's mineral dependence is reversible.
2. America is reclaiming leadership of the industry it pioneered.
3. America's foresight to invest in the national regulatory regime and not surrender decision-making powers to an intergovernmental organization are a competitive advantage.
4. Better resource and better technology produce better metals.
5. Real-world data dispels every catastrophizing claim made by environmental activists.

1. America's mineral dependence is reversible.

U.S. Faces Critical Mineral Crisis as China Dominates Global Supply Chain. China's Halt of Critical Minerals Poses Risk to U.S. Tech and Defense Industries. U.S. Faces Uphill Battle to Secure Critical Minerals Supply Chains Amid Global Tensions.

Against the backdrop of alarming headlines, it may be hard to recall that once upon a time—starting in the 1880s and until 1970—the United States was a mining and processing powerhouse, supplying Europe, Asia and Latin America with many base metals including copper, lead, zinc, aluminum and nickel. The U.S. had a positive trade balance for base metals from 1896 to 1970 (USGS 2016; Northrup 2003).

Since then, domestic production of base metals has declined significantly, leaving the United States with a persistent deficit and dangerous dependence on foreign adversaries. We can change this. Having invested the last 14 years in the exploration and development of deep seabed mineral resources off the western seaboard of the United States, I believe it is possible to make America a mining and processing powerhouse again. It is possible to reverse mineral dependence and even establish dominance in critical minerals like nickel, cobalt and manganese. It is possible to accomplish this without asking people to give up their land, sacrifice their way of life or allow their remaining natural landscapes to be defaced. It is possible without asking anyone in the United States to accept a mine into their backyard or asking people in a developing country on a different continent to do so.

It takes about 4–5 days of sailing from San Diego to reach the vast fields of polymetallic nodules sitting on the abyssal seafloor at over 2.5 miles depths in the area known as the Clarion-Clipperton Zone (CCZ). All four base metals contained in these nodules—nickel, cobalt, copper and manganese—are on the United States critical minerals and materials lists. No comparable terrestrial resource exists and it would take *three* separate mines to produce this combination of base metals on land. The CCZ is estimated to host over 20 billion tonnes of nodules containing more nickel, cobalt and manganese than all terrestrial reserves combined (Morgan 1999, ISA 2010). This resource can offer mineral security for many generations. To give you a sense of scale—at current levels of American consumption—a one-billion-tonne nodule resource contains 450+ years of manganese, 150+ years of cobalt and 80+ years of nickel (USGS 2024).

If a one-billion-tonne resource were developed over 20 years, it could generate an order of magnitude of 100,000+ jobs and \$300+ billion in GDP (TMC 2024). Imagine

revitalized shipyards building and repairing a fleet of U.S. flagged production, survey, supply and transport vessels. Imagine a new generation of American mariners, offshore production engineers and operators as well as deep-sea scientists. Imagine a new era in offshore innovation in survey, monitoring and production technology—even nuclear-powered production vessels. Cast your eyes back to shore and imagine new deep-water terminals and new nodule processing and refining industry producing feedstocks for domestic manufacturing of steel and special alloys, battery precursors and battery cells. No more need for nickel, manganese and cobalt imports. Imagine reversing the trade balance and exporting manganese alloys, steel and battery-powered goods to the rest of the world.

This type of transformation is not unprecedented. At the start of the 20th century, as oil explorers were venturing into the shallow water, few could imagine that one day ~30% of American oil production would come from offshore—yet by 2010 it was a simple fact of life (EIA 2011). I believe 100% of American demand for manganese, nickel and cobalt and some copper could come from offshore. We will not need to wait a century: offshore production could start within two years and ramp up within a decade.

2. America is reclaiming leadership of the industry it pioneered.

The Brits may have discovered polymetallic nodules in the CCZ some 150 years ago, but it was an American geologist, John Mero, who in the 1960s imagined turning vast fields of polymetallic nodules into a new source of base metals for the United States (Mero 1965). It was US-based consortia who successfully tested nodule mining technology in the 1970s (NOAA 1981a). These were the times when the United States could put a man on the moon and build technology to recover polymetallic nodules from the abyss in the middle of the Pacific Ocean.

Alongside pioneers of industry, the National Oceanic and Atmospheric Administration (NOAA) was a pioneer in its own right. Under its Deep Ocean Mining Environmental Studies (DOMES) program running from 1975 to 1981, NOAA completed several environmental research cruises and developed a Programmatic Environmental Impact Statement (PEIS) for the DOMES area that included the CCZ. 25 people across government agencies and universities were listed as preparers of this impressive 300+page volume that was shared widely—with key Senate and House Committees, 40 federal departments and agencies, 10 states, 9 embassies of foreign countries, 57 special interest groups and 359 individuals. The development of this volume was a public affair with 28 public meetings and workshops held over a period of 6 years and involving Federal and State government, academia, environmental and public groups, industry and private individuals (NOAA 1981a).

NOAA also produced a Technical Guidance Document to inform nodule explorers' efforts to collect environmental information for site-specific EISs (NOAA 1981b) and went to develop the total of five such site specific EISs as part of its process to grant exploration licenses (NOAA 1984abcd, 1994). Starting in 1981 and until 1995, NOAA has been regularly reporting on Deep Seabed Mining to Congress, producing the total of 7 reports. In its last report in 1995, NOAA stated that in the 1990s its environmental research efforts had focused on determining the biological effects of the increased sedimentation on the seafloor (i.e., seafloor plumes) that would result from deep seabed mining operations. NOAA's 1975–80 DOMES Project had basically eliminated virtually all other environmental concerns which were raised about deep seabed mining, pending verification during monitoring of further at-sea mining system tests. To address the issue of seafloor plumes, NOAA developed a Benthic Impact Experiment program and, after an initially less successful device, commissioned an American company Sound Ocean Systems Inc (now Okeanus) to build a better machine to simulate benthic disturbance. The machine came to be known as the Disturber 2.0, and as the name suggests was designed to maximize sediment disturbance to study worst case scenarios. It was used not just by NOAA but was borrowed—along with the NOAA team for consistency of use—by several other governments around the world including Japan, India and a group of Eastern European countries to conduct disturbance experiments of their own (NOAA 1995).

The question that loomed large from the beginning of these efforts was who should regulate the exploration and commercial recovery of seabed minerals in international waters.

3. America's foresight to invest in the national regulatory regime and not surrender decision-making powers to an intergovernmental organization are a competitive advantage.

Efforts to regulate the sea go back centuries, with the 17th-century concept of "freedom of the seas" by Hugo Grotius (Grotius 1609) and early 20th-century

attempts by the League of Nations (Hudson 1930). The United Nations turned its focus to regulating seabed minerals in 1967 when the UN General Assembly established the Committee on the Peaceful Uses of the Seabed and the Ocean Floor beyond the Limits of National Jurisdiction (Seabed Committee; UNGA 1967). The committee laid the groundwork for UNCLOS III, which officially started its first session in New York in December 1973. The U.S. was an active participant and leader in those negotiations from the beginning. This process has been going on for so long, most diplomats who worked on this issue back then are long since retired or no longer living.

As U.S.-based consortia successfully completed their mining tests and NOAA made great progress on their environmental impact assessment, the U.S. Congress passed the Deep Seabed Hard Minerals Resources Act in 1980 (DSHMRA). Originally intended as an interim measure in anticipation of the eventual international regime that would be ratified and come into effect with regard to the United States, the Act created a legal framework to enable U.S. citizens to explore and recover seabed minerals in the high seas and authorized NOAA to develop implementing regulations. NOAA delivered implementing regulations for exploration licenses in 1981 (NOAA 1981c) and proceeded to issue four exploration licenses, known as USA-1, USA-2, USA-3 and USA-4. NOAA then invested over six years in the development of implementing regulations for commercial recovery permits, with multiple iterations and several rounds of public hearings and comments. Final regulations came into force in 1989 (NOAA 1989). Under the authority vested with NOAA under DSHMRA, NOAA kept delivering its bi-annual reports to Congress on Deep Seabed Mining until 1995. These U.S. regulatory developments between 1975–1995 spanned five different administrations—three Republican (Ford, Reagan and Bush) and two Democratic (Carter and Clinton). It is worth remembering that the 1970s was the decade of hallmark statutes on environmental protection: the National Environmental Policy Act of 1970, Clean Water Act of 1972, Marine Mammal Protection Act of 1972, Endangered Species Act of 1973 and Magnuson Fishery Conservation and Management Act of 1976 were all explicitly referenced in DSHMRA and implementing regulations. By 1989, America had developed a robust regulatory regime for deep-seabed mining in the high seas that was fully consistent with international law, commercially viable, and environmentally responsible.

The same could not be said about the parallel efforts at the United Nations. The UNCLOS III conference culminated in the adoption of the UNCLOS treaty on April 30, 1982, where Part XI dealing with seabed mining and establishing an intergovernmental regulator the International Seabed Authority (ISA) was so unworkable that several industrialized nations refused to sign or ratify the convention. The United States, under President Reagan, led the opposition including countries like the United Kingdom, Italy and West Germany—objecting to anti-competitive and restrictive provisions including production controls and mandatory transfers of technology. An effort to cajole industrialized nations into ratifying UNCLOS took another 12 years and a new implementing agreement modifying the contents of Part XI of UNCLOS—including changing the structure of the ISA and removing mandatory technology transfers—was agreed in 1994. The Democrat administration at the time was of the view that the 1994 Agreement could potentially meet the objections to the treaty outlined by President Reagan in 1982 and might therefore provide a basis for the United States to join the treaty. Most of those on the other side of the aisle did not have such confidence. Despite President Clinton signing this agreement, U.S. Senate voted against the ratification of UNCLOS and the 1994 agreement due to several concerns that could be generalized to unwillingness to surrender U.S. sovereign power to global bureaucrats. In its 1995 report to Congress, NOAA reported that investment from the U.S.-based consortia had dropped partly because of the regulatory uncertainty posed by the prospect of the U.S. ratification of UNCLOS and the 1994 Implementation Agreement. NOAA also stated that “while the specific concerns among the licensees differ[ed] somewhat, the licensees essentially viewed the new regime as presenting economic and political risks that they do not face under [DSHMRA].”

The ISA started in earnest in 1996 and adopted its exploration regulations for polymetallic nodules in 2000 (ISA 2013). These were largely based on equivalent provisions under DSHMRA and NOAA implementing regulations since, until 1997, the U.S., as a provisional member of the ISA, had a presence and influence on the development of the regulations. ISA did not start working on the exploitation regulations until 2014 when Fiji raised the issue (ISA 2014). Having been an active participant in the ISA proceedings in Kingston, Jamaica since 2009, I can report that the reservations expressed by the Senate and the original American licensees have unfortunately proven to be valid. As a company, we were committed to the grand vision of a regulatory regime that would set a new international benchmark

for regulating seabed activities and protecting the marine environment while making sure that developing nations benefit from the development of seabed minerals. What we learned over the years is that a consensus-driven multi-lateral organization is not a construct that can produce a viable mining code or act as a regulator. If a committee entrusted with the task of designing a horse could at least be expected to produce a camel, an intergovernmental committee can only produce years of workshops, formal meetings, informal meetings and informal informals (sic!) but no final regulations. Despite taking the fully developed NOAA regulations as their starting point, the ISA failed to deliver on its goal to adopt the final mining code in 2020, 2023 and will almost certainly fail again in 2025. Lockheed Martin, a U.S. exploration licensee who hedged their bets by securing the ISA contracts under the UK sponsorship, saw the writing on the wall several years before me when they distributed a memorandum to ISA delegates in Kingston stating that unless real progress was made on the mining code, Lockheed would exit the industry. They were out in March 2023 (Reuters 2023).

It would be easy to jump to the conclusion that the ISA's indefinite drift is a function of incompetence. It is not. Delay, delay, delay is a strategy—a deliberate, self-proclaimed “Fabian military strategy” adopted by the environmental activists who allied themselves with countries that have significant domestic land mining interests and/or the greens in their coalition governments (Vescovo 2022). Their tactics to wear down the industry proponents and scare Member States focused on delivering on the ISA mandate would make the Roman general Quintus Fabius Maximus Verrucosus proud: they include catastrophizing claims, demonizing of key players (including the ISA itself), relentless harrassment of all industry stakeholders and systematic disruption of all industry events (including a “mostly peaceful” and “completely safe” at-sea disruption of an environmental research campaign by Greenpeace). While effective in destroying commercial industry, these tactics are no match for China whose five ISA exploration contracts make it the largest holder of seabed mineral rights and who has been arguing for positions that would eventually make the mining code work for its State-Owned Enterprises—and no private companies. Indeed, the current ISA draft exploitation regulations take us right back to 1982: they reflect an over-bureaucratic, statist, anti-competitive approach to seabed mining; one in which private enterprise is penalized and the exercise of sovereign rights by nation states is subjected to scrutiny by an international body dominated by countries that do not share the values of the United States. Having balked at this approach in 1982, President Reagan would have been even more shocked by the state of affairs in 2025.

The United States have participated in the ISA proceedings as an Observer since the beginning of this would-be-regulator but have not been able to undo draft regulations detrimental to U.S. interests (e.g., draft regulations that prohibit the use of U.S. ports or U.S. flagged vessels which would make transporting CCZ nodules directly to America for processing impossible). There have been four distinct attempts (1994, 2004, 2007, 2012) where UNCLOS ratification was seriously considered by the Senate or its committees but failed to reach a full floor vote. Despite continued advocacy (resolutions in 2018, 2021, 2023), there have been no formal ratification attempts in years. I have come to view this as the competitive advantage of the United States—deep seabed mining is a freedom of the high seas and America already has a robust regulatory regime to regulate U.S. citizens willing to pursue it. America now also has the President willing to put this regime to good use (Trump 2025).

4. Better resource and better technology produce better metals.

Resource, resource, resource—it all starts with the quality of the resource. It is well understood in the mining world, that no amount of operational innovation and excellence can fix your mining project if your starting point is a low-grade resource with toxic levels of deleterious elements. The many advantages of the CCZ polymetallic nodule resource were obvious not only to industry but to NOAA already back in 1981 (NOAA 1981a). The resource is abundant and high-grade—1.4% nickel, 1.1% copper, 0.2% cobalt and 29% manganese—or over 3% in nickel equivalent compared to the average grade of terrestrial nickel deposits that are now trending at half that. CCZ nodules do not contain toxic levels of deleterious elements which makes it possible to turn all of nodule mass into products (TMC 2021).

In its 1981 PEIS for the DOMES area, NOAA compared the environmental impacts of nodule mining to land mining and arrived at the conclusion that “impacts due to land mining would be substantially reduced.” We have come a long way since then, both in offshore mining and onshore processing technology. Robot miners tested in the 1970s sank into the sediment, leaving behind 50–80 cm-deep tracks in the seafloor (Jones 2025). With better buoyancy and precision hydraulic nodule

pickup, our robot miner tested in 2022 only entrains just the top 3 cm of sediment, dramatically reducing the scale of disturbance. In the 1970s, it was difficult to measure exactly how much seafloor mud (“sediment”) was suspended by the robots during mining and sediment that made it to the mining vessel along with nodules, was separated and discharged at the surface. Today, we have several methods to measure how much sediment we disturb; more than 90% of entrained sediment is separated inside our machines and discharged back to the seafloor in a tight footprint due to better discharge head design that maximizes the natural tendency of the plume particles to stick together (“flocculate”) and create a gravity-current that resettles within hours to days. The amount of sediment that is lifted to the surface is limited (<8% of total entrained mass) and it is no longer discharged at the surface but returned at 2,000 meters-depth (“midwater plume”) where any returned sediment does not interact with the food webs of fisheries (TMC 2025).

When it comes to onshore operations, we can now deliver a quiet revolution. Back in 1981, as U.S.-based consortia were in the early stages of developing and testing various nodule processing flowsheets, NOAA contemplated a situation where only three metals would be produced with waste streams containing manganese stockpiled for potential future use. While many mineral processing operations today extract as little as a few kilograms of metal from 1,000 kilograms of ore and spend considerable effort on managing massive waste streams and toxic tailings, we have been able to extract all four metals and productize all of nodule mass, leaving almost no solid waste for us to manage (TMC 2021).

Multiple academic and commercial studies have been published assessing the lifecycle impacts of modern nodule mining, processing and refining operations and comparing them to conventional production routes. NOAA’s conclusion stands—impacts are considerably lower (TMC—lifecycle 2025).

5. Real-world data dispels every catastrophizing claim made by environmental activists.

We know more about the moon than the deep sea. The first written record of this argument goes back to 1954 (Deacon 1954). For over seventy years, it’s been consistently repeated by oceanographers and deep-sea biologists looking for research funding and by environmental activists looking to delay deep seabed mining. There have been 300 offshore research campaigns focused on deep-sea minerals in the high seas, including at least 10 mining tests and 5 benthic impact experiments; almost 150,000 research papers have been published on polymetallic nodules. Yet, according to the anti-deep-sea-mining (anti-DSM) campaign, we still don’t know enough and we are also unlikely to arrive at this sufficient-knowledge-nirvana in the foreseeable future.

As a CEO of a company that over the last 14 years has:

- Invested over \$600M in polymetallic nodule exploration and development;
- Completed 22 successful offshore environmental research campaigns together with 20+ of the world’s leading deep-sea research institutions and contractors;
- Together with our partner Allseas, delivered the first successful pilot of integrated nodule collection technology since the 1970s while closely monitoring its environmental impacts with our research partners;
- Together with our partners in the United States, Canada and Japan, completed bench, pilot and industrial scale processing pilots and smaller scale refining tests;
- Amassed over a petabyte of environmental data (more than all other deep-sea minerals explorers combined and starting to get closer to the likes of the Library of Congress who manages over 20 petabytes of digital data . . .)

As the CEO of that company, I can tell you with some pride and confidence that we know enough to get started. We know enough to understand the environmental risks and how to manage them. We also have enough real-world data to take on every catastrophizing claim made by environmental NGOs against the polymetallic nodule industry in the CCZ. And that is saying something as over the last 5 years, as the anti-DSM campaign ramped up to stop this industry before it begins, we have seen a Cambrian explosion in claims, with pressure groups like Greenpeace deploying considerable creativity to scare policy makers and the public. Picking nodules from the abyssal seafloor has been rumored to:

- Strip-mine the oceans triggering catastrophic biodiversity loss in animals not known to science;
- Turn pristine deep-sea “rainforests” into wasteland that will never recover or will take millions of years to do so;
- Generate clouds of seafloor mud (“seafloor plumes”) that will travel for thousands of kilometers, smothering all filter-feeding animals in their path;

- Generate midwater plumes that will also travel for thousands of kilometers, forcing tuna to have toxic sediment for breakfast and eventually end up as toxic—metal laden tuna meals on your plate;

- Generate noise levels that will destroy marine mammals across the vast expanses of the Pacific Ocean;

- Make climate change worse by disrupting the planet’s largest carbon sink;

- Poison marine life and humans with radioactivity;

- End nodule production of dark oxygen, a newly imagined source of oxygen that may or may not be responsible for the origin of life on Earth and possibly other planets;

- Be the single worst thing to ever happen to our stressed oceans;

- And, to top it off, violate sacred ocean spaces that are central to Pacific Indigenous cosmologies and cultural heritage.

At this point, I think nothing would surprise me. What could however surprise members of the esteemed Committee who may have been exposed to the controversial coverage of deep-sea mining in the media, is what we know with a reasonably high level of confidence because we have decades of research, field tests and validated models to support these statements:

- Scale:** the entire area currently under exploration in the CCZ accounts for 0.3% of the global oceans. There is more area under protection than under exploration. If even half of the exploration area were to be developed over 30 years, the resulting annual footprint would be less than 10,000 square miles. For comparison, trawling is estimated to impact around 2,000,000 square miles every year.

- Environment:** Contrary to the creative illustrations and misleading images of coral reefs often accompanying deep-sea mining articles, the best terrestrial comparison for the abyssal seafloor is not a rainforest but a desert. There are no plants. The living biomass is measured in 10s of grams per square meter, not 15,000–30,000 grams measured in the rainforests. Non-microbial species richness is measured in 1,000s, not millions like in the rainforests.

- Biodiversity loss:** We expect to leave half the nodules unpicked in our areas, leaving plenty of habitat for animals who need nodule surfaces to live. That’s in addition to all the areas that have been set aside for protection.

- Seafloor plume:** Will not travel for 1,000s of kilometers. 95% of disturbed sediment resettles within 1 kilometer of origin within hours to days.

- Midwater plume:** Will also not travel for 1,000s of kilometers. The midwater plume takes the form of a pancake that rapidly dilutes to the range of natural background variation within kilometers horizontally and within 10s–100s of meters vertically. The cut-off selected for mid-water plume modelling is the upper limit of natural range of Total Suspended Solids (TSS) variation of 0.07 mg/l or more than 7,000 times more conservative than the permissible TSS in drinking water as per U.S. guidelines of 500 mg/l. Dissolved metals from the midwater plume dilute to background levels within 1.5 km of discharge. Any bioaccumulation in tuna fisheries is highly unlikely due to discharge at 2,000 m depths where the physical interaction between the plume and the food web of fish stocks is limited. Both tuna’s breakfasts and yours are safe.

- Noise:** The loudest source of noise in our operations is the surface production vessel. Using behavioral thresholds from NOAA, our operations will generate noise that can impact the behavior of marine mammals within a 3.8 km radius from the production vessel. This is typical of drill ships used around the world. We will have observers onboard to spot mammals and halt operations if necessary.

- Climate change:** While the oceans are our planet’s largest carbon sink, most carbon is dissolved in water. Deep-sea sediments in the abyssal plains and rises are so carbon poor that they store less than 0.1% of total oceanic carbon despite covering almost 90% of the seafloor area. With our current technology, we would not be able to make climate change worse even if we tried.

- Recovery:** When a UK-funded research campaign revisited the 1979 mining site of one of the U.S.-based consortia (then OMCO, now Lockheed Martin) 44 years later, they returned with plenty of good news: plumes had “no detectable or slightly positive biological impacts;” full recovery of sediment macrofauna and foraminifera in the tracks and areas covered by plumes; the return of structural complexity to the ecosystem; and megafauna attached to the nodules that were left behind (Jones 2025). When my team revisited our own 2022 mining test site just a year after, we could already measure material recovery. We expect better technology will lead to faster recovery.

- Radioactivity:** Nodules are less radioactive than the granite in the walls of the Capitol building. Basic PPE (Protective Personal Equipment like gloves and masks),

good ventilation of nodule storage spaces and resisting the temptation to swallow a nodule is what it takes to address any health concerns of human workers.

—**Dark oxygen:** Landers that measure oxygen fluxes at the seafloor are finicky devices. The most likely explanation for the errant oxygen measurements that contradict over a decade of consistent measurements of oxygen consumption in CCZ nodule fields is poor protocol in deploying these devices. The paper that posited the controversial hypothesis that CCZ nodules produce “dark oxygen” has so far attracted an unprecedented five rebuttals.

—**Cultural heritage:** We have commissioned cultural heritage specialists to carry out detailed baseline studies of both tangible and intangible cultural heritage (TCH/ICH)—the first ever for a deep-sea minerals project in international waters, consistent with international good practice (such as the International Finance Corporation’s Performance Standards). Some have suggested that our exploration area is part of the sacred deep-sea creation space and should be considered critical cultural heritage. Baseline research, however, did not identify evidence to support this claim. While some perspectives hold that the deep sea as a whole is sacred, we understand this to reflect a broader cosmological worldview rather than a documented instance of traditional use as defined under IFC standards.

I do not want to leave you with the impression that picking up nodules from the abyss in the CCZ is an environmental free lunch. The activity has measurable negative impacts on the receiving environment. But we have gone to great lengths to improve our nodule collection technology and should we be allowed to proceed, plan to monitor the impacts closely and adapt our operations to minimize our impacts further.

* * * * *

In closing, I would like to impress on you that the potential in front of us is not to merely *expand* American mineral production.

—The potential in front of us is to eliminate American dependence on foreign sources of supply for three critical minerals—nickel, cobalt and manganese—and expand domestic production of copper.

—The potential in front of us is to turn the United States into the world’s leading exporter of manganese, be it as alloy or steel or any of the downstream products the world needs and America is willing to manufacture.

—The potential in front of us is to put American regulatory advantage to good use and demonstrate to the world that America still has what it takes to venture into the new frontiers with eyes wide open and putting the lessons learned from regulating extractive industries of the past to good use.

—The potential in front of us is to re-energize American deep-sea scientific community and inspire a new generation of oceanographers and marine biologists to join the offshore environmental exploration, management and monitoring programs.

—The potential in front of us is to reshore the long-lost mineral processing and refining industry and, with the help of American allies like Japan and South Korea, bring back the cleaner, safer and more automated version of that industry and keep using that infrastructure for recycling the same metals for generations to come, eventually ramping down offshore production as we build out our recyclable metal stocks.

—The potential in front of us is to create 100,000+ American jobs and \$300B+ in GDP.

As evidenced by President Trump’s Executive Order *Unleashing America’s Offshore Critical Minerals and Resources* signed on April 24, 2025, this administration recognizes the historic opportunity before us and will not to let this potential go to waste.

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QUESTIONS SUBMITTED FOR THE RECORD BY THE HON. MAXINE DEXTER TO
MR. GERARD BARRON

Mr. Gerard Barron did not submit responses to the Committee by the appropriate deadline for inclusion in the printed record.

Question 1. Will NORI apply to the International Seabed Authority (ISA) for an exploitation plan of work on June 27 as originally stated, or at all?

Question 2. You have described the International Seabed Authority as acting in bad faith, in "indefinite drift", in breach of their obligations under UNCLOS, and said "commercial industry is not welcome at the ISA."¹ Will The Metals Company (TMC), through its subsidiary NORI, continue to hold and as necessary extend exploration contracts with the ISA? Or will NORI cancel its contracts with Nauru and the ISA? If the latter, what are the repercussions for NORI breaking its contracts with Nauru and the ISA?

¹ <https://metals.co/ceo-statement-on-isa-and-usa/>

Question 3. Given the recent peer-reviewed findings that thousands of species new to science depend on nodule ecosystems, how does TMC justify disturbing these habitats irreversibly?

Question 4. Do you accept that the deep seabed is the common heritage of humankind?

Question 5. Do you believe that if the United States unilaterally approves deep-sea mining in the Area, it may lead to an unregulated free-for-all in the deep sea? If not, why not?

Question 6. Is applying through NOAA a backdoor attempt to claim legitimacy in U.S. waters without proper Congressional or international mandate?

Question 7. Does TMC's rush to start deep sea mining commercially undermine the very idea of a fair, precautionary, and science-based process that the international community is trying to build?

Question 8. I want to understand the implications for Nauru of TMC's subsidiary making an application to NOAA. Have NORI or TMC obtained their approval to do so? Will Nauru benefit financially from any prospective mining under approval by NOAA?

Question 9. Can you provide details about the geographical areas and site coordinates that TMC USA has applied for, and clarify whether these are the same contract areas that TMC subsidiaries hold ISA contracts for? Specifically, do these areas overlap or coincide with the NORI D contract area, or the contract area held by TOML?

Question 10. In your written testimony, you assert that seabed mining will "create 100,000+ American jobs and \$300B+ in GDP". Please substantiate this claim with detailed projections.

Question 11. If the technology proposed by Impossible Metals is proven at scale, they argue it will offer a less damaging option to mine the seafloor than TMC's proposed methodology. How would that impact TMC's economic case and social license?

Question 12. DeepGreen, now known as The Metals Company, reportedly met with Chinese companies and has offered to partner with them. Please describe in detail any existing relationships or partnerships The Metals Company has with Chinese companies and the Chinese government.

Question 13. During the hearing, you stated that the impacts on tuna were well studied and not a concern. Can you substantiate this claim with peer reviewed, published, scientific articles that address the migration of tuna due to climate change, the potential uptake of metals-bioavailable or not-by marine life like tuna, and the potential for long-term impacts on various tuna populations due to full scale mining, not just one collector test? If damage to the tuna fishing industry were to occur, will you commit to paying damages for the loss?

Question 14. Allseas is widely known to own the Hidden Gem, the surface vessel, the collectors, and risers for deep sea mining. As Allseas is hosted in Switzerland, and has a substantial presence in the Netherlands, on what basis do you consider that those countries would permit Allseas to carry out the mining activity which would constitute a breach of the United Nations Convention on the Law of the Sea?

Question 15. If you were to receive approval for a permit today, what is your estimate of how long it would be before you would be able to commence exploration activities?

Question 16. You argue that it's in the national security interest of the United States to develop processing capabilities in the United States, which is reflected in President Trump's recent Executive Order.

16a) How many processing plants would need to be built in the United States to process the minerals you expect to be harvested from the seabed?

16b) What is the cost of building one of these processing plants?

16c) Who will fund the processing plants?

16d) What is the timeline for building one of these plants?

16e) According to recent analysis, these processing plants will need special retrofitting to be able to most effectively process minerals from polymetallic nodules. Does the United States have the technical knowledge or workforce to do that?

16f) Where will you sell your nodules/minerals before theoretical U.S. processing plans come online?

Question 17. Please explain why you are seeking subsidies from U.S. taxpayers if your mining ventures are projected to be as inexpensive and profitable as you claim.

Question 18. How can you assure taxpayers that if they subsidize TMC you would not leave them with significant debt, as your former company did in Papua New Guinea? What guarantees would you put in place to ensure that does not happen?

Question 19. Why do you think other countries and contractors would not start mining in the same area as you as soon as the U.S. sets a precedent of unilateral authorization?

Question 20. Do you expect the U.S. government to defend your operations in the high seas against other countries' claims/operations in the same areas?

Question 21. How will you ensure that the minerals and metals coming from your process will not go to Chinese or Chinese-operated or controlled processing plants? How will you differentiate them from those that are processed in China/ by Chinese-controlled or operated processing plants?

Dr. GOSAR. Thank you, Mr. Barron. I now recognize Mr. Gunasekara. Did I say it right?

OK, for your 5 minutes, thank you.

STATEMENT OF OLIVER GUNASEKARA, CEO AND CO-FOUNDER, IMPOSSIBLE METALS, SAN JOSE, CALIFORNIA

Mr. GUNASEKARA. Chairman Gosar, Ranking Member Dexter, Chairman Westerman, Ranking Member Huffman, distinguished members of the Committee, thank you for the opportunity to testify today.

My name is Oliver Gunasekara. I am the CEO and Co-Founder of Impossible Metals. I came to this country 20 years ago as a proud, naturalized citizen, having been inspired by the kind of innovation only possible in America. I am an entrepreneur, and I have founded three American companies. I founded Impossible Metals because I recognized critical minerals have the same strategic importance as coal in the 19th century, oil in the 20th century. It is an essential resource that will determine America's prosperity, security, and leadership for the 21st century.

The demand for critical metals is accelerating. We can meet the shortfall, but only with new minerals because recycling, substitution, or demand reduction failed to meet America's needs. There just is not enough material in circulation for recycling to move the needle in the next 25 years. Substitution comes with compromises such as a reduced driving range. With new mineral sources, the only remaining option would be a diminished economy, families having one less car or turning off the air conditioner.

AI and robotics now enable a low-cost, clean way to collect minerals from the vast untapped resources of the deep sea. Technology can meet the moment for our Nation, enabling the United States to secure resources our global competitors seek to deny us, and to do so more responsibly than most believed were possible even a few years ago.

Impossible Metals is an American company that will responsibly harvest nickel, copper, cobalt, manganese, and rare Earth elements from the deep sea. These minerals are vital for America's defense, infrastructure, and energy industries. Our underwater robots hover to collect the mineral-rich nodules from the sea bed through an AI-driven selective harvesting. We pick up nodules individually, avoiding all visible life, and leaving 60 percent of the nodules untouched to preserve the marine biodiversity.

Today a new land-based mine in the U.S. takes 29 years. Seabed mining is the vital alternative. We can deliver critical minerals at commercial scale in just 3 years, 10x faster, 10x cheaper, 10x lower impact, and without relying on China.

No commercial deep-sea mining has yet occurred. For the last 60 years we have been preparing for this moment. We now have enough data to understand the limited impacts of deep-sea mining. In fact, each project must document any environmental impacts and how they are addressed before commercial deep-sea mining can start.

Deep-sea mining is not just an option. It is the inevitable future of global mineral production. The critical questions we face today are about who will set the standards and how will it be conducted. America must lead to secure the economic and national security interests, ensure environmental stewardship, and protect human rights. We can do so because we are the technology leader, and because we have an enormous reserve of nodules in our own domestic waters.

We have the chance to build a new American industry leveraging American resources. Success would generate 300 billion in domestic economic output over 10 years, and create more than 100,000 jobs. The biggest barrier is legacy regulations. Regulatory uncertainty has inhibited investment and slowed domestic production, but the government can unlock this industry. The Trump administration last week took bold action, and Congress should support and build on that.

First and foremost, we must unlock domestic resources. The Bureau of Ocean Energy Management has authority to offer leases in U.S. waters believed to contain over a billion tons of minerals. Impossible Metals has formally requested that the Bureau initiate this leasing procedure, with a decision expected by late May. Congress should support and streamline this process.

Going further, Congress can accelerate this industry by adding nodules to the defense stockpile, building domestic mineral processing capabilities, accelerating exploration, and funding American innovation. By acting decisively, America can ensure energy abundance and create hundreds of thousands of quality jobs and establish a robust, responsible leadership in critical industry of the future.

Thank you for inviting me, and I look forward to your questions.

[The prepared statement of Mr. Gunasekara follows:]

PREPARED STATEMENT OF OLIVER GUNASEKARA, CEO AND CO-FOUNDER,
IMPOSSIBLE METALS

Hearing of the House Committee on Natural Resources, Oversight and Investigations
Subcommittee — "Exploring the Potential of Deep-Sea Mining to Expand American
Mineral Production" — April 29, 2025

Testimony of Oliver Gunasekara, CEO & Co-Founder, Impossible Metals

Introduction and Summary

My name is Oliver Gunasekara, and I am the CEO and Co-Founder of Impossible Metals. I came to this country 20 years ago and, as a proud naturalized citizen, have been inspired by the kind of innovation only possible in America. Thank you for the opportunity to testify today.

I am a three-time entrepreneur, having founded successful American companies in semiconductors, and now minerals technology. I founded Impossible Metals because I recognized that critical minerals have the same strategic importance as coal in the 19th century and oil in the 20th—essential resources that will determine America's prosperity, security, and leadership for this century.

At the same time, American advances in AI and robotics have reached the point where we can use innovation to solve the traditional problems of mining, creating a new, lower cost, and cleaner way of collecting these minerals from a vast untapped resource — the deep sea. Technology can meet the moment for our nation, enabling the United States to secure resources our global competitors want to deny us, and doing so more responsibly than most believed was possible even a few years ago.

Impossible Metals is a California headquartered, Delaware incorporated company that will responsibly harvest nickel, copper, cobalt, manganese, and rare earth elements from the deep sea.¹ These minerals are vital for America's national defense, infrastructure development, and energy production. Traditional land-based mining methods are often environmentally damaging and linked to human rights abuses, especially when controlled by foreign adversaries like China. Our groundbreaking technology changes this equation by using advanced underwater robotics and AI-driven selective harvesting. Our Autonomous Underwater Vehicles (AUVs) collect mineral-rich polymetallic nodules from the seabed without disruptive cutting, blasting, or tunneling, leaving approximately 60% of nodules untouched to preserve marine biodiversity.

Bringing a new land-based mine online in the U.S. takes 29 years. With supportive regulation, seabed mining could provide minerals to processing facilities at commercial scale within three years — 10x faster, 10x cheaper, and 10x lower impact than the alternatives, without relying on foreign adversaries.

Deep-sea mining is not just an option; it's the inevitable future of global mineral production. The critical questions we face today are about who will set the standards and how it will be conducted. America must lead to secure our economic and national security interests, ensure environmental stewardship, and protect human rights. We can do so because we are the technology leader and because we have a rich reserve of nodules in our domestic waters. We

¹ It remains to be seen whether the rare earths will be economic after processing.

The full document is available for viewing at:

<https://docs.house.gov/meetings/II/II15/20250429/118089/HHRG-119-II15-Wstate-GunasekaraO-20250429.pdf>

QUESTIONS SUBMITTED FOR THE RECORD TO OLIVER GUNASEKARA, CEO,
IMPOSSIBLE METALS

Questions Submitted by Representative Dexter

Question 1. When up to 70% of benthic life is estimated to depend on nodules, how can we be assured there will not be a major loss of biodiversity under Impossible Metals' (IM) proposals?

Answer. Our technology is designed to hover above the seabed, using cutting-edge AI (computer vision) to select nodules that, by location and careful inspection, do not harbor megafauna—exponentially reducing sediment and ecosystem disturbance. This environmentally conscious-by-design approach enables us to leave 30% by mass/60% by volume of the nodules undisturbed. We regard this as an important way to preserve ecosystems, especially compared to existing alternative sources of critical minerals that can result in significant deforestation, ground and drinking water pollution, and other catastrophic environmental effects.

We seek to play by the rules, and existing law requires federal agencies to assess the environmental effects of their proposed actions prior to making decisions. We expect that this will include Environmental Impact Assessments for seabed mining projects, and that these assessments will specifically address biodiversity impacts based on data that is relevant to the specific project site. These assessments must be submitted to the regulator before a lease sale and typically include public comment periods, assuring all interested parties can provide relevant data.

Question 2. Although projected to be smaller than TMC's, the benthic plume produced by IM will still be sufficient to cover deep sea life forms by far more sediment than they are adapted to. The natural sedimentation rate is only of the order of 1–2 mm/thousand years. How will IM ensure the sediment load it creates at commercial scales does not interfere with the viability of benthic organisms and the ecological services they provide?

Answer. The statement “the natural sedimentation rate is only of the order of 1–2 mm/thousand years” is incorrect. This number ignores benthic storms on the seabed floor, which significantly increase the sediment rate.

As Dr. Peacock testified, the sedimentation disturbance of even traditional technologies has been shown to be $\frac{1}{3}$ to $\frac{1}{5}$ of the level hypothesized before actual testing took place. Our modeling shows that our approach will decrease disturbance by an additional order of magnitude, and we will validate this modeling in a deep sea test to demonstrate the lower rate of disturbance. The exploration leasing process will enable further data collection.

It is expected that any lease sale will contain clear, science-based requirements on environmental standards, such as for sediment disturbance. Prospective bidders will document their ability to comply with these standards in advance of a lease sale award, based on data such as the modeling and testing data described above. We also expect monitoring requirements to verify compliance on an ongoing basis.

That said, all forms of mining have impacts on the environment, which is why innovation is critical to reduce these impacts, and why we have designed our systems to be by far the most environmentally sensitive method of securing these critical minerals. Today, 75% of nickel comes from Indonesian rainforests. The rainforest is destroyed to access the nickel laterite ore. We should mine for critical minerals in locations with the least environmental impacts, not the highest, with American environmental and social regulations.

Question 3. Is it correct that for a full-scale deep-sea mining operation you would need around 100 of your mining robots operating at the same time, and if so, what are the implications for animals in the water column of these machines, including from noise and from light?

Answer. Using a fleet of small AUVs rather than a single large collector presents both economic and environmental advantages. It reduces the risk of a single point of failure, increasing overall uptime, and allows a distributed fleet of low-impact AUVs to reduce concentrated impacts in a particular location. Nodules can be left behind in a pattern over the whole large collection area, rather than leaving wide swaths of affected areas alternating with rows of untouched areas.

The Eureka III underwater robots will also significantly reduce noise and light impacts compared to alternatives. The noise profile of the AUV is designed to be low, mainly due to the buoyancy pumps and thrusters. We expect the noise from the Eureka III to be significantly less than other systems, including other vessels and offshore drill ships that operate today. Our Eureka III vehicles only turn on

their lights when they are hovering above the seabed. The lights are off in the water column. Unlike other approaches, Impossible Metals also does not plan to require dynamic positioning of the support vessel, significantly reducing disturbance in the area closest to the surface, where most ocean life lives.

Expected noise and light impacts would be further elaborated in an Environmental Impact Assessment.

Question 4. How much would it cost to build, operationalize, maintain, and monitor that entire fleet?

Answer. Each Eureka III is estimated to cost \$1.8M to build and to have a 25-year life with a regular maintenance program where we spend around \$180K each year on preventive maintenance.

We have published the sixth version of our detailed economic model on our website that outlines the specific costs of building, operationalizing, maintaining, and monitoring the fleet of AUVs over the lifecycle of a representative project. Last updated in March 2025, this includes slides, a webinar, and a detailed spreadsheet.

This model estimates that a deep sea mining project in the Clarion-Clipperton Zone (CCZ) using Impossible Metals' technology at scale would generate \$4 billion in revenue per year and around \$1 billion in profit per year.

Question 5. You claim that your mining will result in minerals that are "10x" cheaper than those that are produced on land. Please explain why that is the case, what you are including in your cost estimates, and how large the error bars are.

Answer. The average all-in sustainable (AISC) cost for a nickel mine in 2024 was \$14,979 per metric ton, including mining and processing costs, according to Woods Mackenzie. Our latest (v6) economic model estimates a cost of \$743 per metric ton of nickel-equivalent metals for a Eureka III system, or approximately 1/20th the cost of the average land-based nickel mine. Due to variation in the price of land nickel mines and alternative potential comparisons, as well as the assumptions involved in any economic model, 10x is a more realistic figure.

Key assumptions include metal pricing, mineral processing costs, royalties, share of nodules left undisturbed, and the cost of alternative sources. More detail is available in the published model and slides. Please see: <https://impossiblemetals.com/blog/introducing-our-latest-concept-economic-model-v6/>.

Question 6. If you were to receive approval for a permit today, what is your estimate of how long it would be before you would be able to commence exploration activities?

Answer. Two to three years.

Question 7. Please explain why you are seeking subsidies from U.S. taxpayers if your mining ventures are projected to be as inexpensive and profitable as you claim.

Answer. Congress has the opportunity to accelerate the development of a new industry that will create jobs and ensure that America leads in this field, and that those jobs are created here. It will also ensure the United States has the critical minerals we need for national security.

Government investments in research and development have historically delivered strong returns to the taxpayer in economic growth and associated tax revenue, innovation, and global leadership, and investments in domestic processing capacity would strengthen America's industrial base and ensure developers do not need to send supplies to foreign countries for processing. This is particularly important for strategic industries like critical minerals.

A RAND Corporation paper from April 2025 said: "Seabed mining presents an opportunity for the United States and its allies to diversify critical mineral supply chains, bolstering critical mineral supply reliability and security. . . . A global seabed mining industry could produce amounts of nickel and cobalt—key elements for lithium-ion batteries—that are equal to the projected United States demand in 2040."

Question 8. You argue that it's in the national security interest of the United States to develop processing capabilities in the United States, which is reflected in President Trump's recent Executive Order.

8a) How many processing plants would need to be built in the United States to process the minerals you expect to be harvested from the seabed?

Answer. Assuming each deep sea mining concession could, at scale, produce 7 million metric tons of dry nodules per year, and 3 concessions are operating concurrently, that would imply 21 million metric tons of nodules per year. Based on CCZ

grades and 80% recovery rates, that would imply the following amount of metal produced per year:

	Metal Volume Produced From 21M tons of nodules	Total US demand in 2023	Total world wide demand in 2023
Nickel	215K metric tons	422K metric tons	3.193M metric tons
Cobalt	32K metric tons	8.3K metric tons	205K metric tons
Copper	181K metric tons	1.8M metric tons	26.55M metric tons

Note, demand for these metals is growing at 7.5% CAGR.

An average processing plant will likely process 2–5 million metric tons annually. So the U.S. would need at least 4 plants to process this amount of nodules and satisfy half of the current United States' demand for nickel, all domestic cobalt demand, and 10% of domestic copper demand.

8b) What is the cost of building one of these processing plants?

8c) Who will fund these processing plants?

8d) What is the timeline for building one of these plants?

Answer. Impossible Metals does not plan to build or own the processing plants; we plan to contract with processing plants to process nodules into pure metals. Therefore, we do not have detailed insight into prospective processing plants' capital costs, financing approaches, and timelines.

8e) According to recent analysis, these processing plants will need special retrofitting to be able to most effectively process minerals from polymetallic nodules. Does the United States have the technical knowledge or workforce to do that?

Answer. We see three phases for nodules processing:

1. Stockpile nodules in United States locations that have good transport logistics, energy for processing, and close proximity to upstream customers.
2. Reuse existing nickel processing plants in friendly nations like Japan, Australia, and Canada. This will require some retrofitting, but will be performed at existing facilities in friendly locations. This has already been demonstrated without refitting at a Japanese facility.
3. Develop new bespoke mineral processing facilities in the U.S. adjacent to the stockpiles.

The United States may lack all the technical knowledge or workforce for domestic mineral processing facilities, but we have a little time to invest and acquire this knowledge and workforce if Congress and the Administration act.

More broadly, if the United States were to lack seabed mining and processing capabilities over the long term, it would be forfeiting access to what is perhaps the world's largest, most accessible, and lowest environmental impact source of these critical minerals—allowing China and other strategic competitors to control this resource and its economic and strategic benefits.

8f) Where will you sell your nodules/minerals before theoretical United States processing plants come online?

Answer. As outlined above, we plan to use friendly nation processing facilities in the interim. Even if the processing happened in friendly nations, the offtake could still be sold to the U.S. industrial base.

Question 9. How will you ensure that the minerals and metals coming from your process will not go to Chinese or Chinese-operated or controlled processing plants? How will you differentiate them from those that are processed in China or by Chinese-controlled or operated processing plants?

Answer. We have no intention to use Chinese or Chinese-operated or controlled processing plants. Existing federal policy reinforces this intention. The Inflation Reduction Act of 2022 has several applicable tax credits and incentives, but only if the minerals do not come from a foreign entity of concern, e.g., China. Chinese export restrictions and intellectual property policies, and economic barriers between the countries, further decrease the desirability of Chinese processing.

Dr. GOSAR. Thank you very much, Mr. Gunasekara.
Now, Mr. Currie, you are recognized for 5 minutes, all the way from New Zealand.

STATEMENT OF DUNCAN CURRIE, LEGAL ADVISOR, DEEP SEA CONSERVATION CENTER, CHRISTCHURCH, NEW ZEALAND

Mr. CURRIE. Thank you, Mr. Chairman, and a privilege to give evidence before this important Committee on this crucial issue of deep-sea mining.

I have practiced international ocean law for over 35 years. I have attended negotiations at the International Seabed Authority since 2012, and I advise the Deep Sea Conservation Coalition in matters of international law. I presented written submissions to this Committee that cover a range of concerns with deep-sea mining. In this oral testimony I will focus on why deep-sea mining is unnecessary, and why pursuing it would bring the U.S. only problems, not solutions.

Firstly, seabed mining is unnecessary. The four metals that can be practically sourced from nodules—copper, cobalt, nickel, and manganese, none of which are rare Earth elements. Because manganese and copper are expensive, nodules are really all about nickel and cobalt. The market for these is volatile, with prices currently relatively low. As we have heard from the members this morning, EV batteries are moving rapidly to lithium iron phosphate technology, which uses no cobalt or nickel.

The OECD tells us that the economic case for deep seabed mining is not evident. Terrestrial mines are more cost effective for these minerals. The technology is tried and tested. Terrestrial deposits will meet foreseeable future demands, especially as technological advancements and battery chemistries continue to move away from critical minerals.

Stockpiling, as was suggested in last week's executive order, will support future demand and makes a great deal of sense, particularly for cobalt and nickel.

The circular economy has an important role to play. Reuse, repurpose, recycle.

There is no commercial deep-sea mining happening anywhere. There are no full-scale mining machines built. The technology required would operate 5,000 meters deep, much deeper than oil and gas installations, in hostile environments. It will be monumentally expensive to build all of the ships, mining equipment, and monitoring systems necessary for this industry.

The junior companies before you today have weak financing and sub-scale, unproven technology that cannot be relied on. The Metals Company grew out of Nautilus Minerals, which failed in Papua New Guinea, ending with a company in liquidation and costing Papua New Guinea over \$100 million.

Next, seabed mining is harmful. In addition to damaging the sea floor and removal of the nodules, the damage from benthic plumes and noise impacts, The Metals Company would discharge a mid-water plume of sediment, metal particles, and dissolved metals into the water column. The Metal Company sometimes likes to confuse the benthic or sea floor plume with the mid-water plume. They are

separate, and it is the mid-water plume that will travel hundreds of kilometers.

Even if Impossible Metals technology does avoid mid-water plume, there is no way to avoid the fundamental removal of nodules which has critical impacts on deep sea ecosystems. The plume would likely impact valuable fisheries and ecosystems crucial to the U.S. and Pacific countries, as well as potential marine genetic resources used for pharmaceuticals.

Next, scientific knowledge is inadequate. Scientific information and understanding about the deep sea is critically lacking. Ninety percent of five thousand species in the Clarion-Clipperton Zone are still undescribed, and we are only now discovering that deep sea oxygen is being produced, possibly by the nodules themselves. This illustrates what we do not know about the deep sea.

Next are international repercussions. The 1982 Convention on the Law of the Sea governs the ocean. It is known as a constitution for the ocean. The deep sea is universally acknowledged to be the common heritage of humankind. The treaty's purview includes maritime boundaries, extended continental shelf claims, and freedom of navigation for vessels. The U.S. can endanger all of those if it issues permits unilaterally. Mr. Barron did not tell you that the U.S. has signed the 1994 implementing agreement, which addressed a lot of the issues that the U.S. had with the early problems with, excuse me, the 1992 convention.

And as we have heard from the members already, insurance companies and financial institutions are turning their backs on deep-sea mining. There is global opposition to deep-sea mining, and this includes the United States and territories across the Pacific. Thirty-two countries support a moratorium or a pause which would put an end to the current discord and chaos, allow the necessary science to be gathered, and for the implications of deep-sea mining to be understood.

The deep sea is a treasure trove of biodiversity and home to untold wonders and possibilities. Destroying these possibilities and going it alone will be disadvantageous to the United States economically, scientifically, and environmentally.

I look forward to your questions. Thank you, Mr. Chairman and members.

[The prepared statement of Mr. Currie follows:]

PREPARED STATEMENT OF DUNCAN CURRIE, LEGAL ADVISOR, DEEP SEA
CONSERVATION COALITION

Testimony of Duncan E. J. Currie
before the United States House of Representatives Committee on Natural Resources,
Subcommittee on Oversight and Investigations
Hearing: “Exploring the Potential of Deep-Sea Mining to Expand American
Mineral Production”
April 29, 2025

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Opening Remarks

Witness Duncan Currie¹ has practiced international oceans law for over 35 years.. He has acted as counsel in several cases involving seabed mining in his home country, New Zealand. He advises the Deep Sea Conservation Coalition in matters of international law, and has attended International Seabed Authority meetings since 2012. A summary of his submission follows.

- **Environmental and scientific concerns:** Science demonstrates that deep-sea mining will cause harmful environmental damage to deep-sea ecosystems, with some impacts likely to be irreversible.² Below, we will discuss concerns related to: midwater and benthic plumes, as well as biodiversity and habitat loss, including the removal of nodules; noise and light pollution; the loss of new knowledge and discoveries such as Dark Oxygen; and the loss of current and future ecosystem services.
- **Threatens U.S. interests under UNCLOS:** The 1982 Convention on the Law of the Sea (UNCLOS) establishes a package of rights and freedoms that States, including the United States enjoy. This has implications for fisheries, the navy, shipping, marine scientific research, marine protection, maritime boundaries, and much else. Stepping outside UNCLOS could be detrimental to U.S. interests as well as those of other countries regarding freedoms of the high seas and including rights to the continental shelves and exclusive economic zones.

¹ The following remarks are only those of the witness and are not the expressed position of any organization.

² Niner, H. et al. (2018). Deep-Sea Mining with No Net Loss of Biodiversity - An Impossible Aim. *Front. Mar. Sci.*, 5. <https://doi.org/10.3389/fmars.2018.00053>.

The full document is available for viewing at:

<https://docs.house.gov/meetings/II/II15/20250429/118089/HHRG-119-II15-Wstate-CurrieD-20250429.pdf>

QUESTIONS SUBMITTED FOR THE RECORD TO DUNCAN CURRIE, LEGAL ADVISOR,
DEEP SEA CONSERVATION COALITION

Questions Submitted by Representative Dexter

Question 1. In your oral testimony, you suggested that unilateral actions to mine the international seabed as envisioned under President Trump's recent Executive Order, "Unleashing America's Offshore Critical Minerals and Resources," will have consequences beyond the deep-sea mining regime of the United Nations Convention on the Law of the Sea. Can you elaborate?

Answer. Unilateral action to mine the deep-seabed beyond national jurisdiction (called the "Area"), as International Seabed Authority Secretary-General Leticia Carvalho said, not only threatens the 1982 United Nations Convention on the Law of the Sea, and decades of successful implementation and international cooperation, but also sets a dangerous precedent that could destabilize the entire system of global ocean governance.

The 1982 Convention not only regulates activities in the Area, such as deep-sea mining, but also is central to the governance of maritime boundaries, the freedom of navigation, exclusive economic zones, the continental shelf, shipping, protection and preservation of the marine environment, and marine scientific research. It is known as the 'constitution of the oceans'. These matters are of great importance to the United States. By acting outside the Convention, the United States would weaken the Convention and may lead to other States likewise acting in contravention of the Convention.

Three legal observers to date have come to similar conclusions that unilateral mining would be unlawful: one as early as 2021, well before the current controversy. Colter Lathrop in a blog observes that while the United States did not sign UNCLOS, it did sign the 1994 Part XI Implementing Agreement, because, as the U.S. President said at the time, "the Agreement meets the objections the United States and other industrialized nations previously expressed to Part XI". Lathrop observes that "[t]he object and purpose of the Implementing Agreement was the creation of a common management regime for the Area and its mineral resources. Unilateral U.S. permitting in areas beyond U.S. jurisdiction, as contemplated in the Executive Order, would severely undermine that common management regime and would constitute a violation of U.S. obligations as a signatory to the Implementing Agreement." This is contrary to the Vienna Convention on the Law of Treaties, whereby signatories including the United States are obliged to refrain from acts which would defeat the object and purpose of the 1994 Implementing Agreement.

The author examines recent State practice, and concludes with respect to "the prohibition against unilateral mining activities, "[i]s this prohibition a rule of customary international law? Almost certainly, yes." "There is widespread state practice that subscribes to the common management of the Area and its resources, including the continuous U.S. practice since 1994 ... Any attempt by the United States to characterize itself as a persistent objector to the formation of the customary rules governing the mineral resources of the Area would be made in the teeth of U.S. practice over the last fifty-five years, which is, at best, inconsistent." He concludes that "[t]he solution is not to destabilize the international order of the oceans that the United States has so intentionally and successfully crafted since the closing days of World War II."

An earlier blog from April 2025 by Cavalcanti de Mello Filho came to a similar conclusion: the common heritage of humankind principle has become customary international law, and the argument that the U.S. has been a "persistent objector" to this rule since its formation is flawed, for the U.S. objection has not been "maintained persistently." He goes further and suggests that in any case, the common heritage principle is arguably a peremptory norm of international law: a core principle that admits of no exception, derogation, or objection. In his view, the issuance of mining permits for The Metals Company would be a serious breach of the principle.

Joanna Dingwall's book is particularly interesting because it dates back to 2021. She concluded that "Given that state conduct within the regime has been overwhelmingly consistent, this gives credence to the argument that elements of the UNCLOS deep seabed regime (such as the prohibition on unilateral mining activities) now have customary status. Secondly, the widespread acceptance and recognition of the regime within the broader international community also supports the conclusion that there is a customary prohibition on mining in the Area outside of the regime." (p. 172)

In addition, acting unilaterally is accompanied by myriad legal difficulties. To name a few:

- No State or natural or juridical person shall claim, acquire or exercise rights concerning the minerals recovered from the Area except in accordance with Part XI of UNCLOS. Otherwise, no such claim, acquisition or exercise of such rights shall be recognized. (Article 137(3)). This would raise questions as to the ownership of any metals taken from the deep seabed, and very likely complications along the supply chain, including processing and including the use of the metals in products. Note that article 137 as part of the regime of the common heritage of (hu)mankind is customary international law and thus binding on the United States of America.¹ Therefore, simply stated, the United States does not own the minerals from the Area that it is purporting to licence.

- The general conduct of States in relation to the Area shall be in accordance with the provisions of Part XI, the principles embodied in the UN Charter and other rules of international law in the interests of maintaining peace and security and promoting international co-operation and mutual understanding (Article 138). Other States will need to avoid being party to a breach of the Convention: for instance, Allseas Group, which owns the mining vessel and equipment that The Metals Company intends to use to carry out any mining, is Swiss-based and operates in the Netherlands. Both the Netherlands and Switzerland are parties to the Convention and are prohibited from participating in any unilateral mining (see the answer to question 4).

- Other States may be encouraged by any United States unilateral mining to follow suit. This could lead to further breakdown in the Convention, massive environmental destruction and even conflict.

In terms of national security, concern was expressed as early as 2016 about tensions over UNCLOS, maritime claims and freedom of navigation (Colin, 2016). Any failure to adhere to UNCLOS and consequent weakening of the authority of UNCLOS can have adverse consequences for United States security interests in the ocean from Asia to the Pacific and the Atlantic ocean, including freedom of navigation and claims to extended continental shelves.

The Pacific Region

The proposed mining area in the Clarion-Clipperton Zone is in the north Pacific Ocean. If the U.S. were to take unilateral decisions to mine or even explore for exploitation purposes in the Area, outside of the framework of UNCLOS, it would pose multiple layers of risk to the Pacific region and to the long-standing relationships between the U.S. and Pacific States.

Such actions, contrary to international law, would be in direct conflict with Pacific regional commitments and the foundation upon which regional aspirations are built.

The 'Boe Declaration on Regional Security' adopted by the Pacific Island Forum Leaders at Nauru in 2018 explicitly references the importance to regional security of adherence to international law;

"6. (vi) We reaffirm the importance of the rules-based international order founded on the UN Charter, adherence to relevant international law and resolution of international disputes by peaceful means."

In 2022, the 18 Members of the Pacific Island Forum endorsed the '2050 Strategy for the Blue Pacific Continent.' The articulated Vision places peace and security at the centre of the strategy, "As Pacific Leaders, our vision is for a resilient Pacific Region of peace, harmony, security, social inclusion and prosperity, that ensures all Pacific peoples can lead free, healthy and productive lives."

The peace and stability that exists via the rules-based order under UNCLOS, benefits all States, not just Pacific Island States. Their collective aspirations are built on agreed rules and norms of engagement as set out in international law.

The signalled unilateral action is threatening to take resources that belong to the international community which the United States does not have the jurisdiction to take, and to persist in this effort is likely to receive responses from many States and international organizations in different forms that could be severely detrimental to U.S. trade, international relations, and maritime security. Unilateral deep-sea mining will undermine the United States reputation and position of influence in the Pacific, which could strengthen the influence of other regional powers.

The Pacific Ocean, and the life that exists within it, has sustained Peoples of the Pacific for thousands of years. Vastly diverse Pacific cultures revolve around and are dependent upon a healthy ocean. It is well understood that deep-sea mining would

¹Joanna Dingwall. International Law and Corporate Actors in Deep Seabed Mining. 2021. <https://doi.org/10.1093/oso/9780192898265.001.0001>. Page 162.

negatively impact ocean health, thus potentially threatening the well-being of Pacific communities, their livelihoods and economies.

In terms of national security, concern was expressed as early as 2016 about tensions over UNCLOS, maritime claims and freedom of navigation (Colin, 2016).

Question 2. Can you clarify your concerns about the mid-water plume that would be generated by deep sea mining, especially in response to the evidence presented by Dr. Peacock during the hearing?

Answer. This is an important issue as the United States could be held liable for damage caused to the environment from deep-sea mining, including transboundary harm and impacts on commercial fisheries, all impacts which could result from the mid-water plume.

Dr. Peacock said in his written testimony that in 2022 in the Clarion-Clipperton Zone, his team participated in a test which included discharging sediment, metal fragments and dissolved metals at 1,200 metres depth, creating a midwater sediment plume. However, his further testimony only discussed the ‘benthic’ plume or the plume created by the collector on the seafloor. As I noted in my written testimony, plumes of wastewater, sediment, and residual metals discharged from ships during mining—expected to be discharged into 1,200–2,000 metre depths from most proposed mining methods—could flow hundreds of kilometers horizontally away from the mining sites, as well as potentially spread vertically: a finding from Dr. Peacock’s own laboratory (Muñoz-Royo et al., 2021). This plume would be a long-lasting plume created throughout the duration of mining activities, with plumes from each mining contract area using the technology.

One challenge highlighted in the Muñoz-Royo et al. study is defining the limit of the plume: to what sediment concentration does a plume need to dilute to before it is no longer a plume? The study presents several scenarios whereby the plume length and height are determined based on different dilution factors, and unsurprisingly, the dilution factor (the lowest is still two times the natural background particle concentration) influences the size of the plume. More importantly, none of these sediment concentration levels are linked to biological impacts. That is, whether and to what extent sediment concentrations created across the plume will harm midwater communities.

There is currently limited empirical evidence available for deep-sea animals exposed to suspended sediment concentrations (there are 15 peer-reviewed studies), and all but one study focus entirely on benthic environments. The one peer-reviewed study for the midwater (Stenvers et al., 202) focused on a jellyfish and showed negative acute and energetically costly responses when exposed to sediment concentrations of at least 17 mg/l. This jellyfish was obtained from a Norwegian fjord, which is a naturally more turbid area compared to the deep waters of the Clarion-Clipperton Zone. This is important as organisms’ sensitivity to increased suspended sediment concentrations are affected by the level of naturally occurring sediment concentrations. That is, for example, organisms that occur in naturally turbid areas (e.g., estuaries) are less sensitive to sediments than organisms from naturally clear waters (e.g., lakes), as shown by van der Grient & Drazen (2022). Meaning, it is highly possible that animals from the Clarion-Clipperton Zone are more sensitive than the ones from the Norwegian fjord, and would respond in negative ways at much lower sediment concentrations (only a few mg/l)—and therefore also respond across a larger part of the plume—as modelled by van der Grient & Drazen (2022).

The midwater plume can elicit a range of responses (van der Grient & Drazen 2022); a plume could disrupt feeding, breathing, communication and buoyancy of deep pelagic species. As the deep pelagic and shallow water (epipelagic) food webs are connected via diurnal vertical migration, impacts in the deep can be transferred via prey-predator interactions to shallower-occurring species, including commercially-important species, as well as whales and species currently ranked as endangered (Martin, 2021, Chin and Hari 2020; Thompson et al., 2023; Drazen et al., 2020).

A paper (Dowd, preliminary results presented at a scientific conference) is expected to show that zooplankton could be negatively impacted as they could (i) get confused and ingest sediment particles instead (and starve even feeling full), (ii) reject sediment particles but this comes with an increased energetic cost (iii) have their food source diluted—which is a problem as it is already an oligotrophic region, and food availability can affect the strength of animal responses to suspended sediments, with lower food availability resulting in stronger negative responses (Kang, 2012).

The midwater plume is also expected to contain elevated concentrations of toxic metals, which could be incorporated and bioaccumulate into ocean food webs, with

impacts on the health of marine ecosystems and humans via our seafood supply (Hauton et al., 2017; Drazen et al., 2020). Additionally, independent monitoring of the BGR/GSR trials by the Mining Impact consortium found that dissolved metals were also released from benthic plumes. In presenting this research, it was noted that these generally exhibit a higher toxicity than solid metals (Haeckal et al., 2024). Last, sediments from the Clarion-Clipperton Zone contain persistent organic pollutants (POPs), which accumulate in the food web (Sackett et al., 2024). Discharging such sediments in the midwater could introduce these POPs into the water column and the pelagic food web.

Many commercially important species are highly migratory, such as tuna, and any contamination of fishes through the food chain could percolate through the wider stock distribution. Climate change is driving increasing overlap between eastern Pacific tuna fisheries and deep-sea mining. Climate models suggest that tuna distributions will shift in the coming decades, increasing the potential overlap between fishing and mining activities within and around the CCZ, which could represent substantial economic and health risks for nations fishing in the region (van der Grient & Drazen, 2021; Amon et al., 2023). The full Committee's Ranking Member, Rep. Huffman, and Subcommittee Ranking Member, Rep. Dexter, observed that toxic plumes could travel hundreds, even 100s of miles.

Note that this is estimated from a point—mining operations will move in space, so the spread of plumes will increase because of changes in mining operations as well. How such operations affect spread of plumes have not been modelled for either type of plume, and instead we only have estimates for a plume released from a stationary point.

If discharged too shallow, they could disrupt pelagic food webs, including tuna, whales and other species that support our economy. The Global Tuna Alliance and other seafood industry groups have called for a halt to deep-sea mining because of the risk that such plumes could pose to disrupting feeding, breeding and migration patterns for tuna. The Global Tuna Alliance's 48 industry partners account for 32% of the global tuna trade. The effect on economically valuable tunas will depend on the depth of the discharge plume. This depth is not, for example, currently taken up in the ISA draft regulations on exploitation, and instead will rely on the decisions of a mining contractor. Their choice of discharge depth may depend on financial, technological and logistical constraints, factors which are at this moment unclear in how they may influence a mining operation. Intentions can be clarified by the industry, but given the potential high risk of this factor, an intention or promise may not be sufficient, as market forces could result in the shallowing of a discharge if it is cheaper. It must be properly considered whether this unregulated factor is acceptable in the management of the Blue Economy. In addition, it is important to understand that different depths have different oceanographic dynamics, such as the direction, seasonal positioning and strength of currents and the effect of passing eddies, and these factors can influence the spread of a plume. For example, the seasonal shifts in the North Equatorial Current and North Equatorial Countercurrent and presence of eddies have not been taken up in any of the plume models investigating midwater discharges thus far (Fiedler & Talley 2006; Perelman et al., 2023).

Modeling independent of the DSM industry predicts that it could take only three months for sediment particles discharged in The Metals Company (TMC)'s subsidiary TOML's (Tonga) licence area to reach the waters of Kiribati and Hawaii with unknown consequences (@ 11–13.30 min). As described in the associated technical paper, this prediction is derived from accredited oceanographic models utilising the most rigorous data available as of 2022, and references the 2022 publications from Dr. Peacock's laboratory.

Dr. Peacock also indicated that during prototype trials by GSR that in-situ monitoring of the benthic plume showed that 2–8% of the sediment plume generated was suspended up to around 15 feet above the seabed. The fate of this lighter portion is unknown, however research (Gazis et al., 2025) highlights variability in sediment deposition in the CCZ due to site-specific currents and physical processes. This 2–8% portion of the sediment plume could be significant taking into the potential high sensitivity of deep-sea animals to suspended sediments given the naturally clear waters, and accounting for the cumulative impacts over the multiple 30 year plus licence periods and the employment of multiple commercial-scale machines, which as noted by Dr. Peacock are 3 times larger than tested prototypes.

It is worth repeating that the benthic (seafloor) plume is separate from the midwater (discharge) plume. Impossible Metals' technology proposes not to create a midwater discharge plume, but the benthic plume remains a significant concern. It is also worth noting that Impossible Metals proposes a yet-to-be proven mining method which, in theory, would reduce sediment plumes relative to other proposed

seafloor mining machines. However, the resulting benthic plume as predicted by modeling commissioned by IM (DHI, 2024) could be sufficient to create a coating of the seabed and a cloud of suspended sediment. Even small sediment loads are sufficient to interfere with the function of, reduce viability, and kill deep-sea organisms, including microorganisms (Meyenkamp et al., 2017).

With these potentially significant risks to marine life, as well as substantial knowledge gaps (Amon et al., 2022), there is a critical need for more independent scientific data to inform decision making. This includes data on site-specific oceanographic and sediment studies to understand the sediment dispersion patterns of plumes in the changing oceanographic dynamics present in the Clarion-Clipperton Zone, and the impacts of various elements of the plume (sediment, wastewater, as well as particulate and dissolved metals) on marine animals and how this translates to impacts to biodiversity and the wide-ranging food-web effects including for commercially important species.

This will require site-specific *in situ* testing with the technology to be used in commercial mining, as well as laboratory experiments and appropriate modelling efforts.

Question 3. Can you please expand on your comments about the role of polymetallic nodules in the deep-sea ecosystem and the consequences of removing them?

Answer. It is important to note that considerable scientific uncertainties exist: we only learned that nodules were radioactive two years ago, and only last year that they may be involved in oxygen production (Sweetman et al., 2024).

Polymetallic nodules form a critical part of the habitat in abyssal ecosystems by providing hard substrate in a soft-sediment environment. This hard substrate provides an anchor, attachment surface or shelter for a multitude of deep-sea animals (Vanreusel et al., 2016; Amon et al., 2016; Simon-Lledó, et al., 2019). In fact, more than 50% of deep-sea megafaunal species, such as corals, anemones, and sponges, in the Clarion-Clipperton Zone depend on nodules as an attachment surface, anchor, or shelter (Vanreusel et al., 2016; Amon et al., 2016; Simon-Lledó, et al., 2019; Uhlenkott et al., 2022). The nodules also harbour diverse microbial communities that are distinct from those on neighbouring sediment and in the surrounding water (Shulse et al., 2017).

Nodules also play a critical role in maintaining deep-sea food-web integrity and their removal, even at the rates proposed by Impossible Metals, will likely result in lower abundance and diversity of seafloor life, which could directly affect ecosystem function and even services (Stratmann et al., 2021). Just a few months ago, the nodules were also found to be creating oxygen in the Clarion-Clipperton Zone (Sweetman et al., 2024). This was the first time oxygen was observed being created in the absence of sunlight, which challenges the previously held scientific consensus that oxygen is produced solely from light through photosynthesis. While the biological relevance has not been confirmed yet, the oxygen that is being produced may contribute to sustenance of life in the deep sea or life on Earth more generally. This recent discovery is an example of how poor our understanding is of the functioning of the CCZ ecosystem, the deep sea generally, and the planet, and is a canary in the coal mine for irreversibly damaging ecosystems, losing these types of mechanisms, before we know about them or understand their significance.

Without the presence of nodules, recolonisation of a significant portion of the inhabiting fauna will not be possible. For example, “Due to the slow growth rates of nodules (ca. 10 mm/My) and overall very low sedimentation rates, short-term recovery is unlikely; the nodules and nodule dependent fauna may take millions of years to recover, and even the partial recovery of the motile sediment-dwelling fauna may take hundreds to thousands of years” (Kaiser et al., 2017). As such, there will be severe and likely irreversible effects on seafloor communities from any type of polymetallic-nodule mining (Simon-Lledó et al., 2019).

It should also be noted that Impossible Metals intends to leave 60% of nodules by number and 30% by mass. So the 40% of the nodules taken will comprise 70% of the mass. This could only be achieved by selectively targeting large nodules and leaving small nodules: the relatively low surface area and mass of which will support less life through the provision of anchors, attachment surfaces or shelter. It appears that this proposal is not validated by peer-reviewed science. This proposed mining strategy is unlikely to maintain ecosystem viability and function—a consequence that would only be understood through long-term studies. Impossible Metals also proposes to use AI technology and video imagery to selectively choose nodules with less fauna. This has not yet been proven and further lacks independent scientific verification. It remains to be seen what species and size of species the technology will actually be able to identify, especially in a seascape

where >88% of species have not yet been formally described or have not yet been discovered (Rabone et al., 2023).

Question 4. In your evidence you raised the potential legal problems regarding companies operating on a U.S. license in international waters. Could you elaborate on what the impacts may be, specifically for The Metals Company given their application?

Answer. The Metals Company themselves have said in a filing to the United States Securities and Exchange Commission dated May 12, 2025 that:

“The announcement or implementation of this strategy may cause additional regulatory and political tensions, delay ISA decision-making, or impair our ability to secure or maintain exploration contracts or an exploitation contract under the ISA framework and may result in our need to engage in costly and time-consuming litigation to enforce our rights. In addition, UNCLOS parties and the ISA are under a legal obligation, under UNCLOS, not to recognize any commercial recovery permit issued to us under DSHMRA; many UNCLOS parties and the ISA are likely to regard such a permit as a violation of international law, including UNCLOS, which could affect international perceptions of the project, and could have implications for logistics, processing, and market access in UNCLOS parties for seabed minerals extracted under a U.S. license and for downstream products containing them, or for partnerships involving foreign entities, and could also result in actions, pursuant to UNCLOS, against TMC under the national laws of UNCLOS parties, any or all of which could have a material adverse affect on our business, financial condition, liquidity, results of operations and prospects”. (emphasis added)

Note that 169 countries, including the top U.S. trading partners, are parties to UNCLOS.

Article 137 of the 1982 United Nations Convention on the Law of the Sea (the “Convention” or “UNCLOS”) provides that:

1. No State shall claim or exercise sovereignty or sovereign rights over any part of the Area or its resources, nor shall any State or natural or juridical person appropriate any part thereof. No such claim or exercise of sovereignty or sovereign rights nor such appropriation shall be recognized.

2. All rights in the resources of the Area are vested in mankind as a whole on whose behalf the Authority shall act. These resources are not subject to alienation. The minerals recovered from the Area, however, may only be alienated in accordance with this Part and the rules, regulations and procedures of the Authority.

3. No State or natural or juridical person shall claim, acquire or exercise rights with respect to the minerals recovered from the Area except in accordance with this Part. Otherwise, no such claim, acquisition or exercise of such rights shall be recognized.

Joanna Dingwall examined article 137 obligations and concluded that, as a matter of treaty law (i.e. for parties to UNCLOS), “there are sufficient grounds to argue that Article 137 binds corporate actors, including nationals of NSPs [non-State Parties, such as the United States], directly, as a matter of treaty law.” (page 189) And as regards non-Parties, “the customary prohibition on unilateral deep seabed mining activities constitutes an international law rule which is directly binding upon corporate actors . . . if corporate actor began mining the deep seabed unilaterally, that actor would violate the customary norm prohibiting this activity and, consequently, would be responsible, as a matter of international law, for this violation.” (page 194)

Paragraph 3 of article 137 is in my view particularly problematic for The Metals Company. No party to the Convention may recognize any claim with respect to minerals recovered from the Area otherwise in accordance with Part XI (refer The Metals Company in the extract above). In sum, no rights shall be acquired or exercised with respect to the minerals. This provision could make it very problematic to process the nodules, and even to sell any metal such as nickel, cobalt, copper or manganese recovered from the metals to any party to UNCLOS. At this stage it cannot be said how far down the supply chain this would apply. Would products including such metals also be unable to be bought by any party to UNCLOS or their nationals?

In addition, to the downstream supply chain difficulties, suppliers will also be constrained. Firstly, UNCLOS Parties are obliged to both comply with Part XI, which addresses deep-sea mining (Arts. 139, 154, etc) to act in accordance with Part XI (Article 138) and are obliged not to aid or assist another State in the commission

of an internationally wrongful act (Articles on Responsibility of States for Internationally Wrongful Acts adopted by the International Law Commission, Article 16). These, and potentially other measures, could hinder The Metals Company in its reliance on its suppliers of technology and expertise, for instance.

The terms of The Metals Company's subsidiary NORI's contract with the International Seabed Authority and with its sponsoring States Nauru and Tonga Offshore Mining Ltd (TOML), particularly in relation to NORI's obligations with respect to the International Seabed Authority, also need to be raised in this context. The ostensible unlawfulness of any DSHMRA permit exposes the operation to risk of litigation that could be costly to the company, the Government, and the taxpayer.

Question 5. Would deep sea mining eliminate extractive mining on land?

Answer. No. Any deep-sea mining would be in addition to terrestrial mining and mines would not close. There are no academic studies that prove that DSM will reduce terrestrial mining of metals in rainforests. Terrestrial mining would continue even if deep-sea mining increases the impact of mining on the globe.

The World Economic Forum found that DSM "will not necessarily lead to mine closures or to planned new mines being abandoned. Nor would it selectively eliminate land-mining operations with the lowest environmental or social performance since pressure on land-based mines would correlate to their production costs rather than their sustainability attributes." (World Economic Forum (2022)). A study commissioned by the ISA found that DSM will not cause overproduction of minerals globally (Lapteva et al., 2020). Rather, mining both the deep sea and on land could drive down mineral prices, reducing neither's destructive practices and lowering prices (Lapteva et al., 2020). To use nickel as an example, TMC's maximum production rate year, according to its March 2021 forecast, will be 119,000 tons (TMC 2021). World production in 2030 is projected to be 5,090,000 tons (and, thus, in 2031 will be at least that number). Therefore, TMC would produce only 2.34% of world's production in 2031. To use nickel as an example, TMC's maximum production rate year, according to its March 2021 forecast, will be 119,000 tons (TMC 2021). World production in 2030 is projected to be 5,090,000 tons (and, thus, in 2031 will be at least that number). Therefore, TMC would produce only 2.34% of world's production in 2031.

Damage to biodiversity on land cannot be compared to damage to biodiversity from deep-sea mining, which is currently unknown. TMC's own reports² acknowledge that a biodiversity comparison of the impacts on species and biodiversity from deep-sea mining versus terrestrial mining can't be done. A December 2023 report found that "the results of the three current studies comparing the cradle-to-gate (nodule-to-commodity) climate impact of deep sea and terrestrial mining vary hugely, estimating that polymetallic nodules could have a higher or lower climate impact than land ores." (Amadi 2023). The report noted that two of the three studies were funded and supported by DSM companies (Amadi 2023). The European Academies Sciences Advisory Council evaluated claims that DSM is the "lesser of two evils when compared with terrestrial mining" and found those claims misleading: "We discuss the validity of such claims and find them misleading, and note also that deep-sea mining lacks the mitigation and remedial measures available to terrestrial mining." (EASAC 2023).

Deep-sea mining currently lacks the mitigation and remedial measures available to terrestrial mining. In terrestrial mining, a four-tier mitigation hierarchy is used to protect biodiversity: (i) loss avoidance; (ii) minimisation; (iii) remediation; and, as a last resort, biodiversity offsets (Van Dover et al., 2017). When comparing this to

²The Metals Company: Life Cycle Analysis: Where Should Metals for the Green Transition Come From? Comparing Environmental, Social, and Economic Impacts of Supplying Base Metals from Land Ores and Seafloor Polymetallic Nodules. At https://metals.co/wp-content/uploads/2023/03/TMC_NORI-D_LCA_Final_Report_March2023.pdf.

"An effort was made through endpoint analysis to assess the impact on ecosystems and some level of biodiversity analysis. However, this method is still very limited as it does not account for the ocean fauna, neither the type of vegetation and terrestrial land type."

And see Daina Paulikas, Dr. Steven Katona, Erika Ilves, Dr. Greg Stone, Anthony O'Sullivan. Where should metals for the green transition come from? 2020.

<https://www.fullertreacymoney.com/system/data/files/PDFs/2020/May/22nd/LCA-White-Paper-Where-Should-Metals-for-the-Green-Transition-Come-From.pdf>

"Biodiversity is acknowledged in the paper as the most significant impact of nodule collection and is treated qualitatively in the paper. Because biodiversity impacts are treated qualitatively, it is difficult to say with certainty that biodiversity and species impacts from deep-sea nodule collection would be less significant than those observed and measured on land."

TMC's own financial filings repeat this: "it may also not be possible to definitively say whether the impact of nodule collection on global biodiversity will be less significant than those estimated for land-based mining." Annual Report for 2021 Form 10-K, p 41–2.

DSM, avoidance of biodiversity loss is not possible as the habitat will be destroyed and biodiversity may also be lost in the water column and areas affected by sediment plumes. With a lack of physical boundaries in the marine environment, impact minimisation is constrained, in contrast to terrestrial mining, where engineering design can limit impacts to the mining site. Similarly, remediation of deep-sea ecosystems is likely to be ineffective owing to the slowness of deep-sea recolonisation of disturbed habitats, the large areas affected, and the irreversibility of some habitat loss (see results from DSM on the Blake Plateau 50 years on) (Planet Tracker, 2023). Lastly, offsets to compensate for biodiversity loss over hundreds of thousands of kilometres of seabed is next to impossible.

DSM will undermine the shift toward a circular economy (EJF, 2024). Recycling would help to increase resilience and supply chain security, while reducing primary extraction of raw materials and its associated environmental and social impacts. High recovery rates of above 90% are feasible for all four DSM Metals (Dominish et al., 2021).

Recoverable minerals from polymetallic nodules, the source which is the current focus of deep-sea mining, are cobalt, nickel, manganese and copper. The first three are a small proportion of the 50 minerals on the U.S. Critical Minerals List, which does not feature copper (which is available only as an effective by-product in polymetallic nodules. (U.S. Congress, 2025). Note that rare earth elements (RREs) are not being targeted as a saleable product from the nodules.

Nickel

USGS in 2024 estimated global reserves of over 130 million tons (with seabed resources not counted in the figures), with 26 million tonnes being in the friendly jurisdictions of Australia and Canada (USGS, 2025)

An extensive global assessment of nickel mines shows that, given current data, land-based reserves and resources are sufficient to meet demand for over 100 years (at 2018 mining rates) (Mudd, 2022). Diversity of supply is provided by six countries holding 80% of global terrestrial nickel, and recent overproduction has led to a recent drop in historical five year prices (USGS, 2025). Action is needed, including improved management and biodiversity protection, to prevent ecological degradation and habitat loss accelerating (Tunncliffe et al., 2025). In 2022, recycled nickel in all forms accounted for approximately 54% of apparent consumption (USGS, 2025).

Cobalt

USGS estimates there are over 11 million tonnes of cobalt in reserves, and the International Energy Agency (2021) estimated that supply can meet projected demand through 2040 with current reserves and moderate investment (USGS, 2025).

Most cobalt is sourced from the Democratic Republic of Congo (DRC) and is mostly a by-product of copper mining. Social conditions and environmental degradation need to be addressed (Earle, 2022; Tunncliffe et al., 2025) but recycling could cut primary demand for cobalt by 35% by 2040 (Dominish et al., 2021). While other terrestrial sources expand, cobalt supply will remain tied to copper and nickel mining from which most cobalt is produced as a by-product. Solutions to address cobalt supply include increased efficiency and sustainability in metal extraction from mines, re-mining of tailings, new technologies in battery chemistry, and recycling and urban mining (Tunncliffe et al., 2025).

Manganese

Manganese reserve estimates are 1.7 million tonnes, with significant reserves in friendly jurisdictions, including 500,000 tonnes in Australia (USGS, 2025). There are significant reserves in non-Russian occupied Ukraine, alongside two shuttered mines which as part of any U.S.-Ukraine deal would significantly add to global and U.S. production. (USGS, 2021). TMC themselves have noted “We will be producing a novel manganese silicate product which does not yet have recognition in the marketplace with customers ... manganese silicate is not a conventional mineral product and may require additional approvals for export and import from our processing facilities to our future customers.” (The Metals Company, 2025).

Copper

Global copper reserves in 2024 were estimated to be 980 million tons of copper—over 3.5 times those in 1970, despite the depletion by mining since then (USGC, 2025).

In conclusion:

- Terrestrial reserves of the metals and minerals that are currently targeted for seabed mining—notably cobalt, copper, nickel and manganese—are already extensive.

- There is no evidence to suggest that deep-sea mining will be cost-competitive with terrestrial mining given such deep-water environments.
- Deep-sea mining will add a new, environmentally destructive, mining industry where there is no evidence it can be managed sustainably, particularly given current lack of knowledge, and copious evidence of the damage that we know it will cause.
- Better governance of terrestrial mining, a circular economy, including more reuse, recycling and repurposing, and technological advances are all well-known routes to meet the needs of the foreseeable future.
- Deep-sea mining is not a substitute for terrestrial mining; it will simply add to the biodiversity loss and challenges faced by the globe.
- For the most part, the large terrestrial mining industry is not involved in deep-sea mining. Instead, the industry is led by untested start-up companies, and has faced considerable economic challenges. Nautilus entered into liquidation in 2019 and Lockheed Martin sold its interests in nodules 2023 to Loke Minerals, which entered into bankruptcy this year.

Question 6. Would mining minerals from the seafloor provide critical minerals supply chain security to the United States?

Answer. No. Deep-sea mining is too speculative and unproven, too slow and too expensive, to alter mineral supply chain economics. Instead of a new, speculative and damaging industry, stockpiling metals from existing sources would provide some security of supply, as is recognized in the Strategic and Critical Minerals Stock Piling Act of 1939.

A recent article published in Nature (Alger et al., 2025) shows that:

1. We already have sufficient terrestrial deposits of the metals and mineral required for energy transitions and we do not to augment supplies through deep-sea mining.
2. The argument that deep-sea mining will avoid negative social effects of terrestrial mining is false because deep-sea mining will not replace terrestrial mining, and
3. Deep-sea mining is a risky and unprofitable investment.

Going further, the European Academies Science Advisory Council concluded in 2023 that “The argument that deep-sea mining is essential to meet the demands for critical materials is thus contested and does not support the urgency with which exploitation of deep-sea minerals is being pursued. There remains much potential for policy to prioritise a circular economy, support innovation, and minimise continued dependence on the linear economy’s focus on extracting virgin materials from nature.”

Note that current deep-sea mining will not provide rare earth metals, which is the key critical mineral resource most frequently cited. (IEA, 2022)

The main battleground in the global competition for critical minerals is not so much raw materials as midstream processing, an area where China dominates. (Zhou & Manberger, 2024). If security of supply is the key concern then the focus should be on ensuring the on-shoring or friend-shoring of processing capabilities.

The Metals Company has claimed that NORI-D has a measured resource of 4 Mt of 1.4% nickel and 0.13% cobalt. If that translates to 56,000 tonnes of nickel and 5,200 tonnes of cobalt, that pales into the comparison of 8 million tonnes of cobalt and 100 million tonnes of nickel in terrestrial sources. Deep-seabed mining at full scale is an untested technology. Deep sea explorer and entrepreneur Victor Vescovo has expressed skepticism about the prospects of deep-sea mining from a practical perspective: “It is an act of God to do anything at 4,000 meters. Everything breaks. Everything is difficult . . . You’re talking about sustained heavy mining operations in depths that exceed the depth of the Titanic.” He has observed that “There are major technical risks mining 5,000 meters down with massive, rotating machinery under 5,000 psi in freezing cold, corrosive saltwater. The technical difficulties of 24/7 commercial mining of the seafloor are massively underestimated. Deep-sea mining is also based on wildly over-optimistic financial assumptions made five years ago which no longer reflect current cost levels, interest rates, or likely . . . Even at full production rates, The Metals Company, for example, will only produce less than three percent of worldwide nickel production. Deep-sea mining will not materially affect terrestrial mining at all, as they would have their backers believe.”

Question 7. Would mining minerals from the seafloor provide us with the minerals we need for national security?

Answer. No: please see the response to question 6. The United States Executive Order of July 2025³ defined critical minerals to mean minerals included in the “Critical Minerals List” published by the United States Geological Survey (USGS) pursuant to section 7002(c) of the Energy Act of 2020 (30 U.S.C. 1606) at 87 FR 10381, or any subsequent such list. Of the 2022 list of 50 minerals,⁴ only cobalt, nickel and manganese will be obtained from polymetallic nodules. Copper and manganese being relatively low value, deep-sea mining of polymetallic nodules largely is directed at obtaining cobalt and nickel.

Rare earth minerals are not present in significant amounts in polymetallic nodules. For security and defence purposes the minerals in nodules would not be the most critical, where rare earth elements are prioritised, and are far less accessible by recycling (DoD, 2022; Vivoda et al., 2025).

No country or company has successfully conducted large-scale commercial deep-sea mining. While deep-sea mining will have a ‘huge impact’ in the marine environment, technologies like seafloor nodule collectors and riser systems are still experimental and unproven at scale (Zhang et al., 2024).

It is naive to believe that even if successful, The Metals Company and similar companies would only provide minerals mined from the sea floor to the United States. They have already in 2021 announced that they concluded an offtake agreement with Glencore, a multinational commodity trading company headquartered in Switzerland for half of their nickel and copper production.

There is no guarantee that minerals collected will be processed in the United States. For example, regarding minerals collected under DSHMRA, as The Metals Company is proposing, The Metals Company stated on their May 14, 2025 investor call that they will not be processing in the United States, nor do they have a timeline to do so. TMC’s CFO Craig Shesky stated that both TMC and NOAA understand the “reality that processing will occur outside the U.S. for some time.”

The answers above and to Question 6 explain why deep-sea mining is not an economic or reliable source of deep-sea minerals, far less one on which the United States can rely for its national security.

Dr. GOSAR. I thank you, Mr. Currie. Now we recognize Dr. Peacock for his 5 minutes.

STATEMENT OF THOMAS PEACOCK, PROFESSOR OF MECHANICAL ENGINEERING, DIRECTOR, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASSACHUSETTS

Dr. PEACOCK. Chairman Gosar, Ranking Member Dexter, and members of the Subcommittee, thank you for the opportunity to talk today.

I am a professor of mechanical engineering at MIT, where I lead the Environmental Dynamics Lab. For the past decade one of our focuses has been on the environmental impacts of deep-sea nodule mining. We do not take a position on deep-sea mining. Our mission is to perform objective research to inform discussions such as we are having today.

Our research has looked closely at the behavior of sediment plumes, clouds of fine material stirred up from the seabed during mining operations. These plumes are critical to understand because

³The White House. Ensuring National Security and Economic Resilience Through Section 232 Actions on Processed Critical Minerals and Derivative Products July 15, 2025. <https://www.whitehouse.gov/presidential-actions/2025/04/ensuring-national-security-and-economic-resilience-through-section-232-actions-on-processed-critical-minerals-and-derivative-products/>

⁴Includes the following 50 minerals: Aluminum, antimony, arsenic, barite, beryllium, bismuth, cerium, cesium, chromium, cobalt, dysprosium, erbium, europium, fluorspar, gadolinium, gallium, germanium, graphite, hafnium, holmium, indium, iridium, lanthanum, lithium, lutetium, magnesium, manganese, neodymium, nickel, niobium, palladium, platinum, praseodymium, rhodium, rubidium, ruthenium, samarium, scandium, tantalum, tellurium, terbium, thulium, tin, titanium, tungsten, vanadium, ytterbium, yttrium, zinc, and zirconium.

they can create impacts beyond the immediate mining area. My research group at MIT and researchers around the world have made significant advances in understanding the potential impacts of deep-sea nodule mining activities. That research indicates that some of the proposed impacts of nodule mining may not be as severe as speculated. Some key findings are as follows.

Test mining activities suspend roughly the top two inches of seabed sediment, not the 6 to 12 inches some had anticipated. Most of the disturbed material, between 92 and 98 percent, either resettled within roughly 300 feet of the mining tracks or remained suspended close to the seabed, typically within 2 feet.

Only a small fraction of sediment, about 2 to 8 percent, was lofted higher into the water column, reaching up to 15 feet in height, not hundreds of feet. These plumes traveled away in concentrations of a few milligrams per liter, roughly the equivalent of a grain of sand in a fishbowl.

Tracks from experimental mining in the 1970s are still visible today, but there is minimal evidence of the sediment plume to the side of the tracks. While persistent biological effects have been observed, the populations of several organisms, including animals in and on the sediment and ranging from small to large sizes, have begun to reestablish themselves despite the physical changes to the sea floor.

Across the Clarion-Clipperton Zone, recent estimates suggest between 6,000 and 8,000 species inhabit the region, of which fewer than 500 have been formally described.

Broadly speaking, the region has at least two major zones to the east and west, but within the CCZ there is variability that affects the seafloor life. Specific areas would need to be protected, an approach the International Seabed Authority has been developing following the advice of scientific experts.

Short-term pilot-scale trials have advanced our understanding, providing a starting point from which to research and assess the long-term impacts of proposed commercial-scale operations. To proceed responsibly, deep-sea mining would have to advance step by step. This would support reliable predictions of the environmental impacts of commercial-scale deep-sea mining, addressing critical concerns such as biodiversity loss and ecosystem function, and environmental monitoring would inform any necessary decisions to stop or amend operations.

Achieving this will require technical innovation. While current sensors are capable of measuring key environmental parameters, they can be expensive and not yet suited for the large spatial scales and long-time scales involved. This will require two things: affordable sensors and platforms such as autonomous vehicles to deploy them, energy sources and subsea communication technologies to extend their reach.

Even with these advances, monitoring will inevitably be challenged by the vast scales of the ocean. Emerging computational systems, especially those enhanced by GPU-based processing and AI, can dramatically improve our ability to improve our performance simulations, analyze data, and make informed decisions.

The U.S. should play an active role in the development and use of technology, sensors, and computational systems to inform deep-

sea mining, but currently it is not. During the 1970s and early 1980s, the U.S. was a global leader in deep-sea mining research and activities, exemplified by the NOAA Deep Ocean Mining Environmental Study, or DOMES Project. Over the past 30 years, U.S. Government funding for deep-sea mining research has been absent.

Meanwhile, China is surpassing the efforts of every other Nation in conducting technology trials, the European Union has invested over \$50 million in three deep-sea mining research programs, Japan has launched a \$100 million initiative focused on nodule mining within its Exclusive Economic Zone, and the full extent of investment by countries like China and India is not publicly known but likely exceeds these figures many times over. Without strategic investment, the U.S. risks falling behind.

Fortunately, the U.S. retains tremendous strength in deep ocean science and engineering. NOAA, with its experience and capabilities, is well positioned to lead U.S.-based efforts. But the U.S. will need to invest significantly and soon, or we will be left to rely on the learnings and technological advancements made by other countries. That will make it harder for the U.S. to engage in this nascent arena, and to ensure that any future deep-sea mining activities are informed by the best science, the best monitoring capabilities, and the strongest protections.

Thank you for your time, and I look forward to your questions.

[The prepared statement of Dr. Peacock follows:]

PREPARED STATEMENT OF PROFESSOR THOMAS PEACOCK PROFESSOR OF MECHANICAL ENGINEERING FELLOW OF THE AMERICAN PHYSICAL SOCIETY MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Good morning, Chairman Gosar, Ranking Member Dexter, and Members of the Subcommittee. Thank you for the opportunity to speak to you today.

I am a Professor of Mechanical Engineering at MIT. Ten years ago, I directed my research group's activities to study human activities in the ocean, with one focus being deep sea mining and its potential impacts. We do not take a position on deep-sea mining; our mission is to perform objective research to inform discussions such as we are having today.

My group, the Environmental Dynamics Lab, or ENDLab, has been the only U.S.-based team working on sediment plume disturbances created by deep-sea mining. A sediment plume is like the dust cloud that is stirred up behind a vehicle driving down a dusty road. Deep sea mining activities similarly stir up sediment from the ocean floor, and that sediment can be carried away from the mining area by ocean currents. This is important because of a sediment plume's potential to create impacts away from, and on a larger scale than, the direct mining site.

We are the only team to have participated in both of the deep-sea nodule mining trials in 2021 and 2022 in the Clarion-Clipperton Zone of the Pacific Ocean. We have published 11 papers in peer-reviewed journals on the topic. I am a member of the International Seabed Authority (ISA) Expert Working Group on Thresholds, and an advisory board member for the EU's TRIDENT project to research monitoring and modeling systems for deep-sea mining.

In recent years, my research group at MIT and researchers around the world have made significant advances in understanding the potential impacts of nodule mining activities. The key findings indicate that some of the impacts of nodule mining may not be as speculated. Some key findings are as follows:

- For the technologies tested in 2021 and 2022, roughly the first 2 inches of ocean floor sediment was suspended into the water column, which is less than the 6-to-12 inches that has been hypothesized.
- Rather than all the suspended sediment forming a plume, 92–98% of the sediment was either deposited on the seabed within around 300 feet of the

mining tracks or remained suspended in the water column less than 2 feet above the seabed.

- The remaining 2–8% of sediment was suspended up to around 15 feet above the seabed, which is less than the hundreds of feet above the seabed that had been conjectured. It is carried away from the mining site by ocean currents in concentrations of a few milligrams per liter, which is roughly equivalent to a grain of sand in a fishbowl.
- Tracks in the seabed from mining trials in the 1970's are still evident today, but there is minimal evidence of the sediment plume to the side of the tracks. While persistent biological effects have been observed, the populations of several organisms, including animals in and on the sediment, and ranging from small to large sizes, have begun to re-establish themselves despite the physical changes to the seafloor.
- Across the Clarion-Clipperton Zone, recent estimates put the total number of biological species between 6,000 and 8,000, only 438 of which have scientific names. Broadly speaking the region has at least two major zones to the east and west, but there is finer scale variability that affects the seafloor life. Therefore, a patchwork of protected areas is needed for effective environmental management. This will entail both putting some large areas off-limits to mining, and protecting some smaller sections within areas that are otherwise open to mining. Such a multiscale approach has been developed by leading scientists for the ISA.

Recent field trials conducted by contractors in 2021 and 2022, which were short-term and pilot-scale, rank among the largest deep-sea monitoring efforts to date, providing a foundation for assessing the long-term impacts of commercial-scale operations. These efforts aim to reduce uncertainty and support informed regulatory decision-making for proposed deep-sea mining operations. While research to date has been valuable and resolved misconceptions, as I described previously, much still remains to be learned about the consequences of scaling up to commercial operations.

Deep-sea mining should only be permitted to move ahead to commercial scales in a step-by-step fashion as the tools and methods required to assess its impacts are further developed and deployed, and learnings obtained. This would allow for essential studies related to biodiversity loss and ecosystem function, to understand at what scale mining in particular areas could be ecologically viable. Furthermore, this would support reliable predictions of the impacts of commercial scale deep-sea mining; guide the creation and enforcement of a strong, effective regulatory framework; and inform any necessary adjustments or critical decisions.

To accomplish this, further advances in sensor technologies and computational modeling are needed. Existing sensors are generally capable, but can also be expensive. Dedicated programs are needed to develop the next generation of cost-effective sensors, platforms such as autonomous vehicles that can host the sensors, energy sources to power the sensors and platforms, and subsea communication tools. This will make monitoring more capable of operating at the scales required, across hundreds of miles and over multiple years.

Even with these advances, monitoring will inevitably be challenged by the vast scales and extreme depths of the ocean. Advanced modeling systems will be needed to analyze the data and to enable prediction, situational awareness, adaptive management, and effective permitting and governance. Emerging computational models, based around GPU processors and enhanced by AI-assisted algorithms, can outperform legacy systems and help derive learnings from sensor data, producing significant gains in insight, confidence, transparency, and trust.

The U.S. should play an active role in the development and operation of technologies, sensors and computational systems for deep-sea mining, but currently it is not. In the 1970's through the mid 1980's, the U.S. was the global leader—a pioneering example being the NOAA Deep Ocean Mining Environmental Study (DOMES) project. Over the past 30 years, however, research funding from the U.S. government has been absent. Meanwhile, China is conducting technology trials at a rate matching every other nation combined. The European Union has funded three projects to the tune of \$50 million to develop resource assessment and monitoring technologies. And in Japan, a \$100-million initiative is taking place to test nodule technology in its Exclusive Economic Zone. Data is not readily available on funding for programs in countries such as China and India, but over recent years the amounts invested are likely much greater than what is being spent by Europe and Japan.

Without strategic investment, the U.S. risks falling behind. With its immense talent pool in deep ocean operations, however, the U.S. could play a leading role in advancing this critical work.

NOAA, with its experience and capabilities, as well as its access to Federally Funded Research and Development Centers across federal agencies, is well positioned to lead U.S.-based efforts. But the U.S. will need to invest significantly and soon, or rely on the learnings and technological advancements made by other countries. That will make it harder for the U.S. to engage in the nascent arena of deep-sea mining, and more challenging to ensure that any future deep-sea mining activities are informed by the best science, the best monitoring capabilities, and the strongest protections.

Thank you again for the opportunity to provide the Committee with information on this topic. I am happy to answer any questions.

QUESTIONS SUBMITTED FOR THE RECORD TO PROF. THOMAS PEACOCK, PROFESSOR OF MECHANICAL ENGINEERING AND DIRECTOR, ENVIRONMENTAL DYNAMICS LABORATORY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Questions Submitted by Representative Dexter

Question 1. In your testimony, you mentioned there are only 6,000–8,000 species in the Clarion-Clipperton Zone. Other studies specify that this figure is specific to the benthic metazoan species, not the entirety of species in the CCZ. What do you believe to be the full measure of biodiversity in the CCZ?

Answer. The estimates cited in my testimony for benthic metazoan species, which make up the bulk of the biomass found in the CCZ, come from the following publication [1]. For additional questions about biodiversity, I recommend reaching out to experts such as Prof. Daniel Jones (National Oceanography Center, UK; dj1@noc.ac.uk), Dr. Adrian Glover (Natural History Museum, UK; a.glover@nhm.ac.uk), and Dr. Bryan O'Malley (USA; bjomalle@eckerd.edu).

Question 2. TMC maintains that the Digital Twin will be a core component of the company's Adaptive Management System which will aim "to ensure operations remain within environmental impact thresholds." Given the dearth of data on deep-sea organisms and processes, as well as data on plumes and their impacts, how can the Digital Twin reliably protect deep sea organisms and ocean ecological functions?

Answer. The role of a digital twin is not to identify what the thresholds should be, but to produce the information needed to evaluate whether a threshold would be crossed under certain mining conditions.

An example of a digital twin capability is to perform physical modeling of the sediment plumes—a topic for which there have been significant advances in understanding over the past 5 years—and identify when and where mining activity would exceed environmental impact thresholds, of which no agreed standard currently exists.

An effective digital twin should integrate the latest developments in modeling and thresholds in order to capture the extent of impact of a mining operation. It is recommended that any digital twins used for monitoring deep sea mining impacts utilize modern computing approaches such as graphical processing units (GPUs) and artificial intelligence (AI), as these will outperform legacy modeling systems. Ultimately, a digital twin should have the capability to be queried and answer whatever environmental impact question is posed to it.

Without environmental impact thresholds, the starting point for a digital twin is to identify where environmental metrics (e.g., suspended sediment concentration) approach natural levels. This furthermore requires parcels of the sea floor to be set aside and undisturbed in order to protect deep sea organisms and ocean ecological functions.

A number of new scientific studies of the technology trials carried out in the CCZ by Global Sea Mineral Resources (GSR) in 2021 and The Metals Company (TMC) in 2022 are increasing our knowledge, particularly of the impacts in regions directly mined and those impacted by sediment plumes. Results from these studies have been presented in public scientific conferences but many of the papers are not yet published.

Overall, a precautionary approach to adaptive management is recommended.

Question 3. Is it accurate to say that little is known about the fate of the fine particle or dissolved components of the benthic sediment plume that could rise some distance in the water column in a DSM scenario? What do we know about how far these components will travel and the ecotoxicology associated with it?

Answer. A great deal has been learned from the two recent mining trials in the CCZ. In our peer reviewed publications, we provide estimates for horizontal and vertical extents of sediment plumes based on operational parameters and background conditions. We also provide estimates of how far these sediment plumes travel at specific impact thresholds. Some insight into the fate of dissolved components can be gleaned from the results for very fine particles. Three of our relevant publications are [2, 3, 4].

My research group does not study the ecotoxicology of sediment plumes, but relevant researchers who have either led or been involved in recent expeditions include Prof. Daniel Jones (National Oceanography Center, UK; dj1@noc.ac.uk) and Dr. Katja Schmidt (BGR, katja.schmidt@bgr.de). The CCZ is already among the most well-studied areas of the deep seabed, but increased U.S. investment in research to characterize sediment plumes and their impacts would further improve our understanding.

Question 4. Independent oceanographic modelling predicts the mid water discharge plume may travel from the TMC Tonga license to the waters of Kiribati and Hawaii over a 3-month period. This prediction is based on accredited oceanographic models using the best publicly available data. What specific aspects of the modelling as described in the technical notes supporting the Blue Peril visual investigation do you disagree with?

Answer. To properly evaluate any modeling approach and its results, the authors of a scientific study should submit a manuscript to a respected scientific journal to undergo peer-review, as consistent with established scientific practice. To my knowledge, the modeling approach used by the Blue Peril visual investigation has not undergone peer review.

It is widely understood that a slowly settling particle can travel a distance of 1000 km in the ocean; we state this in our 2021 study of midwater plumes [2]: “*Extent of impact of deep-sea nodule mining midwater plumes is influenced by sediment loading, turbulence and thresholds*”. The same paper also makes the point—in the title, abstract and conclusions—that for a plume to cause environmental impact, there has to be a sufficient concentration of sediment; the existence of a single particle somewhere does not constitute a plume. By analogy, when an air freshener is sprayed, someone standing 10 feet away may clearly sense it, but someone standing 100 feet away won’t detect it at all, even though some of the air freshener molecules technically traveled that distance.

The Blue Peril video and accompanying paper, for which the modeling was undertaken by Austides Consulting, state that a given area of the ocean could be expected to be “impacted” by sediment plumes. But neither the Blue Peril video nor the accompanying paper disclose the values of any impact thresholds they use, such as suspended sediment particle concentrations or sediment deposition rates. Without disclosing the impact thresholds that are being used, the Blue Peril simulation does not provide enough information to be useful for evaluating the environmental impact of a sediment plume.

Two of our publications [3,4], both cited by the Blue Peril paper, predict the distances at which different thresholds of sediment plume concentrations can be detected coming from collector plumes on the seabed and from midwater plumes. Our studies assume that the normal, background level of suspended sediment without any kind of disturbance is 10 micrograms (μg) of sediment per liter (L) of water, which is roughly equivalent to a pinch of sand in an Olympic sized swimming pool.

For seabed collector sites, our studies indicate that sediment plumes can be detected in concentrations of 1,000 $\mu\text{g/L}$ (100 times the normal concentration and roughly equivalent to $\frac{1}{4}$ cup of sand in an Olympic swimming pool) at a distance of 1 km from the collector site, 100 $\mu\text{g/L}$ (10 times the normal concentration and roughly equivalent to a teaspoon of sand in an Olympic swimming pool) at a distance of 5 km from the collector site, and the concentration of suspended sediment returns to the background level of 10 $\mu\text{g/L}$ at a distance of 17 km from the collector site.

For midwater plumes, our studies indicate that the sediment plumes can be detected in concentrations of 1,000 $\mu\text{g/L}$ at a distance of 4 km from the plume origination site, 100 $\mu\text{g/L}$ at a distance of 20 km from the plume origination site, and the concentration of suspended sediment returns to the normal, background level of 10 $\mu\text{g/L}$ at a distance of 97 km from the plume origination site. These

midwater plume predictions are consistent with additional simulations conducted using an independent modeling system, as described in [2]. Note that not all deep-sea mining companies are proposing to create a midwater plume.

Our results do not support the claim that a midwater plume or collector plume at the TMC Tonga license site would produce a measurable impact in the waters of Kiribati or Hawaii.

Question 5. The ISA set up an international expert group that has been tasked with providing inputs in three main areas of environmental concern: (a) toxicity, (b) turbidity and settling of resuspended sediments, and (c) underwater noise and light pollution. Your expertise is in sediments, which is one component of the environmental thresholds being set by the ISA. How does your testimony differ from the consensus opinion of the IEG with respect to sediments and why are your predictions better?

Answer. The ISA's Intersessional Expert Group (IEG) and its subgroup on turbidity have yet to release any consensus findings, and thus I have no basis to compare my testimony. The contributions of my research group are part of the evidence base being created by the international scientific community and are being incorporated into the IEG's findings.

Question 6. You are listed as a co-author on a long-term study published in Nature in March of this year. The paper concludes: "our results show that mining impacts in the abyssal ocean will be persistent over at least decadal timeframes and communities will remain altered in directly disturbed areas, despite some recolonisation." How do you reconcile that finding with your testimony that seemed to downplay the impact caused by seabed mining?

Answer. The findings in the study published in Nature in March of this year [5] are consistent with my testimony, in which I stated persistent biological effects have been observed from mining experiments conducted in the 1970s. One goal of my testimony was to enumerate some of the impacts caused by deep seabed mining, specifically to characterize the current state of scientific understanding around sediment plumes and to contrast that with claims made about sediment plumes that are not based on sound scientific evidence. My testimony was reviewed by several lead authors of the Nature paper and was approved by them.

Question 7. Is it possible to remediate environmental damage in the deep sea? If so, what kind of damage and over what time frame? Is there damage that cannot be remediated? Please be specific about damage to species, sediments, water columns, noise, light, carbon cycle, and other ocean processes.

Answer. These are areas of ongoing scientific research. My expertise and ongoing research projects are focused on characterizing sediment plumes. We make our findings available to policymakers for incorporation into the complex decisions surrounding the governance of deep seabed mining.

Other research groups are better positioned to provide authoritative inputs on the other topics in question. For example, there are ongoing studies by the JPI-Oceans Mining Impact 2 project investigating the ecosystem impacts of deploying artificial, inert nodules to recreate the physical conditions that preceded the collection of polymetallic nodules [6]. For further information on this, I recommend reaching out to Dr. Sabine Gollner (NIOZ, sabine.gollner@nioz.nl).

Expert assessment suggests that other forms of mitigation, such as set-aside areas and impact minimization through engineering design, may be more efficient management strategies than remediation [7,8]. In fact, the approach of deliberately setting aside parcels in the CCZ is already the norm. Approximately 2 million sq. km. (about 30% of the area of the CCZ) has already been set aside for protection under the ISA's CCZ Environmental Management Plan as a network of 13 "areas of particular environmental interest" (APEIs). The design and designation of the APEI network started over 20 years ago based on a series of scientific workshops (led initially by U.S. scientists) and has been refined on several occasions. To date, all entities granted exploration contracts by the ISA have followed ISA guidelines on the protection of these regions.

For matters related to carbon sequestration, the following publication provides an assessment of the risks [9], determining them to be 'trivial'. For further details, I recommend reaching out to Prof. Beth Orcutt (Bigelow Laboratory for Ocean Sciences; borcutt@bigelow.org) and Dr. Bryan O'Malley (USA; bjomalle@eckerd.edu).

As I stated in my testimony and my remarks, federally-funded research programs that invest in our understanding of the impacts of deep seabed mining on biodiversity and other ocean processes are important and necessary.

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Dr. GOSAR. I thank you, Dr. Peacock.

The gentleman from Arkansas, the Chairman for the Full Committee, is now recognized for 5 minutes.

STATEMENT OF THE HON. BRUCE WESTERMAN, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ARKANSAS

Mr. WESTERMAN. Thank you, Chairman Gosar, and thank you to the witnesses for being here today.

You know, by now our country's reliance on critical and other hardrock minerals is widely known. These minerals are essential to America's national security, to our economy, to our energy infrastructure, and to many other things. This Committee has repeatedly emphasized the importance of these minerals and of securing American mineral supply chains.

Although the United States is blessed with some of the most abundant mineral deposits, our abilities to discover, extract, and process critical and other hardrock minerals has declined for decades. Not only have we closed refineries and processing facilities, but we have also choked mineral mining operations with red tape. At the same time, we have failed to effectively combat the lawfare waged by radical non-profit groups who are determined to delay and terminate critical and crucial mineral projects within our borders.

Fortunately, we have championed an all-of-the-above approach to mineral exploration and extraction policy. This approach includes streamlining permitting for terrestrial mining projects and encouraging American companies to continue investing in emerging technologies which even includes space mining. And today we are here to better understand the possibilities of how the minerals readily available on the sea floor can be extracted in a manner that is both efficient and environmentally friendly.

In fact, just last week President Trump signed an executive order streamlining the process through which American companies can work to identify and extract minerals like cobalt, copper, manganese, and nickel from both American and international

waters. These seabed minerals are most often found in rocks or polymetallic nodules that line the ocean's floor. These nodules are estimated to exist worldwide in numbers as great as 200 trillion tons, and have the ability to produce the raw materials necessary for batteries, electronics, and steel.

While venturing to the cold, dark depths of the sea floor to collect critical minerals sounds like something from a science fiction movie, the United States has possessed the technology and knowledge necessary for seabed mining since at least the 1970s. Today American companies are leading the charge to not only utilize these capabilities, but also develop new and exciting technologies and methods to harvest polymetallic nodules from the sea floor in a manner that is both more efficient and friendly to the marine environment than was ever imagined.

Frankly, other adversarial nations like China have eyed seabed mining without serious competition from the United States for far too long. We cannot continue to rely on China for the minerals we currently use, and we certainly cannot allow China to capture the market for offshore resources. This path would only continue to impose a never-ending threat of mineral supply chain collapse. Only by unleashing American offshore critical minerals and natural resources can we secure our own critical mineral supply chains. We can revolutionize energy production. We can strengthen our national security, and at the same time we can grow our economy.

I look forward to a robust discussion on how we can ensure efficient development of seabed mineral resources. I appreciate your expertise and for being here today to discuss this important issue.

And I will say there is a lot going on in Congress this week. Hopefully, more members will come in because this is such a critical discussion that we need to have. But I can assure you that people are very busy with other committee markups and hearings taking place, but that doesn't minimize the importance of what we are here to discuss today.

Thank you, Mr. Chairman, I yield back.

Dr. GOSAR. I thank the gentleman. We are now going to move into the questions from the members. I will recognize the members as we go down the road. Now we are going to recognize Mr. Case from Hawaii for his 5 minutes.

Mr. CASE. Thank you very much, Mr. Chair and Ranking Member, and I truly appreciate your courtesy in allowing me to rejoin the Natural Resources Committee for this critical hearing.

And it should come as no surprise that my concern is for our marine environment. I have introduced two pieces of legislation that would affirmatively place a moratorium on any domestic or international deep-sea mining until we know exactly what is going on in our oceans. So no surprises where I am coming from on this.

Mr. Barron, back a couple of years ago, when you were questioned about concerns with environmental impacts of deep-sea mining, you stated in the press that where you wanted to mine is a "marine desert." "If you measure the amount of life there, it is measured in grams per square meter. There are no trees, no plants at all." You also said that your mechanism for deep-sea mining is

blasting a jet of water to the nodule to lift it up. “In this part of the ocean floor there isn’t much to impact to begin with.” Do you stand by those statements?

Mr. BARRON. Thank you for the question. Yes, I do.

Mr. CASE. OK. And what is the basis, the scientific environmental basis for your statements that basically there won’t be any particular impacts from—can you point to a specific study? Like, you held up a bunch of paper there. Is that from the original Act back in 1980, or is that more recent? Or what is the basis for that statement?

Mr. BARRON. Well, I think it begins with the fact that if we think about all of the landscapes on our planet, and if we were to draw a bar chart and on the right hand side you would have an environment that has the most life that could be impacted, that would be called our tropical forests.

Mr. CASE. Yes. What I am asking for is, do you cite a specific scientific study?

Mr. BARRON. Yes.

Mr. CASE. And where is that study for the basis for your statement? That is what I am getting at.

Mr. BARRON. Yes, and I will get to that in a moment.

Mr. CASE. But I have a limited amount of time, so what I am doing is I am asking a very specific question. What is the scientific basis for your statement?

Mr. BARRON. Well, I will draw you to my testimonial, where we cite many of the studies that have been carried out. And in fact, just recently, of course, I heard people refer to the DOMES study that was carried out from the trials that were done in the 1970s.

Mr. CASE. OK.

Mr. BARRON. Our own studies, we revisited the area where we had collected nodules from in 2022. And when we went back a year later, we found that the tracks had recovered 30 percent to pre-disturbance levels, and that is one—

Mr. CASE. OK, so are those your studies, Mr. Barron?

Mr. BARRON. Well, they are studies we fund—

Mr. CASE. Your company’s studies?

Mr. BARRON. They are studies we fund.

Mr. CASE. OK. They are studies you fund. And as far as the underlying environmental impact statement that you referenced, that was back to the 1970s, which was related to the passage of the law in 1980 that we are relying upon today for our environmental protections. Is that correct? Under the executive order.

Mr. BARRON. The trials were done in 1979. And of course, the study that went back last year was a broad range of funders, all independent, who went back on a study that was published only 2 weeks ago, I believe.

Mr. CASE. OK. All right.

So I have read that executive order. And first of all, I see absolutely no reference to environmental protection whatsoever in the President’s executive order. The word “environment” is mentioned once, and it is kind of a throwaway. It is a reference to a 1980 law which we propose to proceed under. Obviously, a lot has changed, I believe, since 1980. So Mr. Currie, let me just focus a

couple of questions on you because, fundamentally, I don't think that we have those studies in hand right now.

First of all, it strikes me that we are only studying one kind of extraction. So, for example, a—plucking a module—a nodule off of the sea floor. The videos I have seen show a big, old clamshell dredge coming down, impacting—going down deeper than two inches, by the way—and sucking up a bunch of the ocean floor. We also have the technique which is fundamentally strip-mining the ocean floor and dragging stuff across it. Is there any limitation on what kind of mining we would be able to do under this executive order that you know of, or are we just focusing our studies only on one particular type of least intrusive impact?

Mr. CURRIE. Yes. I would not call it least intrusive impact. I think what—the kind of damage that you talk about is clear. In my opening remarks I talked about the damage to the nodules. We know the nodules themselves have life on them. We know between 50 and 70 percent of deep-sea life are dependent on the nodules. We know that the deep-sea plume will smother the life that is down there.

And it really is very deeply concerning to hear Mr. Barron make such clearly scientifically incorrect statements, when this is the company that proposes to do the seabed mining in the deep sea 5,000 meters deep, far away from any regulatory authorities, far away from any—

Mr. CASE. OK.

Mr. CURRIE [continuing]. Any controls.

Mr. CASE. I am not going to overstep my welcome in this Committee, and my time is up.

Dr. GOSAR. We will do a second round, if you would like to stay around.

Mr. CASE. Thank you so much, and I would ask for a consent to be able to submit written records—sorry, written questions.

Dr. GOSAR. Without objection.

Mr. CASE. Thank you so much.

Dr. GOSAR. So ordered. I appreciate it.

Mr. CASE. OK.

Dr. GOSAR. The gentlewoman from Oregon is recognized for her 5 minutes.

Dr. DEXTER. Thank you, Mr. Chair.

Mr. Barron, Lockheed Martin, a U.S. company with a market cap of about \$100 billion and extensive experience in material needs for the defense industry, recently quit their investment in seabed mining and sold their seabed resources subsidiary. The shipping giant Maersk also recently dropped its investment in your company, and leading tech and EV companies—there is several of them—have joined calls for a moratorium. What do you know that these major companies didn't about the profitability of this industry or the necessity of extracting critical minerals from the sea floor for civilian and defense enterprises?

Mr. BARRON. Thank you. Well, Lockheed Martin still have exploration licenses under NOAA regulations. They did sell their licenses that they had been granted through the International Seabed Authority because of the uncertainty of that regulator being able to put in place the mining code.

In answer to your question about what do I know that those car companies know: a lot, because my company, The Metals Company, has spent hundreds of millions of dollars funding independent scientific organizations to carry out those environmental studies. And not one single name of those companies that you read out, those car companies, have ever contacted us to ask, "What is your evidence?" They claim to care a lot about the environment, and I am sure if they really did, they would want to hear both sides.

What I can tell you is that the American car industry has not done that virtue signaling by saying, "We will join that moratorium."

Dr. DEXTER. Understood. However, if it was a good investment, they don't need to necessarily know the science. They will know that somebody is showing a profit.

So given that The Metals Company has yet to demonstrate a commercially viable deep-sea mining operation, how can you assure U.S. regulators and taxpayers that sponsoring your permit is not simply subsidizing a high-risk foreign startup with little to no guaranteed return?

Mr. BARRON. America has an urgent need for critical minerals. America has a need to re-industrialize. It needs to secure these metals.

The beauty of these nodules, of course, is that they are much more metal-rich compared to land-based alternatives, and that has a massive impact on the economics. The people that speculate about economic viability tend to be the activists who oppose the industry.

Dr. DEXTER. It is interesting that China has moved away from cobalt, which, obviously, is rich in here, and they have every reason to double down on that with their rich resources that they have available. So I would consider that when we are making those investments.

Mr. Currie, thank you for coming. There is a lot of focus on resource exploration in the development of extraction technology on the sea floor. But recent studies suggest that the infrastructure needed to process polymetallic nodules is still uncertain and untested, and that no companies have developed plans for processing. Is the seabed mining industry prepared to process all the nodules they claim they will bring to the surface?

Mr. CURRIE. That is a very good question, Member, because the crucial issue here is, frankly, processing. China dominates the market with these metals, particularly cobalt and nickel, because they dominate the processing.

Processing is a very labor-intensive activity, very environmentally harmful activity, very difficult to do it. China has been doing it for many decades. And really, that is the answer to your question of, you know, what does the U.S. do about access to minerals. It is not as if China is digging up the minerals from its own land and dominating the market in that way. It is doing it firstly because of the processing, secondly because of the access to minerals it has through contracts and foreign direct investment. And there is no reason to believe it wouldn't do the same thing with deep-sea mining.

And I also note, with respect to your question to Mr. Barron, that Loke Minerals, who did purchase the shares in UK Seabed Resources, has gone bankrupt recently, just to add one more list of companies that have gone bankrupt during the attempts to seabed mine. Thank you.

Dr. DEXTER. Thank you. We are running short on time, but I did want to ask, The Metals Company has initiated a process to acquire licenses and permits to extract minerals from the ocean floor through the United States. These permits, and this is to you, Mr. Currie, these permits, which are supported by a recent executive order made by President Trump, risk violating international agreements governing ocean activities. Based on your experience with permitting at the International Seabed Authority, will major cuts to staff at BOEM and NOAA make it easier or harder for them to issue these permits?

Mr. CURRIE. Issuing these permits will be an extraordinarily difficult issue. We are dealing with an area 5,000 meters deep, in the area beyond national jurisdiction. This is why the International Seabed Authority has had such difficulty in finalizing the regulations. It is a difficult thing to do. There are international legal complexities, there is questions about the actual title to the area that Mr. Barron would want to mine. There is questions about the access title to the minerals because the law of the Sea Convention is very, very clear no one country may expropriate minerals from the deep sea bed.

And so—and there is a host of questions. The mining company that would undertake the physical mining for The Metals Company, Allseas, is a Swiss company. Switzerland is not going to allow their company to breach international law. Nauru must be deeply unhappy with what is happening there. You know, Nauru faces the twin horns of a dilemma. Either get paid nothing for the minerals that are brought up by The Metals Company, or does get paid something and it participates in the breach of international law.

And there also is a question about the Jones Act. There is a host of very, very difficult questions, which, frankly, I don't envy the few remaining staffers at NOAA to have to deal with.

Dr. DEXTER. Thank you.

Thank you, Mr. Chair.

Dr. GOSAR. Well, thank you. You are welcome. The gentleman—the full Committee Chair, Mr. Westerman, is recognized for his 5 minutes.

Mr. WESTERMAN. Thank you, Chairman Gosar.

Mr. Gunasekara, I hope I got that right. Thank you for being here. I am excited to learn more about the work that you and your company are doing.

And you recently submitted a formal request to the Bureau of Ocean Energy Management to begin the process of leasing harvesting rights within the U.S. Exclusive Economic Zone off the coast of American Samoa. Why did you choose to initiate the process with BOEM at this time?

Mr. GUNASEKARA. Well, the U.S. critically needs these metals. I think it is very clear that China controls the vast majority of critical minerals. And yet, in our own Federal waters, we have

huge quantities. And fortunately, Congress passed a law that allows U.S. entities like ourselves to request the starting of this process. So we very much would like the Administration to use the authority that Congress has given it to start the process so that we can actually ultimately get to the point where we can extract these minerals from the deep ocean around the territory of American Samoa.

I want to be clear, though. We want to do this in an environmentally sensitive manner. We don't expect to be able to do it without an environmental impact statement and being very clear what is the impact. But in our view, we critically need an independent source of these minerals. These minerals are in our own waters. We can extract them with much less cost and much less time and much less environmental impact.

Mr. WESTERMAN. Your company focuses only on picking up the nodules. You are not like some of the early technology, where you are picking up a lot of material off of the floor, is that correct?

Mr. GUNASEKARA. Yes, it is a completely new type of collector. So our collector doesn't actually land. We are exclusively focused on the polymetallic nodules, the potato-sized rocks. So like all people going after this resource, there is no cutting or blasting. Literally, these are like golf balls on a driving range that we have to pick up.

And now, our vehicle hovers, it doesn't actually land. And it uses AI with its cameras, to look for life. We know very occasionally, every few hundred nodules there is a deep sea coral or a sponge. We will detect that using the AI on the vehicle, and then we will quarantine that area and fly over the top, leaving it completely undisturbed.

In addition, we will always leave around 60 percent of the nodules left undisturbed. And because the vehicle is hovering, there is minimum sediment impact. We don't have a discharge plume. We minimize noise. We basically took as an input the environmental concerns, and designed a 21st century technology solution to mitigate those concerns.

We are also significantly less expensive. And I do want to be clear, our economic model, version 6, which is on our website, including the spreadsheet, is showing how we are 10 times less expensive than the average nickel mine in 2024, 10x. That is for the mining and the processing. This allows us to avoid Chinese dumping.

The problem with China is that they are very, very good at manipulating the price and driving Western companies out of business. Because our cost base is going to be so low, we are somewhat isolated from that strategy.

Mr. WESTERMAN. It sounds like your technology has moved along at a faster pace than regulatory reforms. I know that, in addition to BOEM, NOAA also plays a role in the process for seabed mining in the U.S., now depending on which area is involved. Can you talk about the weaknesses and strengths of the different agencies involved in the permitting process?

Mr. GUNASEKARA. The good news is that there is legislation. The bad news is that it is quite old, and we feel could be improved.

Specifically in the BOEM case, which is where we are focused, there are four public consultation periods. There is no defined timetable. Again, given the President's determination of an emergency, we would like to see a more dedicated time frame for when this process can start.

I want to be clear. We want environmental review. We want to do an environmental impact. We are very strong in protecting the environment. But we don't want it to take decades. It is too important.

Mr. WESTERMAN. I agree with that, and that applies to many things.

But Mr. Chair, I am going to go ahead and ask this question.

Dr. GOSAR. Go ahead, please.

Mr. WESTERMAN. A concern that I have, and you mentioned it in your testimony, is that the processing of all these critical minerals basically happens in China. You did mention that there are some other countries, I think, Japan and Australia, that have some processing capabilities. But when we look at this issue from a national security standpoint, if we are simply mining the material and shipping it to China, we are not really helping ourselves on the national security. Talk about how much capacity is out there with more friendly countries, and the need to co-develop processing facilities here in the U.S. or in Canada or somewhere close if we are going to be mining this material.

Mr. GUNASEKARA. It is essential that we develop domestic capabilities, and I think the President's previous executive orders talk about that.

But I think in the short term, stockpiling is a great option. It will stimulate the industry. And if we build the stockpiles in strategic locations in the U.S., where there is the infrastructure and the power, it will encourage industry to invest in building those.

In the intermediate, we can do processing in friendly nations. The Metals Company actually has proven that Japan has the capability. They have worked with a partner there, and actually proven that nodules can be processed in an existing nickel refinery. And our belief is that could also be duplicated in Australia and potentially in Canada, as well.

So we see three stages: first stage is stockpile; second stage is reuse friendly nations; third stage is build our own bespoke optimized processing here in the U.S.

Mr. WESTERMAN. I am way out of time, Mr. Chair.

Dr. GOSAR. Oh, I thank the gentleman. We are going to have a second round here.

You know, I am a touchy-feely guy. I actually have a nodule right here from the Mojave Desert. It is filled with rubidium. I know you guys have some. Could you send those around to everybody, please?

I got to tell you, when I went through TSA with that, everybody was talking about that, that nodule right there. So you will see they are very interesting. Did you get a chance to see this?

Mr. BARRON. Mr. Chairman, I am happy to say a nodule just like this one was presented to the President last week, and now sits on the Resolute Desk.

Dr. GOSAR. Well, I guess my point is I found this on a desert, and it is surrounded by sand. So you think there would be some commonalities there, OK?

Dr. PEACOCK, that is why I want to come back to you. It seems like you have been doing the studies that have shown there is really no impact. Can you give us a little bit more background on that?

Dr. PEACOCK. Certainly, yes. So we monitored the collect trials that took place in the Clarion-Clipperton Zone in 2021. We established very clearly what the physics and what the scales of the plumes were.

So as I stated in my testimony, 92 to 98 percent of the sediment deposited within about 300 feet of the mining activity, the remaining 2 to 8 percent of the sediment was about no higher than about 10 to 15 feet above the seabed, and happy to answer any more questions or further details on that—

Dr. GOSAR. Yes. Is there anything else that could disturb those sands and bedrock down below?

Dr. PEACOCK. Natural processes are you talking about?

Dr. GOSAR. Yes, like volcanoes, seismic activity.

Dr. PEACOCK. That has not been determined right now. In the Atlantic Ocean there are some data sets that talk about what are called benthic storms that naturally suspend sediment. There is no data yet on that in the Pacific Ocean. And of course, those storms wouldn't remove nodules from the seabed.

Dr. GOSAR. Right, but I am talking about more of the sand.

Dr. PEACOCK. So at present there is not data in the Pacific Ocean whether there is these benthic storms that would do that. There is some data in the Atlantic Ocean.

Dr. GOSAR. Now, are you familiar, Dr. Peacock, with microprocessors?

Dr. PEACOCK. A little.

Dr. GOSAR. OK. So the new technology is getting everything out of this ore. So it is pulverized. My understanding, there is a number of sequences. There is pulverized, there is electrolysis. They use surfactants to take it all off, and they are basically getting everything out of the ore. Is your opinion the same way?

Dr. PEACOCK. I apologize, could you repeat the question? I don't quite understand—

Dr. GOSAR. Yes, these microprocessors, they are doing ore very differently. They are pulverizing the ore, they are using different surfactants and whatever, weights of the things to pull off the everything that is in these ores. Are you familiar with those?

Dr. PEACOCK. No, I am not familiar with the processing technology there.

Dr. GOSAR. OK. Are you familiar with Schlumberger?

Dr. PEACOCK. I know the company Schlumberger, yes.

Dr. GOSAR. Are you familiar with how they actually concentrate lithium?

Dr. PEACOCK. No, I don't work on the processing side.

Dr. GOSAR. This comes back to the technology. It is advancing very, very fast. And Schlumberger can actually go into—like, say we have a subterranean big lake west of me in Phoenix. It is actually in Buckeye. They can't use water because it is very heavy

metal and very briny. And they are hooking up these machines that actually will use the water, because when you are using lithium you have to use a lot of water. And they are actually producing cleaner water than actually what they are finding there. So I think there is a lot of upside on a lot of this.

Mr. Barron, I think part of your problem is that on land we can't find a mine that the other side would like and would go along with. And they are no longer—29 years, over 3 decades. The Resolution Copper over here in eastern Arizona, in the copper corridor was mined for over 100 years, and still we have gotten nowhere with it. So they haven't produced one piece of copper. So that is our frustration here.

The other thing is misuse of some of the language in the law. A president has no jurisdiction beyond 2 years and less than 5,000 acres to withdraw in any way, shape, or form. So we have got to get back to the rule of law on that aspect.

So I am going to cut my question short and go to the next round. So Mr. Case, you so diligently stayed behind, we would love to give you your next 5 minutes.

Mr. CASE. Thank you very much.

Dr. Peacock, I am going back to your testimony. Basically what your testimony offers is a view of minimal environmental impact, based on your monitoring of tests conducted in 2021 and 2022. Were those Mr. Barron's company's tests?

Dr. PEACOCK. No. The second test was The Metals Company test. We did a small component of that. We provided a new sediment sensor that we designed for monitoring. The first test was for a company called Global Sea Mineral Resources, also independently monitored by a European consortium called the Mining Impacts Consortium.

Mr. CASE. OK, so these were private companies wanting to conduct deep-sea mining. You are monitoring their tests, correct?

Dr. PEACOCK. Correct.

Mr. CASE. OK. And according to your testimony, these were—I am trying to find your quote—they were “small-scale, short-term pilot tests,” is that right?

Dr. PEACOCK. That is correct.

Mr. CASE. OK. So these were not large-scale, longitudinal, real deep-sea mining tests. They were not tests of that. They were kind of like, hey, get in there, do a small pick, find out what the sediment is, et cetera.

Dr. PEACOCK. I would agree with that with one exception, which is the scale of the vehicles themselves was not dissimilar from what a commercial scale would be. They were about a third the size of a commercial scale vehicle.

Mr. CASE. OK. And were there a variety of approaches to deep-sea mining tested, or were they focused on the pluck that has been, you know, testified to, one of the measures?

So, in other words, did they, for example, do the large-scale clam-shell drop from the top of the ocean to the bottom, impacting the bottom, digging up deeper than a couple of inches? Did they do a dredge across the bottom? Did they do any of that stuff, or was it just like one approach?

Dr. PEACOCK. So both companies used the same technology, which is this hydrodynamic suction technique.

I am not really aware of any commercial companies using that sort of dredging type approach—

Mr. CASE. OK.

Dr. PEACOCK [continuing]. From the top of the ocean.

Mr. CASE. All right. So you just did the suck thing, the hydrodynamic—go down there with a suction thing and suck it up.

Dr. PEACOCK. Yes, that is one of the main technologies that people are looking at.

Mr. CASE. All right, but it is possible that there is other ways of getting stuff from the ocean floor. Correct?

Dr. PEACOCK. Yes—

Mr. CASE. You didn't test for that.

Dr. PEACOCK. A—

Mr. CASE. OK. And similarly, you only tested for sediment. You didn't test for other marine impacts, correct?

Dr. PEACOCK. My group led the sediment studies, but there was an entire European consortium of 23 institutions that did all the biological studies.

Mr. CASE. OK, and I want to get to that, because I am reading your testimony further. And you have a couple of specific recommendations in here.

First of all, you say that you need to be very careful about where you conduct these extraction activities. You recommend a patchwork of protected areas. You suggest large areas off limits to mining, protecting some smaller areas. You definitely recommend a regulatory framework. You recommend dedicated programs to determine sensors to detect impacts, monitoring. You talk a lot about the International Seabed Authority. In fact, you are a consultant, or you are actually a member of the International Seabed Authority indirectly, right?

Dr. PEACOCK. I am on the Expert Committee for Thresholds—

Mr. CASE. OK.

Dr. PEACOCK [continuing]. For the ISA.

Mr. CASE. All right. So you are not sitting here as an expert recommending that we do whatever we want on the seabed. You are recommending a specific regulatory framework for protecting the environment which is similar to what the ISA is doing. Right?

Dr. PEACOCK. Yes. I advocate for a step-by-step approach at increasing scales of operation and with robust guidelines of regulations to oversee that process.

Mr. CASE. OK. And do you have a view about whether the executive order offers such a regulatory framework?

Dr. PEACOCK. I don't have a view on that. I don't have—

Mr. CASE. OK.

Dr. PEACOCK [continuing]. Familiarity with it.

Mr. CASE. Mr. Currie—and I am going to do this rhetorically, and you can answer within 30 seconds—fundamentally, the executive order ignores the International Seabed Authority, throws it out, that we are going to go this alone, right?

China is a member of the International Seabed Authority, and China is obviously trying to manipulate it to its ends, but it is at least doing it within a framework of the International Seabed

Authority Law of the Sea. We have decided not to do that. Is it correct that the actions by this President would incentivize China to go it alone, with no environmental regulation whatsoever?

Mr. CURRIE. That is one possible outcome. The other possible outcome is that China positions itself as the leader of multilateralism and goes it that way. China is very smart about the way that thinks forward. They are clearly very, very invested in pursuing deep-sea mining, but not in any particular rush.

Mr. CASE. OK.

Mr. CURRIE. So I think you would find China coming back with a very measured response.

Mr. CASE. OK. Thank you very much.

Dr. GOSAR. I thank the gentleman from Hawaii. The gentleman from Arkansas is recognized for 5 minutes.

Mr. WESTERMAN. Thank you, Mr. Chairman, for doing two rounds.

Dr. Peacock, I wanted to discuss your research related to seabed mining. We often hear from folks who are opposed to seabed mining that we don't actually know what exists on the sea floor. Is that an accurate assertion?

Dr. PEACOCK. I often find these general statements not very enlightening.

In terms of the global sea floor, the entire global sea floor is mapped to a resolution of 1.5 kilometers. About 25 percent of the ocean is mapped to resolution of 100 meters. There are areas of the Clarion-Clipperton Zone that are mapped to within one centimeter.

On the biological side, indeed, across the Clarion-Clipperton Zone, as I mentioned in my testimony, there are several thousand anticipated species, but only 500 have been named. But at particular nodule sites that have been studied for 10 to 20 years, there is far greater knowledge of what lives at those sites.

Mr. WESTERMAN. Thank you. In your written testimony you talked about the need for improvement to technologies related to deep-sea mining. And I know we have had a little bit of discussion about that already, but can you elaborate on what technologies need to be improved and how the government can ensure that entrepreneurs have the space to address these technological needs?

Dr. PEACOCK. Yes. There are capable sensor systems that exist now that are being used throughout current trials. But as efforts would scale up, there is a need—for example, improved energy supplies to operate in the deep ocean for long periods of time. Battery technologies are challenged for their duration. Low-cost vehicles that could travel over these large distances of tens to hundreds of kilometers that the mining sites are assigned over 30-year timescales. So these kind of advances would be needed.

And also on the computation side, the ocean is big, deep, and vast. We can gather as much data as we can, but there will always be a need for computer modeling to help make the best use of that data. So advances in AI and GPU-based computing technology can really enhance our ability to understand where critical knowledge gaps are and where we should invest in and put sensors.

Mr. WESTERMAN. And the last question I want to ask you is, what areas do you think the United States surpasses China with technology and resources for deep-sea mining and vice versa?

Dr. PEACOCK. The U.S. has a leading history, of course, from the 1970s in operating in the deep ocean. And NOAA is a world-leading institution in terms of ocean research. In regards to deep-sea mining, there has been very little investment from the U.S., of course, in the last few decades. So at this point entities like China, Japan have advanced capabilities compared to the U.S.

Mr. WESTERMAN. Now, Mr. Barron and Mr. Gunasekara, I want to ask that same question to you. Where do you see U.S. technology leading over China, or where does China have better technology than us in deep seabed mining?

Mr. BARRON. Well, I have had the benefit of traveling to China a year ago and visiting Sanya on Hainan Island, where there is a community of 27,000 people all dedicated to building the technology stack.

The good news is America did lead the space, as I articulated, in the 1970s. And American companies and universities have played an important part in our own operation. We have four universities who are contributing to our environmental research. We fund them, but they are free to go and do the work and publish their results. We conducted our own boat out of San Diego, where we ran 22 campaigns from the Port of San Diego carrying out research. Those campaigns run for between six and 8 weeks.

And I think the innovation available in America is tremendous, and I think that you need to have something—a starting gun, and I think that starting gun was triggered last week by the President's executive order.

Mr. GUNASEKARA. I would add and say that our technology is leading. I have spent 20 years living and working in Silicon Valley, and we have been able to pull together the most advanced technology, a completely new way to harvest these metals with the least impact and the least cost. Of course, China will copy us, you know, although we have U.S. patents. Right now we are in the driving position of having, I would say, the most advanced technology for this. But if we don't move quickly, China will overtake us. They are doing two—

Mr. WESTERMAN. So you think China has had the same focus on the environmental sensitivity of harvesting these nodules that the U.S. has had?

Mr. GUNASEKARA. No, not at all. You know, they are actually doing two collector tests this year in the Clarion-Clipperton Zone under the ISA. And so we can see these are traditional-style collector vehicles that don't have as good an environmental impact as what we are attempting to deliver.

Mr. WESTERMAN. Thank you.

Dr. GOSAR. I thank the gentleman. The gentlewoman, the Ranking Member, Dr. Dexter, is now recognized for her 5 minutes.

Dr. DEXTER. Thank you, Mr. Chair.

Mr. Gunasekara, last year your company applied for mining exploration in U.S. waters near American Samoa, which BOEM denied after consultation with American Samoa. Shortly after, American Samoa announced a deep-sea mining moratorium in their territorial waters, citing threats to marine life, cultural heritage, and the territory's tuna fishery which is a profoundly important one.

But just this month your company announced that it is applying for a lease to explore and potentially mine in Federal waters near American Samoa. Why are you pursuing this venture when it is clear the most impacted community is opposed to the industry and the impacts it will cause to their environment and its economy?

Mr. GUNASEKARA. So we have had extensive dialog with the new Administration. There has been an election since the moratorium was signed by the previous governor. There is a new governor. And in our discussions we see that they are quite supportive, especially for the economic and jobs opportunity that deep-sea mining would unlock for them.

It also—as I would say, the proposed area is hundreds of miles away from any land population, so significant distance. And with our technology there is no mid-water plume. There will be zero impacts to fishing. Of course, we will confirm that with an environmental impact assessment.

The final thing I would say is that the Cook Islands, which is adjacent to American Samoa, recently signed an MOU with China for deep-sea mining. This is an opportunity to pull the Cook Islands back into the U.S. camp, because American Samoa is the nearest port with infrastructure that ultimately would be required for any deep-sea mining operation in the Cook Islands.

Dr. DEXTER. OK. My guess is that the chance that there will be impacts on the fishing industries and on those cultural and community interest has not been verified that there will be no impact. We are making an immense assumption there, I would guess. Do you agree that that is accurate?

Mr. GUNASEKARA. That is accurate, but that is the whole purpose of an environmental impact assessment.

You know, we are asking for this process to start. In the current legislation there are four public consultation periods. So there would be a lot of opportunity to have all stakeholders contribute and provide input.

I want to be clear. Our request is not to go mining tomorrow. It is to formally start the process, which is going to take many years.

Dr. DEXTER. And Mr. Currie, I saw you nodding there. I would love your sort of assessment of the risks to the community and the fisheries from your assessments.

Mr. CURRIE. What struck me, frankly, is the dissonance of the answer Mr. Gunasekara gave you and your question, if I may say so, about the cultural impacts.

What we have learned in the International Seabed Authority in the last few years is that Pacific Islanders have very strong cultural ties to the Pacific Ocean, to the deep sea. It is not just about the physical impacts, it is about the cultural impacts, and these need to be taken into account. In my own country in New Zealand, the law requires that the Maori, the local people there, have an input into their cultural heritage, into their cultural perspective. And this is absolutely crucially important. That is the first thing.

And the second thing is, yes, the Impossible Metals activities there, with their partnerships with local industry seem to be, you know, really flying in the face of the local concerns and the moratorium that still is in place.

Dr. DEXTER. Thank you. I am going to try to be quick, Mr. Chair. But Mr. Barron—sorry, I am trying to make this quick—commercially valuable tuna and their food source support a multi-billion-dollar tuna industry in the Pacific. But these are fish that are high on the food chain. And some toxics, like manganese metals, concentrate as they move up the food chain. Tuna in particular are one of the unfortunate repositories for mercury, for example, which is toxic to people. And now the tuna in the fisheries would be exposed to toxic metals found in sediment or discharge plumes generated through seabed mining.

What guarantee can you provide that deep-sea mining will not harm the Pacific tuna fisheries that American fleets and American consumers of seafood depend on?

Mr. BARRON. Well, the good news is tuna are very heavily studied, and we have studied them when it comes to polymetallic nodules. And the food web that tuna depend on will not be impacted by any of our return sediment or any of the activities we carry.

Firstly, we are not in the migration path, but also we return the water at 2000 meters below sea level. And as part of the studies we carried out in 2022 from a production environment, we monitored and measured the benthic and pelagic plume. We had 50 assets in the water measuring while we were in the production phase. So we have an enormous amount of data around this. And NOAA, who obviously, have a regulatory environment to oversee this, will be furnished with all of that information.

New Zealand, of course, have done extensive studies on this topic through their Federal agency. Mr. Currie would no doubt be aware of them. And so it is well understood that tuna will not be impacted by our activity in the CCZ.

Dr. DEXTER. So just to verify, there have not been commercial-level mining yet done, so I find it hard to make that sort of statement based on small-level production at this point.

Mr. BARRON. Well, I think the fact is the commercial trials we ran provide us the model to be able to then go and expand that model into a multi-year operation.

But the key to think about is where tuna operate. They operate in the top hundreds of meters of the surface. And of course, they often feed on plankton that will go down to 1,000 or sometimes 1,200 meters. And that is why, with the feedback of environmental scientists, we return the water to a depth of 2,000 meters.

There are some people that think we should tip the return water over the back of the boat because it would create an algae, and it would be an amazing sequester of carbon. And maybe 1 day in the future that is what the regulator will ask us to do because of the environmental benefits that come with that. But for the moment our proposal is to return that water at 2,000 meters below sea level, out of every harm's way.

There, of course, have been studies around bioavailability, as well, and it appears that these metals in water are not bioavailable to species that digest them anyway.

Dr. DEXTER. So I just want to make the statement that, as a physician we have made many hypotheses on the complex biological ecosystems of the body, and our assumptions that we

make based on small studies oftentimes are proven wrong over time. So I just want to caution this Committee using small-degree data over short periods of time in an incredibly complex ecosystem to make assumptions about.

Thank you, Mr. Chair.

Dr. GOSAR. I thank the gentlewoman. Thank you, because you led into my questions.

But the gentleman from Florida, Mr. Webster, is recognized for his 5 minutes.

Mr. WEBSTER. Thank you so much, Mr. Chairman, and thank you for kind of getting me into this Committee, I appreciate it. I have a question for Mr. Gunasekara.

I sent a letter to then-Defense Secretary Lloyd Austin, I think it was in 2023, urging him to develop a plan to counter the Chinese Communist Party's dominance and continued investment in critical minerals. Additionally, the United States holds only the observer status in the International Seabed Authority, the entity regulating deep-sea mining.

Since the sending of that letter in 2023, have you witnessed a difference on how the United States counters the CCP presence in seabed mining?

And in what ways does still holding the observer status with the ISA affect your presence in the industry?

Mr. GUNASEKARA. So China has, over the last few years, made massive investments in deep-sea mining. They actually hold four concessions through the ISA, more than any other country. And what we know is that they have to submit an environmental impact statement for any collector testing, as has been done with other companies. And two of their companies are actually doing collector testing this year. So they are moving very, very rapidly, heavily invested.

Now you are correct, the U.S. has not ratified the UN Law of the Sea, and so it only holds observer status, which means that it cannot take its full-time position on the council. The U.S. is the only country that is guaranteed a permanent seat on the council, which is part of the executive branch of the International Seabed Authority. But fortunately, there is a law that was passed that allows the U.S. to regulate, even though they have not ratified the sea.

So, you know, I think it would be ideal that the U.S. influence could accelerate the timelines at the International Seabed Authority. As Mr. Barron pointed out, it has been 14 years since work started on the mining code, it is still not finished, and it is effectively being filibustered by a small number of countries that want to protect their domestic mining or have extreme environmental concerns. And so we would love to see that work actually conclude, and I think U.S. leadership, if it was a member, could help.

Mr. WEBSTER. OK, I have another question then. During the Biden administration you submitted a request to initiate the leasing process for critical minerals exploration in the U.S. economic zone, and that request was subsequently denied. You have now resubmitted the request to the Bureau of Ocean Energy Management. How will America lead critical mineral exploration in

this portion of the globe and contribute to the ability to challenge China's growing dominance in deep-sea mining?

Mr. GUNASEKARA. Well, one of the advantages that we have over China is that we do have these minerals in our Exclusive Economic Zone. That is something that China actually does not have. And so this gives us the ability to effectively mine our own waters. So the Federal waters, the Exclusive Economic Zone around American Samoa, are our Federal waters. They are exactly the same as if they were on Federal land. And the ability to mine them ourselves, I think, is a great mitigation against China's control.

Obviously, those laws have already been passed but they are quite old and quite comprehensive in the fact that they need multiple public consultations. We would love to see a streamlining so that we could actually do all the environmental work and actually be mining in the next few years, not in the next 30 years, which is the average of a mine in the U.S.

Mr. WEBSTER. Thank you very much.

I yield back.

Dr. GOSAR. I thank the gentleman. I will now take my 5 minutes.

This young lady talked about studies and, you know, the scientific methodology that goes with it. So, you know, Dr. Peacock, coming back to you again. Once again you have a hypothesis, then you try to develop whether it is true or not, and you go beyond that, right? And you start with small pilot studies and you build and build and build them.

Now, you are on that verge right now, it sounds to me like, because you had that one study that was a real big one and a bunch of smaller ones, right?

Dr. PEACOCK. There have been two pilot-scale trials in 2021 and 2022 that brought a great deal of information. That is the latest.

Dr. GOSAR. OK. Now, this collection of these nodules is nothing new, right, Mr. Gunasekara?

Why I say that is I was in Norway 6 years ago, and they were showing us that the Chinese, with their icebreakers, were actually up in the Arctic Ocean doing this already, right?

Mr. GUNASEKARA. Absolutely, yes. I mean, China is investing in marine technology in all areas. They are building massive amounts of ships, underwater vehicles. Their navy is growing really rapidly, and deep-sea mining can be seen as a proxy for dual-use technology, especially the type of technology that we are building, which is autonomous underwater robots. These absolutely can have dual use and military applications.

Dr. GOSAR. Oh, I certainly agree with you, because we had autonomous vehicles being built for Resolution Copper because they are extracting copper at 7,000 feet and below. That is where the majority of that is coming from.

So China follows all the rules, Mr. Gunasekara. They follow all the rules, right?

Mr. GUNASEKARA. Not directly. They—yes, I mean, they—

Dr. GOSAR. So they only fish in their waters, right?

Mr. GUNASEKARA. Yes, they—

Dr. GOSAR. Yes, that is not what I hear. That is not what happens. You know, so from that standpoint I think we got some problems here.

Mr. Currie, Indigenous people—OK, I have lived my whole life with Native American Tribes. A lot of their concepts are based upon what they have gone through the ages with, but these are teaching moments. Would you say that is true or not?

Mr. CURRIE. I am sorry. What moment, sir?

Dr. GOSAR. So these are teaching moments when we have something that is different or may be construed as different as far as an Indigenous Tribe.

Mr. CURRIE. They certainly have a different perspective, if that is what you are saying, sir, absolutely.

Dr. GOSAR. Yes. So these could be teaching moments, you know, for example, let's say that we are talking about the collection of uranium, OK? And when we look at the breccia pipes in northern Arizona, OK, there are collapsed bed.

Now, I am not a geologist, my dad was, but he taught us that these are collapsed or more concentrated in that area, and they are also the lowest point. And so when you are getting radiation, every time it rains, every time it blows you get that radiation. But if you sit down and say, listen, but if you take this out, you are going to have less of that contact. So you have to weigh those prospects—going back to the scientific methodology.

But these are teaching moments because we are explaining why they are getting that exposure, how they are getting that exposure, and how much they are getting that exposure. So that plays a big deal with it, does it not?

Mr. CURRIE. Yes. I think what I was trying to say to the other member is that the cultural perspectives are important on their own, quite separate from the scientific issues. I mean, traditional knowledge is certainly becoming a very big topic of discussion in international law. I have just come from a meeting in the United Nations last week where it was very much in evidence.

But I think the point is not just the Indigenous viewpoint of what is happening. That is important. It is also their cultural connection to the deep sea that is what I was really referring to.

Dr. GOSAR. Well, I guess my point is they are not mutually exclusive.

Mr. CURRIE. No.

Dr. GOSAR. I think—there you go. That is what my whole point was, is that—

Mr. CURRIE. Thank you, sir.

Dr. GOSAR [continuing]. You have this hypothesis, and you have to disprove it, and you include people when you are doing that. And I think that is what—how medicine has gotten so good—or bad, however you want to look at it, depending upon how you approach it, the disease or whatever.

So now I am going to ask you a question for each one of you. I will start with you, Mr. Barron, and it is the same question for all four of you. I already warned you about this. What was the question you wanted asked today? What is the question that wasn't asked, and what is its answer?

Mr. Barron, you are first.

Mr. BARRON. Well, that is a challenging one. My question would be, what if the environmental impacts are indeed exactly as we predict they will be?

And what if recycling won't meet the needs that are sometimes speculated? What is the alternative?

And I can provide you the answer, as well. There isn't a good one. We need to find a supply of critical minerals with the lightest environmental and human impacts. And seafloor nodules are that answer.

Dr. GOSAR. Thank you, Mr. Barron.
Mr. Gunasekara?

Mr. GUNASEKARA. My comment would be on let's consider how we get the metals we use today. Let's take nickel. Seventy-five percent of it comes from rainforests in Indonesia. The majority is used in stainless steel, a little bit in batteries.

Those rainforests are being completely destroyed because the nickel laterite ore is directly below the rainforest. The biodiversity, the carbon storage is immense. Let's talk about the social impact. There are Indigenous people that live—often they are being forced off their land at gunpoint. The water is being polluted. The fish are dying. It is an absolutely terrible situation. And guess who controls all of it? China. This is the current situation.

We can deliver minerals from our own waters at lower cost. Lower cost will mean that those mines will close in Indonesia, just as today Indonesia has caused many mines in Australia to close because the prices come down. And to be clear, I am comfortable with the price coming down. We have plenty of margin available with our 10x lower cost, and it will enable everyone to afford newer technologies like electric vehicles and other infrastructure. So we can do a huge benefit for the planet environmentally, socially, and we can isolate ourselves from China control.

Dr. GOSAR. Thank you.
Mr. Currie?

Mr. CURRIE. Thank you, Mr. Chair. That is a fascinating question.

I would like to ask what would happen if the U.S. goes it alone. And what I postulate, firstly, I think it would be a tragedy for the United States in stepping outside the multilateral framework and all the many effects it may have, including the freedom of navigation, marine scientific research, the U.S. standing in the world.

I think it has the potential for initiating a free-for-all such as Mr. Case talked about. Whether it is China, whether it is another country, if one country is doing it, if one operator is doing it, you may well get many operators doing it, causing massive destruction on an unprecedented scale. You would have a great deal of legal litigation in the United States, possibly international. I think it will be a tragedy for the environment, a tragedy for the United States, and most importantly, a tragedy for multilateralism that has been in place for over 40, 50 years, recognizing that this area is a common heritage of humankind, needs to be looked after, needs to be for all generations and all peoples to look after.

And it is difficult. It is frustrating. It is difficult, no doubt about that. But it has worked for 50 years, and we think that is the way to go. Thank you.

Dr. GOSAR. I thank you.
Dr. Peacock?

Dr. PEACOCK. Thank you very much.

I think the question I would like to be asked is, are the latest scientific findings being used to drive decisions and discussions about deep-sea mining?

And my answer to that is, I think, unfortunately, it is not the case. For example, we hear the topic of will deep-sea mining disturb carbon sequestration in the deep ocean. I think that was established in about 2020 that this is not an issue. I have studied sediment plumes for 10 years, but I read articles that a mining operation two-and-a-half miles down in the Pacific Ocean 1,000 miles away will reach Hawaii, which is simply not the case.

The latest topic, of course, is dark oxygen. That has been a very high-profile scientific study. And the scientific community is looking into it. The consensus emerging is that this does not seem to be an issue. There is a paper from 2006 that finds the opposite findings from the latest paper that came out.

So I just really encourage the whole debate to take on board the latest science and data. Of course, I am going to do that. I am a faculty member at MIT. That is my role and that is my job. But I really think it is important to take on board learnings when we get them, whether they are good or bad. There is still a lot of questions about biodiversity, ecosystem function. We need to pay attention to those. But when something is determined and scientifically shown to be the case, we need to accept that and move on. Thank you.

Dr. GOSAR. Wow, what a discussion. You know, I wish more people were here watching and seeing this. I know that the Committee will have a bunch of more questions, and they will have to submit them in a certain way. Let's see, and we will ask our witnesses to respond with those questions in writing. Under Committee rule 3, members of the Committee may submit these questions to the Subcommittee clerk by 5 p.m. on Friday, May 2. The hearing record will be held open for 10 business days for these responses.

If there is no further business—

Dr. DEXTER. Mr. Chair, I just wanted to request that I be allowed to submit into the record several reports and documents.

Dr. GOSAR. Without objection, so ordered.

Dr. DEXTER. Thank you very much.

Dr. GOSAR. I will tell you I am fascinated by this, and I will tell you, we need to keep our eyes open. I am not so leery of America. I want America to dream again. I want her to build again. I want her to lead again. And I think that is very important.

You know, so Mr. Currie, I know that you are in New Zealand. We share a common bond there. And I thank you very much for your travels.

And with that, the Subcommittee stands adjourned.

[Whereupon, at 11:54 a.m., the Subcommittee was adjourned.]

[ADDITIONAL MATERIALS SUBMITTED FOR THE RECORD]

Submissions for the Record by Rep. Dexter

The People of American Samoa Stand Against Deep-sea Mining

April 28, 2025

To Whom It May Concern,

We, the undersigned community members of American Samoa, write to express our strong opposition to deep-sea mining proceeding in national and international waters. We are united in standing with former Governor, Lemanu P.S. Mauga, who has taken a clear and commendable position against deep-sea mining by placing a moratorium on all deep-sea mining activities in our territory ([source](#)).

Last year, we came together to make it clear to the Bureau of Ocean Energy Management that we oppose Impossible Metals' unsolicited lease request to explore the seafloor for mineral extraction near our islands. Even though our community has already expressed clear opposition to the exploitation of our resources by Impossible Metals, the company has decided to make another lease request. Again, we oppose this attempt to exploit the natural resources of our islands, especially by a company who has clear disregard for our consent.

Our opposition is rooted not only in our deep cultural and spiritual connection to the ocean—which is essential to our way of life and identity—but also in serious concerns regarding the national security, economic, and environmental implications of deep-sea mining.

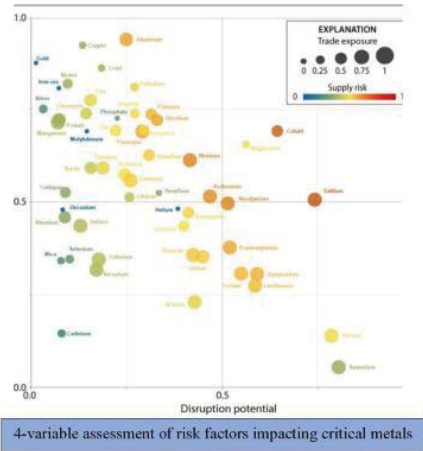
As Pacific Islanders and U.S. citizens, nationals, and permanent residents, we are deeply alarmed by the potential for deep-sea mining to create new geopolitical vulnerabilities. By issuing permits for the potential commercial recovery of seabed minerals in international waters, this could open the door to a race for control over ocean resources by foreign powers. These contracts could allow China—and potentially other actors—to extract not just minerals, but also critical maritime data that could be used for military or surveillance purposes. Deep-sea mining could provide economic and geostrategic footholds to actors whose long-term goals may not align with American values or interests. Weakening the commitment to the stewardship of international waters, or the territorial waters of the countries located closest to American Samoa, undermines our collective security.

Deep sea ecosystems remain among the least studied and understood places on the planet and support vital ocean ecosystem elements such as fish stocks, coral reefs, and ecosystem functions. Not only do the environmental impacts of deep-sea mining threaten the health of these ecosystems and our fisheries, but opening up this frontier for commercial exploitation for minerals at a time of growing opposition from the international community against the industry ([source](#)) will undermine the ability for the U.S. to demand compliance from other states in areas like illegal fishing, which remains one of the most significant threats to our economy, food security, and maritime sovereignty in American Samoa.

American Samoan families depend on healthy fisheries. Our food security and our livelihoods depend on our ability to catch fish, especially tuna, in our territory's waters. Research has shown that deep-sea mining could have serious impacts on commercially significant fisheries, such as tuna ([source](#)). Whether it is in our territory's waters, federal waters, or international waters, the potential impacts of deep-sea

The full document is available for viewing at:

<https://docs.house.gov/meetings/II/II15/20250429/118089/HHRG-119-II15-20250429-SD001.pdf>



Critical Minerals for Defense Critical Review

Submittal Date: March 11, 2025

Prepared By:

Andrew Thaler, PhD
Blackbeard Biologic: Science and
Environmental Advisors



The full document is available for viewing at:
<https://docs.house.gov/meetings/II/II15/20250429/118089/HHRG-119-II15-20250429-SD002.pdf>

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/318093120>

Biodiversity loss from deep-sea mining

Article in *Nature Geoscience* · June 2017
DOI: 10.1038/ngeo2683

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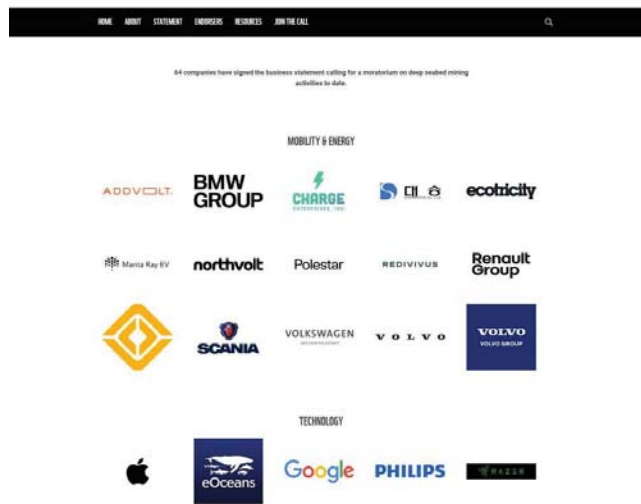
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44 companies have signed the business statement calling for a moratorium on deep seabed mining activities to date.

MOBILITY & ENERGY

ADDVOLT, BMW GROUP, CHARGE, ecotricity, Mantra Ray EV, northvolt, Polestar, REDIVIVUS, Renault Group, VOLKSWAGEN, VOLVO, VOLVO

TECHNOLOGY

Apple, eOceans, Google, PHILIPS

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Current Biology

How many metazoan species live in the world's largest mineral exploration region?

Highlights

- We provide the first checklist for the Clarion Clipperton Zone (CCZ) metazoan fauna
- 5,142 unnamed species (informal names) are recorded from the CCZ
- Total estimates of species richness range from >6,000–>8,000
- An estimated 88%–92% of species in the CCZ region in total are undescribed

Authors

Muriel Rabone, Joris H. Wiethase, Erik Simon-Lledó, ..., Helena Wiklund, Tammy Horton, Adrian G. Glover

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In brief

Species-level biodiversity information is key to understanding ecosystems and tracking environmental impacts. Rabone et al. provide the first checklist (436 species) and total species estimates (>6,000–>8,000) for the world's largest mineral exploration region, the CCZ. Estimates provide a baseline to build biodiversity knowledge at a regional scale.

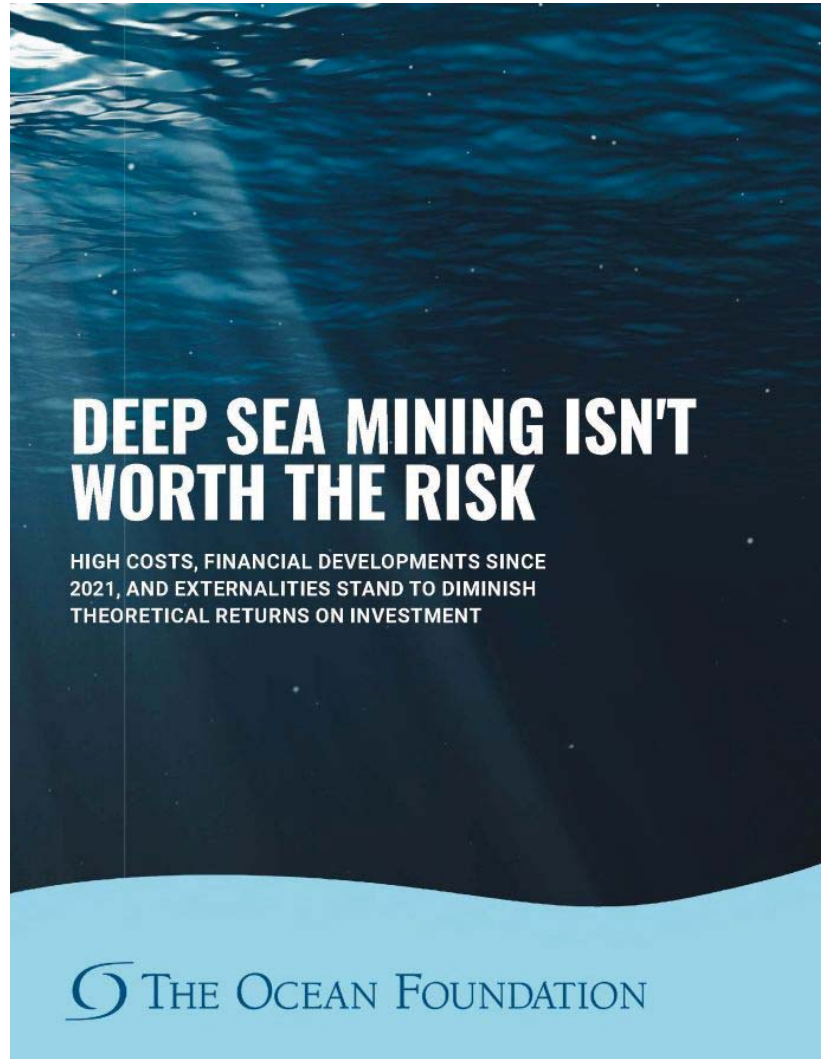


Rabone et al., 2023, *Current Biology* 33, 2383–2396
June 19, 2023 © 2023 The Author(s). Published by Elsevier Inc.
<https://doi.org/10.1016/j.cub.2023.04.052>



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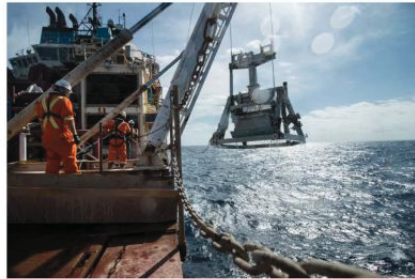
EXCLUSIVE SUSTAINABLE BUSINESS

Shipping Giant Maersk Drops Deep Sea Mining Investment

Maersk is selling its stake in The Metals Company, the latest big name to divest itself of its seabed mining interests

By Yusuf Khan

May 3, 2023 10:18 am ET | WSJ PRO



Maersk said it now holds less than 2.3% of TMC and is in the process of selling all of its shares. PHOTO: A.P. MOLLER-MAERSK

Shipping company [A.P. Moller-Maersk](#) is selling its stake in deep-sea mining firm [The Metals Company](#), even as the legal process to allow seabed mining approaches its final stages.

Maersk told [The Wall Street Journal](#) that it now holds an interest of less than 2.3% in TMC and is in the process of selling all of its shares. The shipping company held more than 9% of TMC in 2021, according to data from [FactSet](#) and has been an investor in the company since 2017.

<https://www.wsj.com/articles/shipping-giant-maersk-drops-deep-sea-mining-investment-c226df39>

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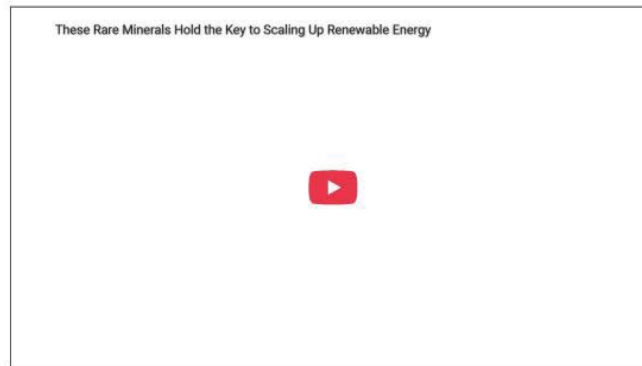
<https://docs.house.gov/meetings/II/II15/20250429/118089/HHRG-119-II15-20250429-SD007.pdf>

A new frontier for global energy security

Critical Minerals

Critical minerals such as copper, lithium, nickel, cobalt and rare earth elements are essential components of many of today's rapidly growing energy technologies – from wind turbines and electricity networks to electric vehicles. Demand for these materials is growing quickly as energy transitions gather pace.

The types of mineral resources used vary by technology. Lithium, nickel, cobalt, manganese and graphite are crucial to battery performance. Rare earth elements are essential for permanent magnets used in wind turbines and EV motors. Electricity networks need a huge amount of aluminium and copper, the latter of which is the cornerstone of all electricity-related technologies. Learn more about the various minerals in the short video below.



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Advance Unedited Version
English Only
12 May 2020

Report to the International Seabed Authority

Study of the Potential Impact of Polymetallic Nodules
Production from the Area on the Economies of Developing
Land-based Producers of those Metals which are Likely to be
Most Seriously Affected

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Polymetallic Nodules


- Chemical Composition
- Theories of Formation
- Geographical Distribution
- Exploration Technologies
- Processing Technologies

NATURE OF THE MINERALS

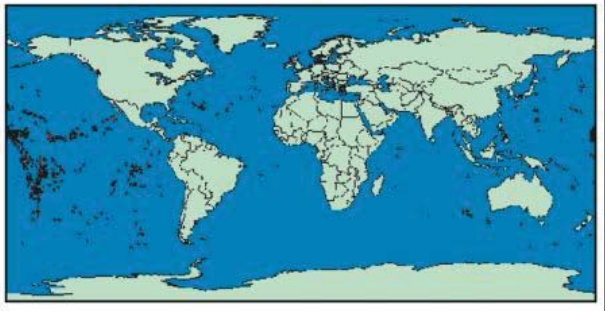
Polymetallic nodules were discovered at the end of the 19th century in the Kara Sea, in the Arctic Ocean off Siberia (1868). During the scientific expeditions of the H.M.S. Challenger (1872-76), they were found to occur in most oceans of the world.

Polymetallic nodules, also called manganese nodules, are rock concretions formed of concentric layers of iron and manganese hydroxides around a core. The core may be microscopically small and is sometimes completely transformed into manganese minerals by crystallization. When visible to the naked eye, it can be a small test (shell) of microfossil (radiolarian or foraminifer), a phosphatized tooth of shark, faunal debris or even fragments of earlier nodules. The thickness and regularity of the concentric layers are determined by the successive stages of growth. On some nodules they are discontinuous, with noticeable differences between the two sides. Nodules vary in size from tiny particles visible only under a microscope to large pellets more than 20 centimetres across. However most nodules are between 5 and 10 cm in diameter, about the size of potatoes. Their surface is generally smooth, sometimes rough, nannulitised (knobby) or otherwise irregular. The bottom, buried in sediment, is generally rougher than the top.

The nodules lie on the sea bottom sediment, generally half buried. Some nodules are completely covered by sediment and, in some areas, nodules have been collected even though they are invisible on photographs. They vary greatly in abundance. In some places they cover more than 70 per cent of the bottom, the nodules touching one another. However it is considered that, to be of economic interest, the abundance must exceed 10 kilograms per square metre, with an average of 15 kg/m² over areas of several tenths of a square kilometre. They can occur at any depth, but the highest concentrations have been found between 4,000 and 6,000m.



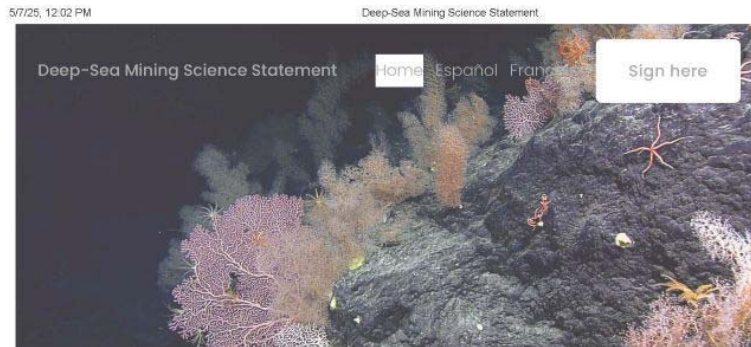
Polymetallic nodules.



World map showing the occurrence of polymetallic nodules.

The full document is available for viewing at:

<https://docs.house.gov/meetings/II/II15/20250429/118089/HHRG-119-II15-20250429-SD010.pdf>



Marine Expert Statement Calling for a Pause to Deep-Sea Mining

Signed by 931 marine science & policy experts from over 70 countries

The deep sea is home to a significant proportion of Earth's biodiversity, with most species yet to be discovered. The richness and diversity of organisms in the deep sea supports ecosystem processes necessary for the Earth's natural systems to function. The deep ocean also constitutes more than 90% of the biosphere, and plays a key role in climate regulation, fisheries production, and elemental cycling. It is an integral part of the culture and well-being of local communities and the seafloor forms part of the common heritage of humankind. However, deep-sea ecosystems are currently under stress from a number of anthropogenic stressors including climate change, bottom trawling and pollution. **Deep-sea mining would add to these stressors, resulting in the loss of biodiversity and ecosystem functioning that would be irreversible on multi-generational timescales. Amongst the specific concerns over the impacts of deep-sea mining are:**

- the direct loss of unique and ecologically important species and populations as a result of the degradation, destruction or elimination of seafloor habitat, many before they have been discovered and understood;

<https://seabedminingsciencestatement.org>

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Article

Long-term impact and biological recovery in a deep-sea mining track


<https://doi.org/10.1038/s41586-025-08921-3>

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Daniel O. B. Jones^{1,2}, María Belén Ariza³, Loïc Van Audenheede⁴, Sabena Blackbird⁵, Corie Boolookos⁶, Guadalupe Bribiesca-Contreras^{7,8}, Jonathan T. Copley¹, Andrew Dale⁹, Susan Evans¹, Bethany F. M. Fleming¹⁰, Andrew R. Gater¹, Hannah Grant¹, Mark G. J. Hart¹, Veerle A. I. Huvenne¹, Rachel M. Jeffrey¹, Pierre Josso⁹, Lucas D. King⁹, Erik Simon-Lledó⁹, Tim Le Bas¹, Louisa Norman¹, Bryan O'Malley¹, Thomas Peacock¹⁰, Tracy Shimmield¹¹, Eva C. D. Stewart^{12,13}, Andrew K. Sweetman⁹, Catherine Wardell¹⁴, Dmitry Aleynik¹⁵ & Adrian G. Glover²

Deep sea polymetallic nodule mining is in the exploration phase at present with some groups proposing a move towards extraction within years¹. Management of this industry requires evidence of the long-term effects on deep-sea ecosystems², but the ability of seafloor ecosystems to recover from impacts over decadal scales is poorly understood³. Here we show that, four decades after a test mining experiment that removed nodules, the biological impacts in many groups of organisms are persistent, although populations of several organisms, including sediment macrofauna, mobile deposit feeders and even large-sized sessile fauna, have begun to re-establish despite persistent physical changes at the seafloor. We also reveal that areas affected by plumes from this small-scale test have limited detectable residual sedimentation impacts with some biological assemblages similar in abundance compared to control areas after 44 years. Although some aspects of the modern collector design may cause reduced physical impact compared to this test mining experiment, our results show that mining impacts in the abyssal ocean will be persistent over at least decadal timeframes and communities will remain altered in directly disturbed areas, despite some recolonization. The long-term effects seen in our study provide critical data for effective management of mining activities, if they occur, including minimizing direct impacts and setting aside an effective network of protected areas^{4,5}.

Recent rapid growth in exploration for polymetallic nodule deposits is raising societal awareness of deep-sea mining¹. More than 21 billion tonnes of nodules, potato-sized mineral aggregations rich in critical metals such as cobalt and nickel, are estimated to lie on the abyssal seabed of the Clarion–Clipperton Zone (CCZ, North Pacific)⁶. However, Pacific nodule fields also sustain highly specialized animal and microbial communities with low abundance and biomass, but high species diversity compared to other deep-sea sedimented communities^{7–11} with most of the species still undescribed¹². Falling beyond national jurisdiction, the seafloor mineral resources of the CCZ are regulated by the International Seabed Authority, which is at present developing the legal, financial and environmental framework to underpin any potential full commercial exploitation, if it occurs. Robust understanding of the effects of mining disturbance is thus urgently needed¹³.

The expected high sensitivity of abyssal communities to change combined with the potential spatial and temporal scales of mining operations (for example, roughly 400 km² yr⁻¹ of mining per operation with expected 20-year mine life^{14,15}) sets them apart from most other anthropogenic stressors in the deep sea. Nodule mining is expected

to cause immediate effects on the seabed surface and habitat in the path of collector vehicles, including mechanical disturbance, hard substratum habitat removal and sediment compaction. It will generate sediment plumes in the water column that can redeposit beyond mined areas¹⁶ causing biogeochemical alterations of the sediment and increased water turbidity at scales that could have significant impacts on ecosystems¹⁶. Recent estimates suggest plume redeposition could expand the visible seabed footprint several kilometres beyond the extent of test mining operations^{17,18}. Over the multi-decadal life of a single operation, impacts from direct disturbance and plumes could extend over hundreds of square kilometres¹⁹ and cumulative impacts of many operations could be greater. However, biological effects of these physio-chemical alterations remain poorly understood, particularly over long timescales. Evaluation of the potential resilience of abyssal ecosystems to cumulative effects is largely constrained by the scarcity of full-scale experimental tests, and little is generally known about long-term recovery or succession patterns in abyssal ecosystems⁴. In this study, we define ‘recovery’ as a return to the original state of the ecosystem stated in terms of the parameter assessed, which includes

¹National Oceanography Centre, European Way, Southampton, UK; ²Natural History Museum, Cromwell Road, South Kensington, London, UK; ³School of Environmental Sciences, University of Liverpool, Liverpool, UK; ⁴Ocean and Earth Sciences, University of Southampton Waterfront Campus, European Way, Southampton, UK; ⁵Scottish Association for Marine Sciences, Oban, Argyll, UK; ⁶British Geological Survey, The Lyell Centre, Research Avenue South, Edinburgh, UK; ⁷Heriot-Watt University, Riccarton, Edinburgh, UK; ⁸Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain; ⁹Eastern College, Saint-Petersburg, FL, USA; ¹⁰Massachusetts Institute of Technology, Cambridge, MA, USA; ¹¹Re-mail: aj@glos.ac.uk

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Mining Company Seeks Trump Support to Shortcut Access to Seabed Metals

 nytimes.com/2025/03/27/climate/mining-company-seeks-trump-support-to-shortcut-access-to-seabed-metals.html

Eric Lipton

March 28, 2025



A ship chartered by the Metals Company returning to San Diego from the Clarion Clipperton Zone of the Pacific Ocean in 2021.Credit...Tamir Kalifa for The New York Times

March 27, 2025

The long-running battle over whether to allow Pacific Ocean seabed mining took an unexpected turn Thursday when a company disclosed it had been confidentially negotiating a plan with the Trump administration to circumvent a United Nations treaty and obtain authorization from the United States to start mining in international waters.

The proposal, which drew immediate protests from environmental groups and diplomats from some countries, represents a radical shift in the contentious debate over accessing deposits on the sea floor that contain copper, cobalt, manganese and other metals that are needed for electric-car batteries.

The International Seabed Authority, established 30 years ago by an agreement now ratified by more than 160 nations, has jurisdiction over seabed mining in international waters, outside the coastal areas of each nation.

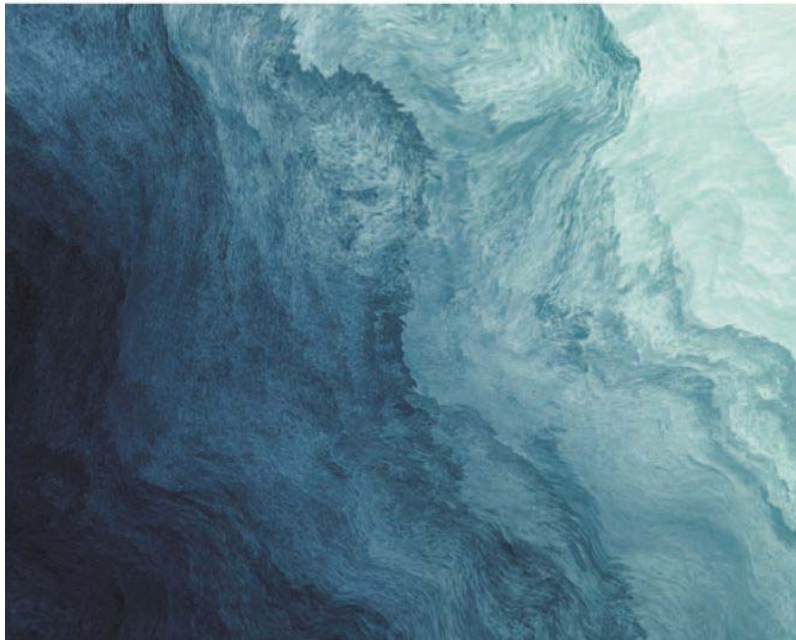
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The Ocean Economy to 2050



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Seafood Market Statement Supporting a Pause on Deep-Sea Mining

The deep sea is Earth's largest and least understood ecosystem. It constitutes more than 90% of the planet's biosphere, is home to remarkable and poorly known biodiversity, and is integral to food webs supporting fisheries that billions of people rely on globally.

Deep-sea mining, a rapidly emerging and potentially extensive industry involving the extraction of mineral resources from the deep seabed, poses a threat to the ocean and its inhabiting life. While the extent of deep-sea mining impacts is yet to be determined, it will certainly lead to significant habitat destruction and biodiversity loss, with many potential impacts on fisheries and seafood supply. These include:

- The generation of sediment plumes that could travel long distances and may smother and/or prevent feeding or visual communication between organisms in the pelagic food web, directly or indirectly impacting the health of economically-important fish populations.
- The release and spread of potentially toxic metals that could remain in the mesopelagic zone for much longer than sediment. The mesopelagic zone is the natural entry point for mercury into oceanic food webs and the human seafood supply. This raises concerns that the metals and toxins discharged into the mesopelagic zone could be absorbed by nearby species, some of which may be critical food sources for seafood species, leading to increased bioaccumulation and contamination of fisheries.
- Noise and light pollution that may cause disruptions in/alterations to behavior of species leading to stress and changes of migratory routes, especially for small pelagics, tuna and tuna-like species. This could create unknown consequences in fishing mortality and fishing-effort displacements.

The above is especially concerning given the significant overlap between current fishing grounds and areas licensed for mineral exploration.

As producers, fishers, retailers, suppliers, and managers of sustainable seafood, we recognize the critical role of healthy and productive ecosystems in supporting sustainable fisheries and seafood supply chains. As such, we are deeply concerned about the aforementioned potential impacts of deep-sea mining on the health and resilience of the ocean, and the consequences it might bring in terms of the quality and quantity of seafood supply and the communities they support.

It is both logical and responsible to implement the precautionary approach vis-a-vis this new extractive industry that could drastically alter the marine environment we depend on with unknown and unintended consequences.

The full document is available for viewing at:

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Trump Order Encourages Controversial Deep-Sea Mining for Critical Minerals

Published Apr 24, 2025 at 8:10 PM EDT

Updated Apr 24, 2025 at 10:30 PM EDT



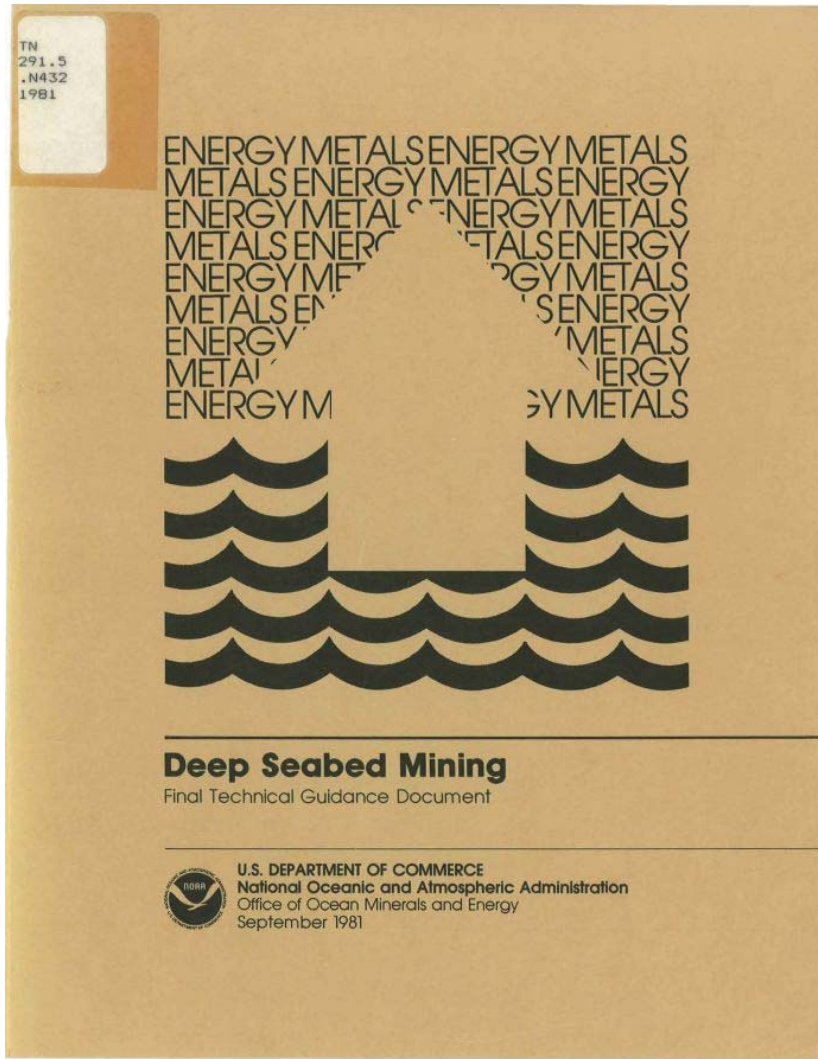
<https://www.newsweek.com/trump-order-encourages-controversial-deep-sea-mining-critical-minerals-2063932>

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[SUPPLEMENTAL MATERIALS SUBMITTED FOR THE RECORD]

The following documents were submitted as supplements to Mr. Barron's testimony:



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<https://docs.house.gov/meetings/II/II15/20250429/118089/HHRG-119-II15-Wstate-BarronG-20250429-SD009.pdf>



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

THE ADMINISTRATOR

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REC'D DEC 22 1981
CARRIA TRAINOR

EC2440

Honorable George H. Bush
President of the Senate
Washington, D.C. 20510

Dear Mr. President:

It is my honor to transmit the Deep Seabed Mining Report of the National Oceanic and Atmospheric Administration (NOAA) to the Congress pursuant to Section 309 of the Deep Seabed Hard Mineral Resources Act (P.L. 96-283).

This report describes NOAA's progress in implementing the Act, and our continued development of the deep seabed mining program in a legally sound and environmentally sensitive manner. Also discussed are NOAA's efforts in the negotiations of agreements with foreign nations to facilitate reciprocating states arrangements to provide an interim legal regime for seabed mining pending an acceptable Law of the Sea treaty, and our outlook for the future of deep seabed mining.

Sincerely,


John V. Byrne

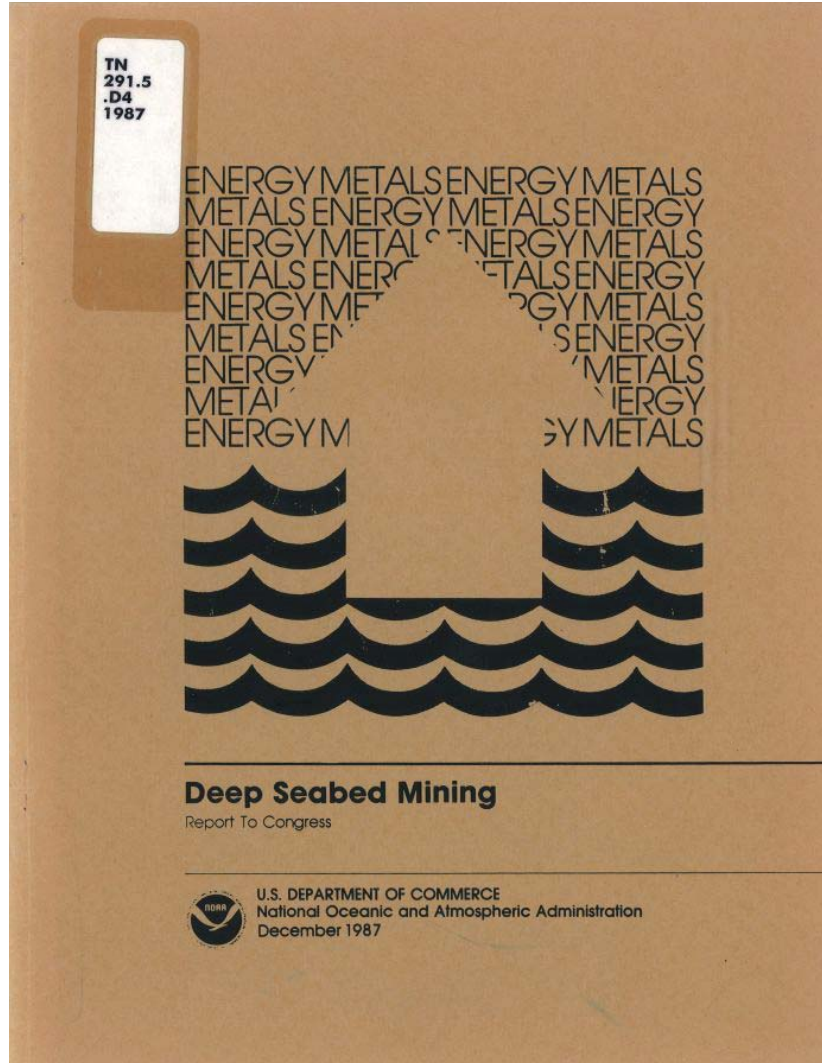
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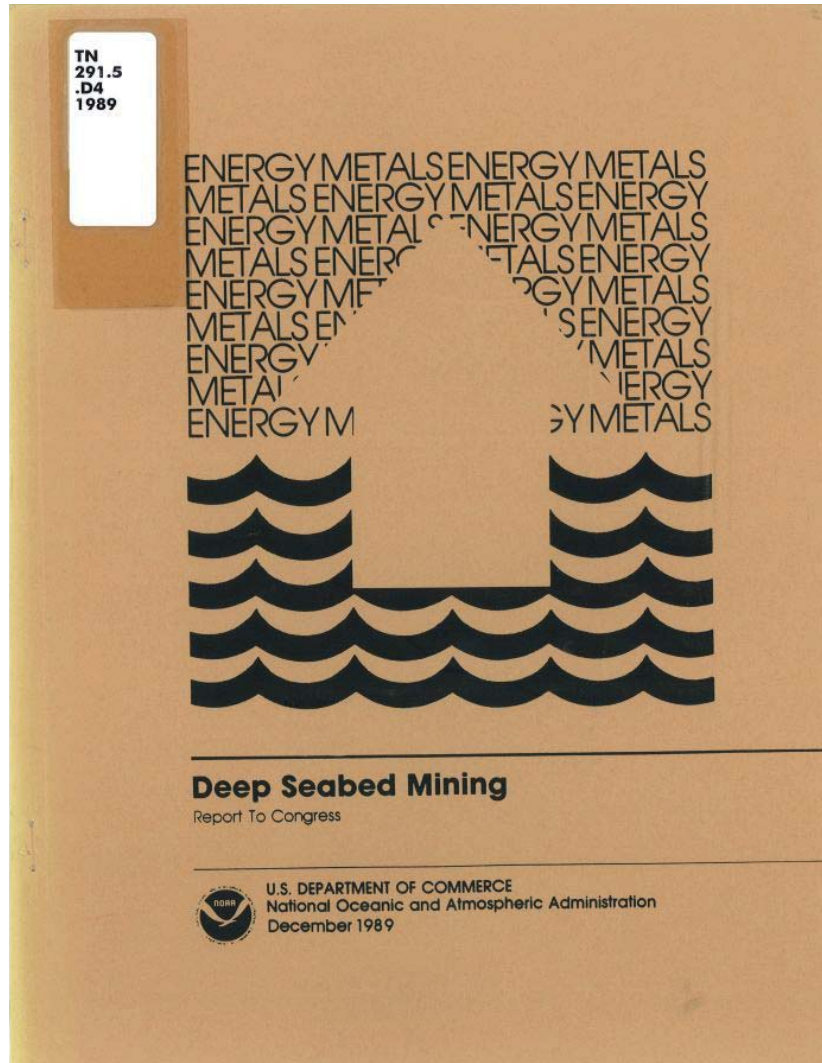


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National Oceanic and Atmospheric Administration
A young agency with a historic
tradition of service to the Nation

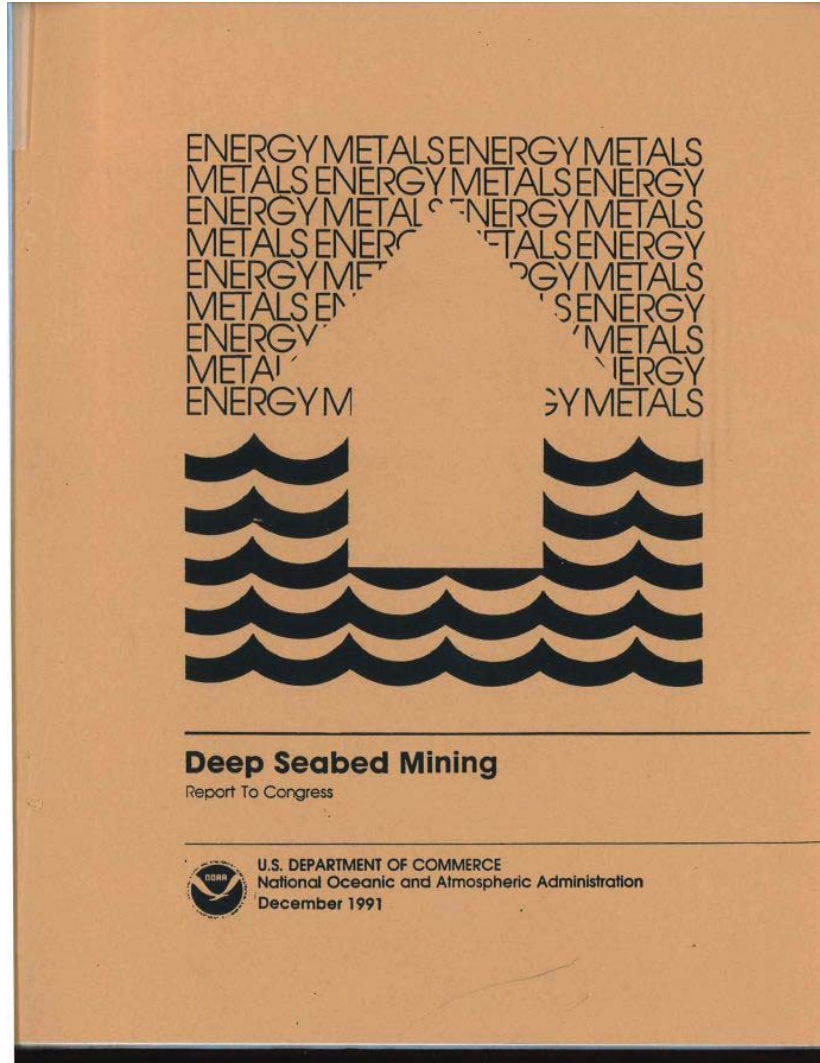
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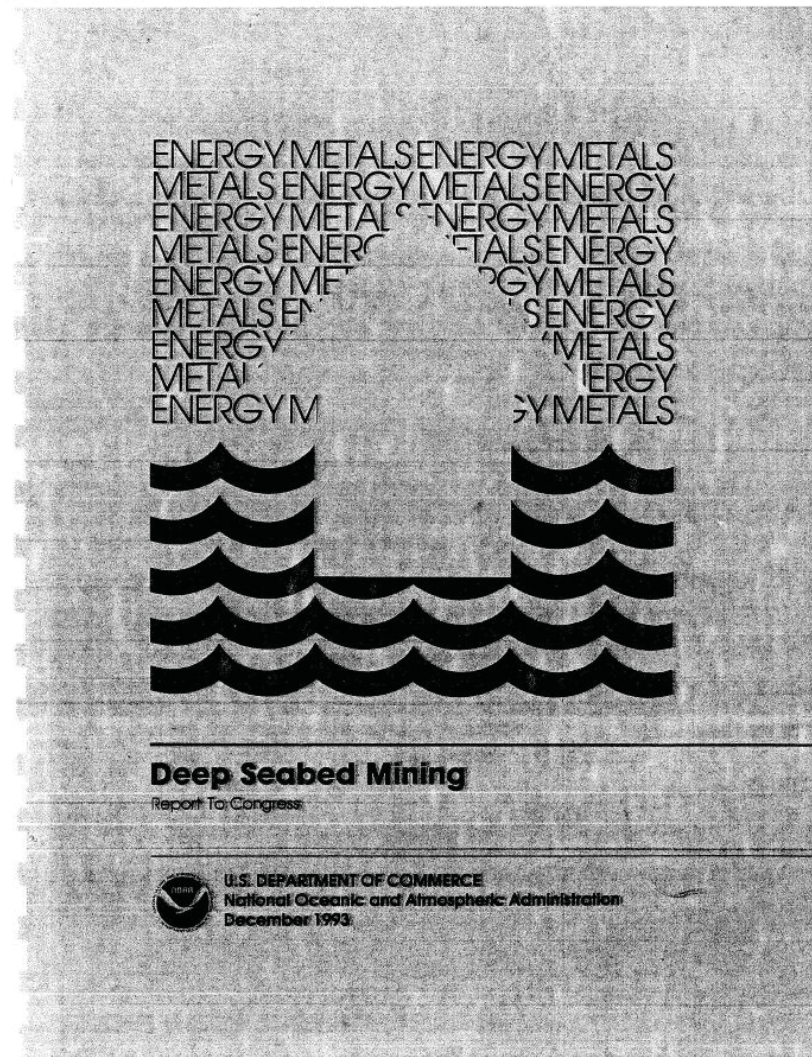
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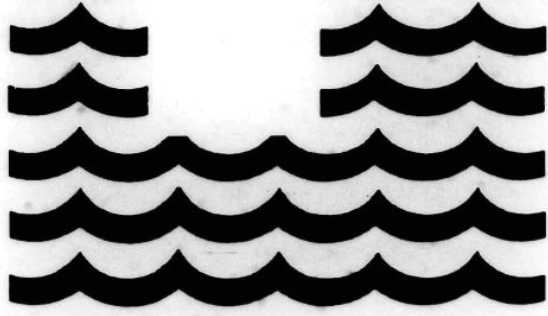


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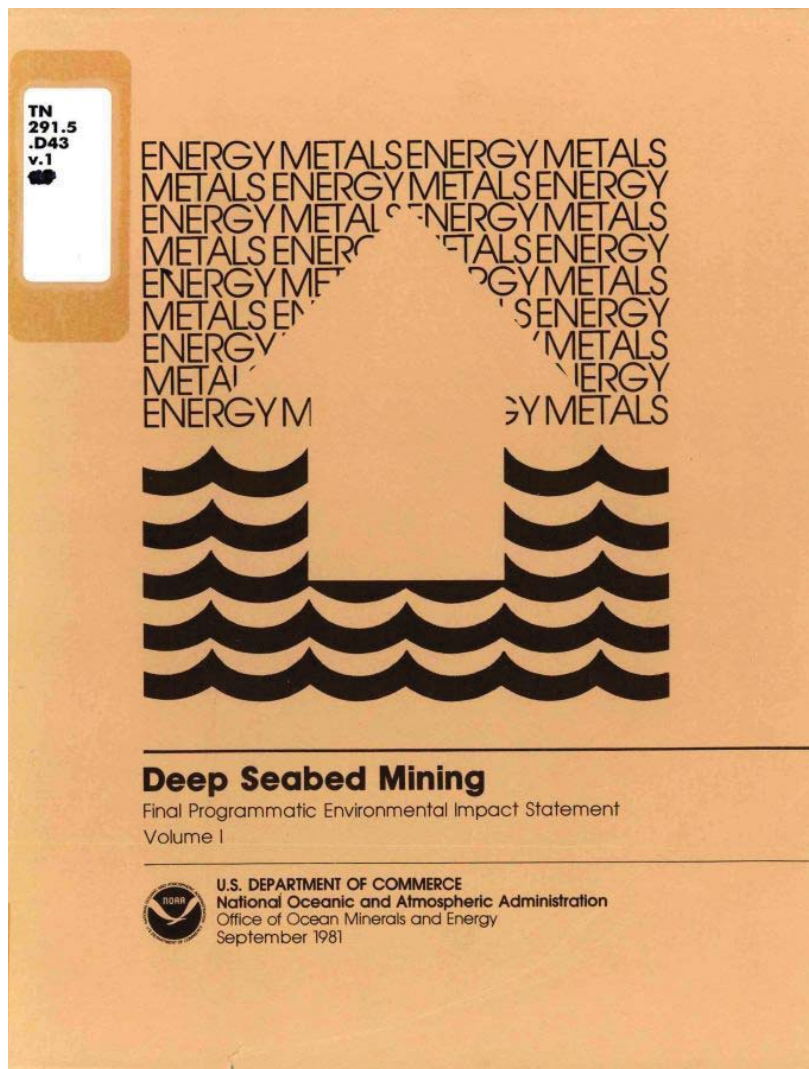


Deep Seabed Mining
 A Report to Congress

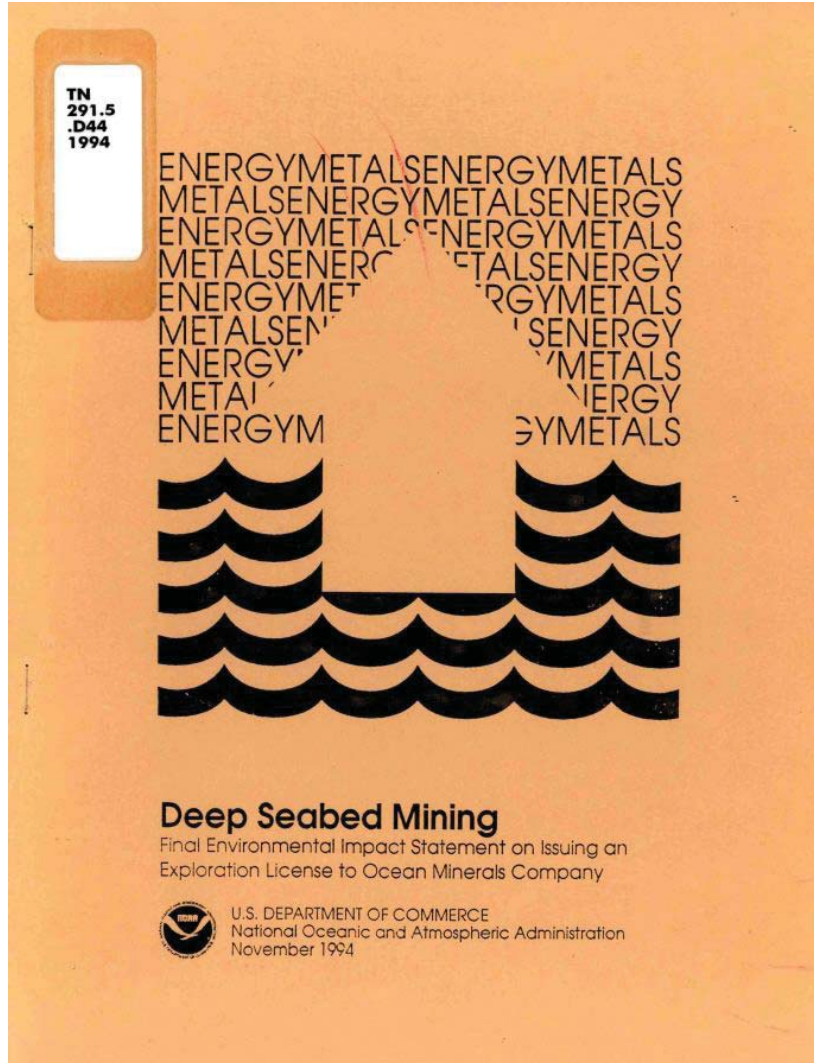


U.S. DEPARTMENT OF COMMERCE
 National Oceanic and Atmospheric Administration
 December 1996

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15 CFR Part 970 - DEEP SEABED MINING REGULATIONS FOR EXPLORATION LICENSES

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[Subpart F—Resource Development Concepts \(§§ 970.600 - 970.603\)](#)
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[Subpart H—Safety of Life and Property at Sea \(§§ 970.800 - 970.801\)](#)
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30 USC Ch. 26: DEEP SEABED HARD MINERAL RESOURCES
From Title 30—MINERAL LANDS AND MINING

CHAPTER 26—DEEP SEABED HARD MINERAL RESOURCES

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1402.	International objectives.
1403.	Definitions.
	SUBCHAPTER I—REGULATION OF EXPLORATION AND COMMERCIAL RECOVERY BY UNITED STATES CITIZENS
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Title 15 – Commerce and Foreign Trade**Subtitle B – Regulations Relating to Commerce and Foreign Trade****Chapter IX – National Oceanic and Atmospheric Administration, Department of Commerce****Subchapter D – General Regulations of the Environmental Data Service****Part 960** Licensing of Private Remote Sensing Space Systems**Subpart A** General§ 960.1 Purpose.§ 960.2 Jurisdiction.§ 960.3 Applicability to existing licenses.§ 960.4 Definitions.**Subpart B** License Application Submission and Categorization§ 960.5 Application submission.§ 960.6 Application categorization.**Subpart C** Application Review and License Conditions§ 960.7 License grant or denial.§ 960.8 Standard license conditions for all tiers.§ 960.9 Additional standard license conditions for Tier 2 systems.§ 960.10 Additional standard and temporary license conditions for Tier 3 systems.§ 960.11 No additional conditions.§ 960.12 Applicant-requested waiver before license issuance.§ 960.13 Licensee-requested modification after license issuance.§ 960.14 Routine compliance and monitoring.§ 960.15 Term of license.**Subpart D** Prohibitions and Enforcement§ 960.16 Prohibitions.§ 960.17 Investigations and enforcement.**Subpart E** Appeals Regarding Licensing Decisions§ 960.18 Grounds for adjudication by the Secretary.§ 960.19 Administrative appeal procedures.**Appendix A to Part 960**Application Information Required**Appendix B to Part 960**Application Submission Instructions**Appendix C to Part 960**License Template

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