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Conference on Deep Seabed Mineral Mining

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Acknowledgements:

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Introduction

In June of 2021, the country of Nauru invoked the "two-year rule" of the International Seabed Authority (ISA), the intergovernmental body tasked with governing the mining of minerals in international waters. In doing this, the country expressed its intention to apply for a mineral exploitation permit in the summer of 2023. If this occurs, the ISA will either have to complete its mining regulations (which include rules for environmental protection) by that deadline or consider the application using a provisional rulebook. In short, the prospect of seabed mining commencing in international waters has become more of a possibility than ever before.

Directors of RNRF recognized the opportunity to explore this issue at a critical moment and called a Conference on Deep Seabed Mineral Mining. The conference brought together a group of professionals from the scientific, nonprofit, and government sectors. Attendees met virtually on December 17, 2021.

The conference began with a presentation on the ecology of the seabed and gaps in our current knowledge of seabed mining's environmental impacts. It continued with a governance-focused presentation about the ISA, including discussion of the two-year rule, the viability of a mining moratorium, and paths forward for the international seabed mining regime. The conference then shifted focus to seabed minerals' role in the clean energy transition and creating a zero-carbon economy with responsibly sourced minerals. The final section covered U.S. government perspectives on the ISA and seabed mining in general.

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Executive Summary

Ecology and Knowledge Gaps Relevant to Deep Seabed Mining Environmental Impacts

Lisa Levin, Distinguished Professor of Biological Oceanography at the Scripps Institution for Oceanography, University of California, San Diego, spoke about deep ocean ecosystems and the services they provide. She also spoke about the known impacts of deep seabed mining and relevant gaps in knowledge that will require further study.

She began with a history of deep-sea exploration, demonstrating how significantly our understanding of deep ocean ecology has improved in recent decades. She then described the unique forms of life that have evolved at the bottom of the ocean, able to survive severe heat, pressure, and other extreme conditions. Some of these organisms can provide valuable ecosystem services, including aiding in the development of pharmaceuticals and providing the basis for food chains.

Levin explained the several types of ecosystem disturbances that would be caused by deep seabed mining, impacts to the seabed and water column which may last for centuries. She also described the gaps in current scientific knowledge that could prevent the mitigation of environmental harm from mining activities.

The International Seabed Authority and Current Issues in the Governance of Seabed Mining

Pradeep Singh, Research Associate at the Institute for Advanced Sustainability Studies, spoke about the history and role of the International Seabed Authority (ISA). He presented updates on its activities, potential paths forward for the seabed mining regime, and the legal obligation to ensure that mining activities are carried out with minimal environmental impact and for the benefit of humankind.

He described the history of the UN Convention on the Law of the Sea (UNCLOS), which established the ISA to govern seabed mining in international waters. He also reviewed the articles of UNCLOS relevant to the governance of seabed mining, as well as the structure and responsibilities of the ISA. These responsibilities include the development of mining regulations, an ongoing process.

In 2021, the country of Nauru invoked an ISA rule that allows it to apply for a mining contract in two years' time. This action has disrupted ISA's timeline for drafting its exploitation regulations, especially in the context of the pandemic.

Singh gave updates from the December 2021 meeting of the ISA Council, during which the Authority's agenda was set for 2022. He ended his presentation with a section about the environmental responsibilities of the ISA and its legal duty to act on behalf on humankind.

Minerals Demand and the Renewable Energy Transition

Payal Sampat, Mining Program Director at Earthworks, examined various factors that will determine the mineral needs of the energy transition, and she proposed a path forward for securing those minerals in a socially and ecologically responsible way. She also emphasized that the transition to a clean energy economy presents unique opportunities for modifying and improving longstanding mining practices. Terrestrial mining has a poor environmental and human rights record. At the same time, an expansion of mineral mining is necessary to provide minerals for clean energy technologies, especially electric vehicle batteries. These two realities have led to increased calls for seabed mining as an alternative to harmful terrestrial mining. However, Sampat argued that this is a false choice. She proposed an alternative framework for minimizing the harm done by the mining industry during the energy transition. Components of this framework include demand-side shifts in consumption and prioritizing different modes of transportation; working toward a circular economy for minerals; and ensuring responsible sourcing of new minerals.

U.S. State Department's Current Perspectives and Activities on Deep Seabed Mineral Mining

Gregory O'Brien, Foreign Affairs Officer in the U.S. Department of State's Office of Ocean and Polar Affairs, explained the department's current perspectives on seabed minerals and the ISA. In recent

years, U.S. government agencies have been working to evaluate critical mineral needs and ensure the security of supply chains. The U.S. views seabed minerals as a possible mid- to long-term option, not an immediate source of new minerals. While the U.S. is not a member of the ISA, it still has an interest in the development of a stable and internationally recognized seabed mining regime that provides for the effective protection of the marine environment. That regime has not been defined at present. This position was reiterated at the December 2021 ISA Council meeting.

Observations and Recommendations

The conference yielded many constructive observations and recommendations that can be found throughout this report. A brief list of leading observations follows:

The UN Convention on the Law of the Sea provides a framework for coordinating the use of international waters and managing seabed mining. It is in the U.S.'s best interest to ratify UNCLOS ito fully participate in negotiations and rulemaking at the International Seabed Authority.

Article 145 of the UN Convention on the Law of the Sea requires "The protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment." Further scientific research is necessary to determine whether seabed mining is compatible with these requirements. UNCLOS allows mining to commence under certain conditions; it does not require mining to commence at all costs.

Seabed mining is a new frontier being explored in the context of the energy transition. Other frontiers should be explored to contribute to a clean energy economy: incentivizing shifts in consumption and transportation, building a circular economy, and holding the mining industry to a high standard. There are multiple paths to the goal of a carbon-free economy, and false choices should be avoided.

Minerals are not the only source of economic value in the deep ocean. Ocean biodiversity provides ecosystem services, including supporting essential fisheries and the development of new pharmaceuticals and other uses. These services are economically important, and the commencement of mining could be at odds with their preservation.

The UN Decade of Ocean Science for Sustainable Development provides key opportunities to close knowledge gaps related to seabed mining impacts.

A dedicated environmental and scientific subsidiary body should be added to the International Seabed Authority. This body would work alongside the Legal and Technical Commission to define "harm to the marine environment," as well as to rectify ambiguities in environmental processes and develop criteria for assessing exploitation applications. This would help solve the current dearth of environmental and scientific expertise at the ISA.

The Initiative for Responsible Mining Assurance (IRMA) has articulated a detailed set of standards and oversight systems to help make terrestrial mining more ecologically and socially responsible. This "Standard for Responsible Mining" is already operational and should be adopted more widely.

Mineral mining in the U.S. is governed by the U.S. General Mining Law of 1872, a piece of legislation that is almost 150 years old. Mining companies in the U.S. and abroad are frequently exempt from environmental laws. The Clean Water Act is an example in the U.S. Around the world, mining regulations should be modernized to create legally binding regulations for the protection of human rights and the environment at the regional, state, national, and international level.

The technology that will be widely used in the energy transition is evolving and has not yet been fully defined. There is considerable uncertainty about the quantity of minerals that will be necessary to transition to a clean energy economy, so it cannot yet be concluded that seabed minerals are needed.

Deep seabed ecosystems must not be sacrificed for seabed mining. Sustaining the biodiversity of the deep ocean is more important than meeting deadlines for the commencement of mining.

Ecology and Knowledge Gaps Relevant to Deep Seabed Mining Environmental Impacts

Introduction

The deep ocean has historically been one of the least well-understood environments on earth. While knowledge of the ecosystems on the seabed has improved drastically in recent decades, there are still gaps in scientific understanding and new discoveries are still being made. The prospect of seabed mining is more immediate than ever before, and improved scientific knowledge is necessary to make well-informed decisions about its commencement. **Lisa Levin**, Distinguished Professor of Biological Oceanography at the Scripps Institution for Oceanography, University of California, San Diego, spoke about deep ocean ecosystems and the services they provide. She explained the known impacts of deep seabed mining, as well as relevant gaps in knowledge that will require further study.

Background and History of Deep-Sea Exploration and Research

Levin began her presentation by explaining the history of deep ocean discovery and exploration, as well as our current understanding of deep-sea ecology and ecosystems' potential vulnerability to seabed mining.

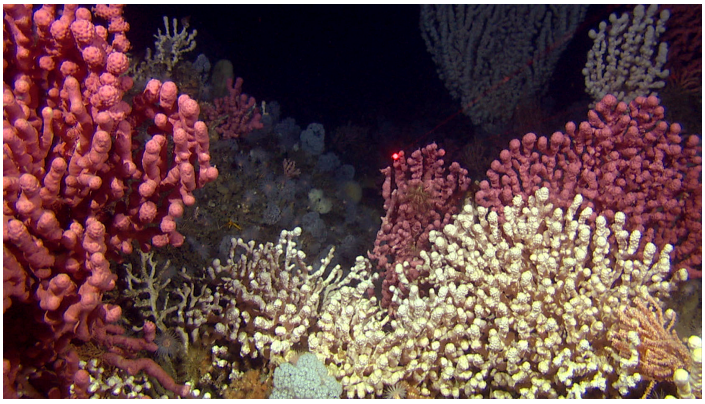
The "deep sea" refers to areas of the ocean greater than 200 meters in depth, but much of the ocean is drastically deeper. The average depth of the ocean is 3,800 meters, and the deepest part of the ocean is almost 11,000 meters. The deep sea makes up the majority of the ocean's area and about 95% of its habitable volume. Additionally, 60% of the deep sea is located in international waters.

For most of human history, the deep ocean was a space of legends, mythology, and mystery; it was not until the 1800s that expeditions set out to explore it. For about the first 100 years of deep ocean exploration, the picture that emerged was that of a homogeneous, muddy sea floor that was cold, dark, salty, and high-pressure. Scientists thought that this was a stable environment that was quiet and food-limited, like a desert.

However, since the early 1900s, understanding of the deep seabed and its ecosystems has improved considerably. A host of new exploration tools has revealed a wealth of environmental heterogeneity, and scientists' original understanding of the deep sea as a desolate, lifeless landscape has been dispelled. It is now understood that there is life in every corner of the ocean. Modern research tools include sonar that has allowed scientists to map the sea floor in tremendous detail, down to centimeters in resolution. Acoustic tools have revealed the fluxes of gases escaping from the sea floor and daily vertical migrations of plankton. Submarines and remotely operated vehicles have allowed up-close exploration of the deep seafloor and water column and the collection of samples. Autonomous vehicles have been able to take pictures and video and conduct chemical sensing. This wide host of tools has drastically improved scientific understanding of the deep ocean.

The picture that has emerged has been one of a deep sea that is highly heterogeneous, both in the water column and on the sea floor. This heterogeneity of habitat generates high levels of biodiversity. For example, beneath upwelling areas, some oxygen minima zones are covered with bacterial mats. The sea floor has tens of thousands of sea mounts, which are underwater volcanoes that provide a lush home for many fish and invertebrates. Canyons and fjords host a wealth of biodiversity, including sponges and corals, which can go on for many kilometers and support countless other species. In the 1970s scientists discovered hydrothermal vents, and with them entire ecosystems that rely on chemical energy rather than photosynthesis. Shortly after, similar organisms were discovered that rely on methane seeps. Mesopelagic regions of the deep-water column host the largest

migrations on earth – billions of small fish and invertebrates migrating up and down every day. The deep pelagic also hosts many different animals that scientists are just beginning to discover.



Cold water coral

These numerous different habitats in the deep sea generate biodiversity, but they also host resources that are of interest to people. For example, the bacteria in oxygen minimum zones produce phosphorites, and deep-sea habitats including sea mounts, methane seeps, and cold-water coral and sponge reefs support commercial fisheries. The polymetallic nodules on the abyssal plains of the seafloor contain copper, zinc, cobalt, and nickel. The precipitates that form at hydrothermal vents form sulfides that are rich in copper, zinc, lead, silver, gold, and other minerals. The ferromanganese crusts that form on sea mounts between depths of 500 and 2500 meters are also rich in metals. These mineral resources all have economic value and are of interest for potential seabed mining operations.

Adaptation to Extremes Yields Superpowers

These different ecosystems, in addition to hosting resources, host animals that have developed what Levin calls "superpowers." Organisms in the deep sea, due to the extreme conditions in which they live, have adapted unique, enzymes, proteins, and tolerances which may someday be of use to humans for industrial processes and biomedical cures. These superpowers include characteristics like being able to tolerate incredibly high temperatures, hydrogen sulfide levels and pressure (up to 800 atmospheres) that would be deadly to humans. Some organisms can even live at very low oxygen and pH levels.

Another superpower of deep ocean organisms is extreme longevity. Some fish can live in the deep sea for over 100 years. A few, like the Greenland Shark and tubeworms, can live hundreds of years. Some deep-sea corals can even survive for thousands of years, and some deep-sea sponges are believed to be over 17,000 years old. The great longevity of these organisms is accompanied by slow maturity and slow growth rates, which makes it difficult for these species to respond to or recover from disturbances.

In about the last 40 years, organisms have also been discovered that are capable of novel feeding modes. Some feed off chemicals instead of conducting photosynthesis. Some have symbiotic bacteria which can oxidize sulfide, methane, or hydrogen to provide food for their hosts, which can include tubeworms, mussels, clams, and crabs. New organisms that have these symbiotic relationships are still being discovered. Other symbionts can serve functions like the digestion of wood and whale bones.

Biodiversity as a Service

The genetic diversity in the deep sea provides the genetic potential for the ocean to adapt to change, but it also has attributes that can be very useful to humans. For example, some enzymes found in the deep sea can break down lipids and have been used to develop cold-water detergents. Others can be useful for UV resistance. Metabolites and drugs produced from sponges and other deep-sea invertebrates can have antibiotic, anti-cancer, and anti-inflammatory properties. One has even been identified that is very similar to a drug for Alzheimer's.

Novel biomaterials from the deep sea can also have utility – some sponges have fiber optic characteristics, deep sea coral can provide templates for bone grafts, and the scaly-foot snail is being investigated as a potential basis for new armor for cars, aircraft, and other equipment. Other organisms have anti-fouling properties and detoxification properties. Some microbes even have been found to naturally scrub CO2 out of carbon dioxide

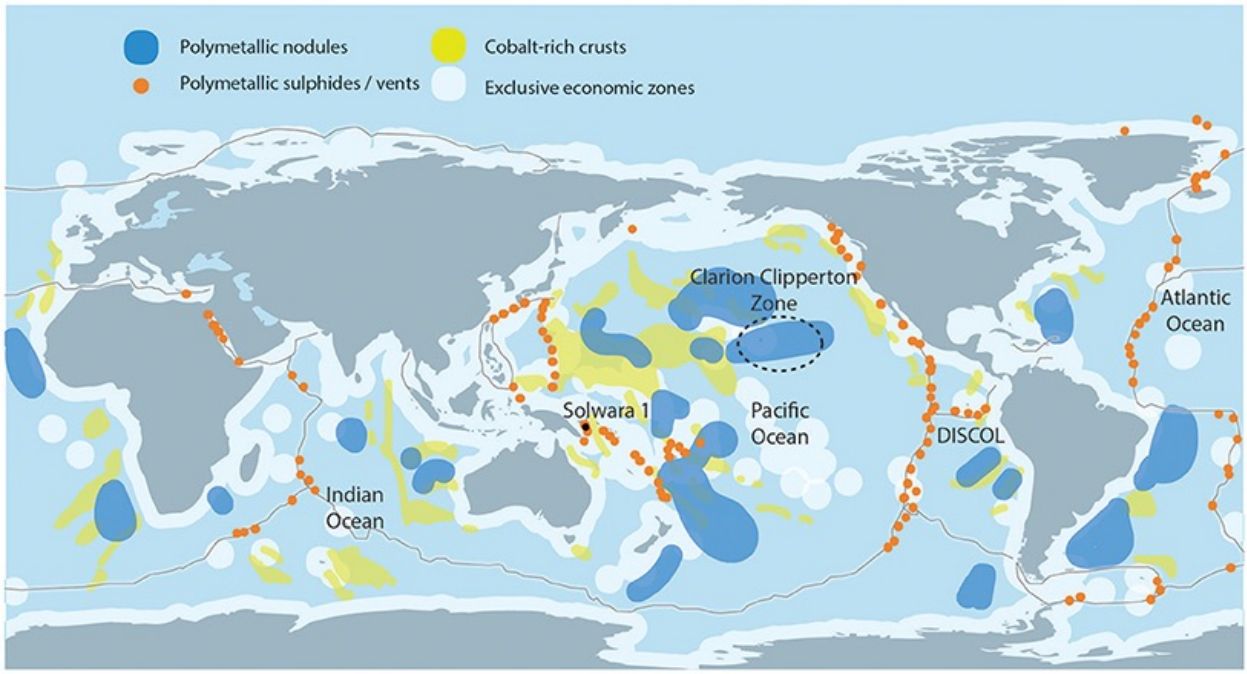
vents. These are being investigated for terrestrial applications to help address climate change. This is just a sample of the potential uses for the deep ocean's biodiversity.

Scientific understanding of deep ocean ecosystems is still improving, and the ecosystem services that can come from biodiversity are still being revealed. There are many supporting services involving the provision of substrate, different kinds of refugia, and food chain support to animals, some of which are harvested commercially. One regulating service provided in the deep sea is remineralization, or turning organic matter back into nutrients which make their way to the surface and fuel the phytoplankton growth and primary productivity that fisheries rely on. Deep sea organisms also conduct carbon transport and storage, followed by carbon burial when that material reaches the deep seabed. The deep sea also provides a host of cultural services, including scientific study and inspiration for literature, art, and film. Aspects of the traditional knowledge and cultural heritage of indigenous peoples also often rest with the deep sea.

The deep sea is heterogeneous and high in biodiversity, filled with animals with different lifestyles, feeding modes, and life histories that determine their vulnerability to disruption, especially when they are long-lived, grow slowly, and mature late. Endemicity is common, by habitat and location – every species is not located everywhere. Rarity is also common – many of the species that have been recovered from the deep sea, especially small ones, have only been observed once or twice. Additionally, the sea floor and water columns are highly connected through the migrations of animals, the sinking of particulate matter, and the physics of the ocean. The biodiversity in the deep ocean also underpins many ecosystem services that can be of use to humanity.

Deep Sea Biodiversity and Deep Seabed Mining

Levin focused the rest of her presentation on the specific ecosystems which would be impacted by deep seabed mineral mining in international waters. Three main ecosystems are being targeted for prospective mining activities: polymetallic nodules, polymetallic sulfides, and cobalt-rich crusts. Each of these is located largely in international waters, and each hosts different biodiversity, growth rates and lifespans of organisms, as well as potentially different ecosystem services. They are all still being explored – most sea mounts, nodule areas, and hydrothermal vents have yet to be studied. There is a vast array of organisms associated with these different ecosystems.



Map of mineral resources on the seabed; Miller et al. 2018

The area of the deep ocean of greatest interest for mining is the Clarion Clipperton Zone (CCZ) in the middle of the Pacific. The International Seabed Authority (ISA), the UN body tasked with administering seabed mining in international waters, has issued several exploration contracts in this area. This massive area (it is thousands of kilometers across) has become one of the best-studied areas of the sea floor because of these contracts. Scientists have found over 600 megafaunal invertebrates in this region. However, most of the organisms in the CCZ are tiny and almost invisible to the naked eye.

Small animals found in the Clarion Clipperton Zone

Mining Comes with Environmental Impacts over Large Areas for Long Periods

Mining activities have significant environmental impacts. They can involve removing the sea floor or nodules from the sea floor, causing sediment plumes into the water column in areas that are normally calm and devoid of suspended sediment. They can also involve replacing waste water back to the sea floor or somewhere in the water column.

The exploration contracts for polymetallic nodules cover a massive swath of the ocean in the CCZ – 75,000 km2. Should exploitation activities begin, they would need to last about 20-30 years in each contract area to make mining profitable and to fully exploit the mineral resources found there. Over the course of these decades, the area of disturbance on the sea floor would be very large. In just one year, these seabed mining operations would mine more than twice the area of the largest coal mine in Germany.

Seabed mining activity would cause several types of disturbances, including physical disruption and animal removal from the sea floor; suspended sediment plumes; the alteration of geochemistry and substrates on the sea floor; contaminant and metal releases from sediments; loss of animal structures; and potentially changes in the food web. Many of these changes would occur not only on the seabed, but in the water column as well.

Article 145 of the UN Convention on the Law of the Sea (UNCLOS) calls for the effective protection of the marine environment from harmful effects. Before the commencement of mining, it is important to understand the harmful effects of deep seabed mineral mining. Levin went into detail on impacts as they are currently understood and characteristics of seabed ecosystems that make them especially vulnerable to disturbance:

Altered substrate: Mining the sea floor will involve the removal of substrate and loss of vertical topography. It will also cause changes in the heterogeneity and texture of the substrate. These impacts may cause the loss of genetic, species, functional, and habitat diversity in deep sea ecosystems. In the CCZ, more than half of animals are associated only with the nodules themselves, so these impacts would be difficult to avoid.

Loss of biogenic habitat: Structure-forming animals on the sea floor provide habitat for other kinds of animals that live in and on them. Often these animals are very complex and fragile and grow slowly, so their recovery from damage caused by seabed mining would take a long time.

Alteration of geochemical underpinnings: The bacteria that can live in any of these ecosystems is determined by the geochemistry of the environment. Bacteria are the base of the food web for deep sea animals. In chemosynthetic systems, they fix carbon using hydrogen sulfide, methane, hydrogen, iron, or manganese. Microbial diversity is important because it supports animals through the use of symbionts and free-living bacteria, which many deep-sea animals consume. This microbial diversity cannot be maintained without stable, intact geochemistry.

Plume Interference: Seabed mining can cause turbidity, or suspended sediments that can affect animals in the water column and on the sea floor. This can impact vision and expose animals to metal contaminants, which can bioaccumulate and impact development.

Great longevity, slow growth, late maturity: These characteristics are all very common in deep ocean organisms, and they can all reduce resilience and the ability to recover from disturbance. Environmental damage from deep seabed mining may persist for centuries or indefinitely due to these slow growth rates.

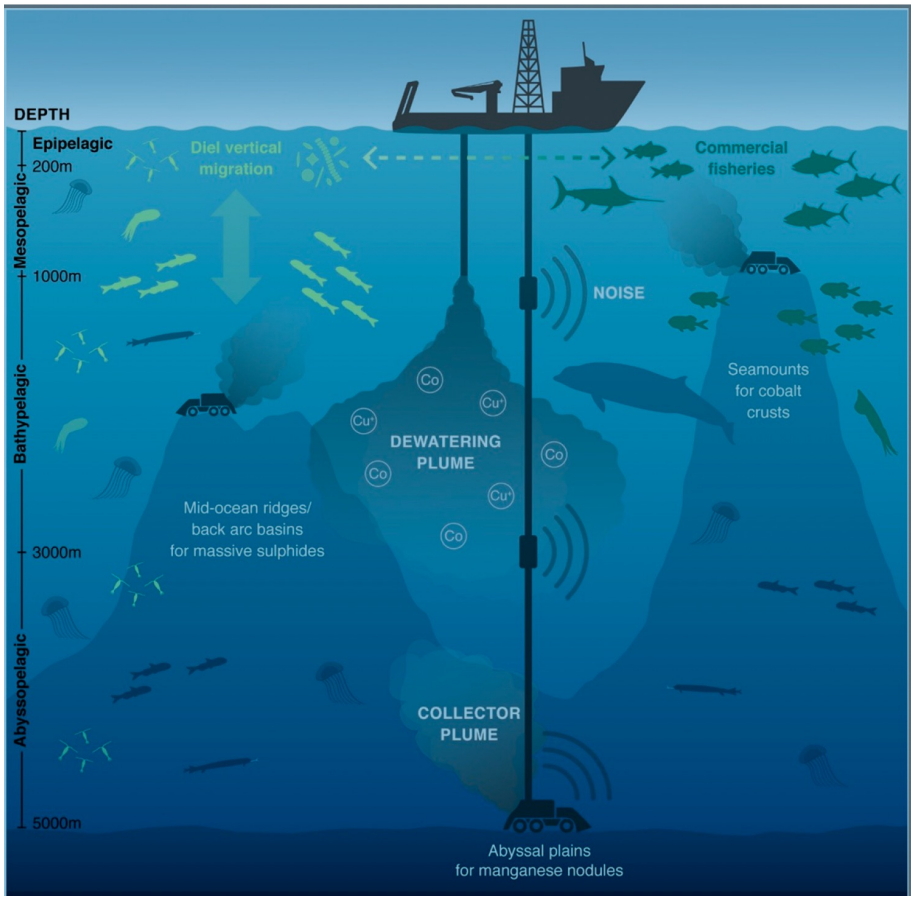
Limited Spatial Extent: Some animals have limited spatial extent and their habitats, like seamounts or vents, are patchy and isolated. This yields high endemism. Mining may cause breaks or changes in patterns of population connectivity and can even cause risk of local extinctions. Cumulative impacts with multiple mining contract areas can play a role in this, as well as cumulative impacts from other disturbances like climate change and fisheries.

Bentho-pelagic coupling and pelagic impacts: Disturbances on the sea floor can have impacts upward in the water column. Sound, light, and plume effects can affect animals' migrations. There are numerous potential impacts extending vertically into the ocean, many of which have yet to be studied in great detail.

In the 1980s tests were initiated on sites in the CCZ, to be revisited 2-3 decades later to determine the rate at which ecosystems would recover from seabed mining. After this period, it was found that scars on the seabed were still sharp – there was no erosion or deposition. Some smaller animals had recovered in the test zones, but not all of them, and microbes still had not recovered their full function. This tells us that in these abyssal polymetallic nodule zones, recovery from mining disturbance may take centuries.

Climate change projections for the deep ocean are also relevant for the assessment of mining risks. Climate impacts will be heterogeneous in areas of the sea floor targeted for mining. Some areas will experience dramatic climate change during the time period when extraction would take place. In fact, some areas have already experienced climate change that exceeds natural variability and historical conditions. Other areas will not see such drastic climate change.

The crusts and nodules being targeted for seabed mining grow very slowly, over the course of millions of years. If removed, they would not be replaced naturally. This reality has inspired proposals to place artificial substrates on the seabed after mining has taken place – for example, artificial nodules. This may make it possible to mitigate some effects of seabed mining and accelerate the restoration of the environment. There are currently



Mining-generated sediment plumes and noise have a variety of possible effects on pelagic taxa. Drazen et al. 2020, PNAS. Amanda Dillon (graphic artist).

experiments underway to study this possibility, but it may be decades before their results are known and scientists understand whether the introduction of artificial substrates could accelerate ecosystem recovery.

Gaps in Knowledge

Levin closed her presentation with an explanation of the gaps in current knowledge that will need further study to effectively manage the impacts of seabed mining. First, understanding of the species that will be impacted by mining needs to improve. This includes studying how long they live, as well as when, how often, and how much they reproduce. It also involves studying the food web – what do certain species eat, and what eats them?

Another gap in knowledge is the natural temporal variability in seabed ecosystems, including seasonality, interannual variability, and interdecadal variability. Knowledge of appropriate indicators of ecosystem health is also important, such as the tolerances or threshold values of certain animals to impacts like suspended plume sediments, metal concentrations, and other environmental changes. Connections among different populations of organisms also require further study.

Gathering more information about the impacts of mining will allow scientists and decisionmakers to properly assess:

- The spatial extent and duration of environmental impacts;
- The risk of species loss and extinction;
- The potential for recovery and how long it might take;
- The effectiveness of remediation or restoration methods;
- Impacts on adjacent ecosystems and fisheries, including those in exclusive economic zones;
- How ecosystem services (and therefore humans) will be affected;
- And the cumulative impacts associated with multiple mining operations, climate change, and other ocean disturbances.

Conclusion

Further study of the deep ocean is needed to operationalize the precautionary principle and ecosystem-based management. There are opportunities for science to contribute answers to questions about the impacts of seabed mining, but that will not happen immediately. The UN Decade of Ocean Science for Sustainable Development and the scientific networks associated with it offer a great opportunity to carry out this kind of science. Levin concluded by recommending that we take advantage of these exploration and observation programs to seek out answers about the impacts of seabed mining.

To view the PowerPoint associated with this presentation, click **here**.

About the presenter: Lisa A. Levin is a Distinguished Professor of Biological Oceanography at the Scripps Institution of Oceanography, University of California, San Diego. She is co-founder and co-lead of the Deep-Ocean Stewardship Initiative, which seeks to integrate science, technology, policy, law and economics to advise on ecosystem-based management of resource use in the deep ocean and strategies to maintain the integrity of deep-ocean ecosystems within and beyond national jurisdictions. She also helped establish and co-leads the Deep Ocean Observing Strategy, a program within the GOOS. She is active in bringing science to deep-sea policy and contributes to global assessments (IPCC, WOA, IPBES). Dr. Levin served for six years as Director of the Center for Marine Biodiversity and Conservation at Scripps. Her current research interests include biodiversity of continental margin ecosystems, the effects of climate change (especially ocean deoxygenation) and human impacts on the deep ocean, with work in the Pacific, Indian and Atlantic Oceans. She is a Fellow of the American Geophysical

Union and the Association of AAAS and has given the Anton Brun (IOC), Sverdrup (AGU) and Revelle (National Academy) medal lectures. She was awarded the ASLO Redfield Lifetime Achievement Award in 2018 and the Prince Albert I Grand Medal in Ocean Science in 2019.

The International Seabed Authority and Current Issues in the Governance of Seabed Mining

Introduction

The International Seabed Authority (ISA) is the intergovernmental body tasked with regulating and organizing all mining activity in international waters. **Pradeep Singh**, Research Associate at the Institute for Advanced Sustainability Studies, spoke about the history and role of the ISA, as well as recent updates on its activities. He also spoke about potential paths forward for the seabed mining regime and the ISA's obligation to protect the marine environment and ensure that mining activities are carried out for the benefit of humankind.

Early Commercial Interest in Seabed Minerals

The first discovery of deep seabed minerals was in the 1860s, when polymetallic nodules were identified in the deep ocean. However, there was no commercial interest in this resource for over a century. Mining of the deep sea began to receive serious consideration in 1965 due to a book authored by John L. Mero, in which he claimed that there was an abundance of polymetallic nodules on the deep seabed and that they had very high commercial value. Almost immediately, this new interest in conducting mining activities in international waters made small and developing states nervous. At that point in time, only developed countries had the technology and financial strength to access seabed minerals. Developing states feared a "might is right" scenario, as Singh put it, in which only wealthy countries would be able to access and exploit these resources in the ocean.

In 1967, Arvid Pardo, a Maltese ambassador to the UN, gave a speech to the UN General Assembly (UNGA) First Committee. He implored UN member states to declare resources beyond national jurisdiction to be resources of "common interest." His speech was followed by a string of UNGA resolutions between 1967 and 1970, which ultimately declared mineral resources in areas beyond national jurisdiction to be the "common heritage of mankind." Their exploitation was to be administered by an international organization. Soon after, another resolution was agreed upon to convene the third UN Convention on the Law of the Sea, which took place between 1973 and 1982.

1982 UN Convention on the Law of the Sea

After almost a decade of intense negotiations, the UN Convention on the Law of the Sea (UNCLOS) was adopted in 1982. It is a comprehensive agreement with several sections dedicated to different topics. The section with greatest importance to deep seabed mineral mining is Part XI: The Area, although other sections are also relevant to the issue, including Part VII: High Seas and Part XII: Protection and Preservation of the Marine Environment.

Part XI of UNCLOS outlined the regulatory framework for deep seabed mining in the "Area" (referring to the international seabed beyond areas of national jurisdiction). It also created the International Seabed Authority, an international organization that exists to organize, regulate, and control the exploitation of minerals in the Area.

Even though UNCLOS was adopted in 1982, it did not immediately enter into force due to a lack of support at the time. Many developed nations chose not to ratify the convention due to disagreement over Part XI. UNCLOS was developed as a "package deal" – states had to ratify either the whole thing or none of it. Disagreements over Part XI prevented the entire agreement from entering into force.

In fact, in the mid-1980s, developed states created their own regime for deep seabed mining in the Area. They drafted reciprocal agreements in which countries had rights to certain areas beyond national jurisdiction. This resulted in a tense situation with developing states, most of which supported UNCLOS and hoped for the ISA to be the body that would ultimately regulate the international seabed. The UN Secretary General convened further negotiations in

1990 with the goal of bringing all interests together under the ISA. This resulted in a new agreement in 1994, changing the implementation of Part XI of UNCLOS. The new agreement included some considerable concessions from developed states, such as agreeing to provide financial assistance and technology to developing countries. They also made some concessions in the decision-making processes at the ISA. With these compromises, UNCLOS received overwhelming support.

The map in Figure 1 shows the extent of The Area in white. In blue is the Exclusive Economic Zones (EEZ) of coastal states, which extend up to 200 miles from the coast. In certain situations, countries can lay claim to the continental shelves that adjoin to their EEZ. These areas are shown in red on the map. While these areas of the ocean are technically still part of the High Seas, their seabed and subsoil fall under national jurisdiction. This means that they are not part of the Area and their mineral resources are not subject to regulation by the ISA.

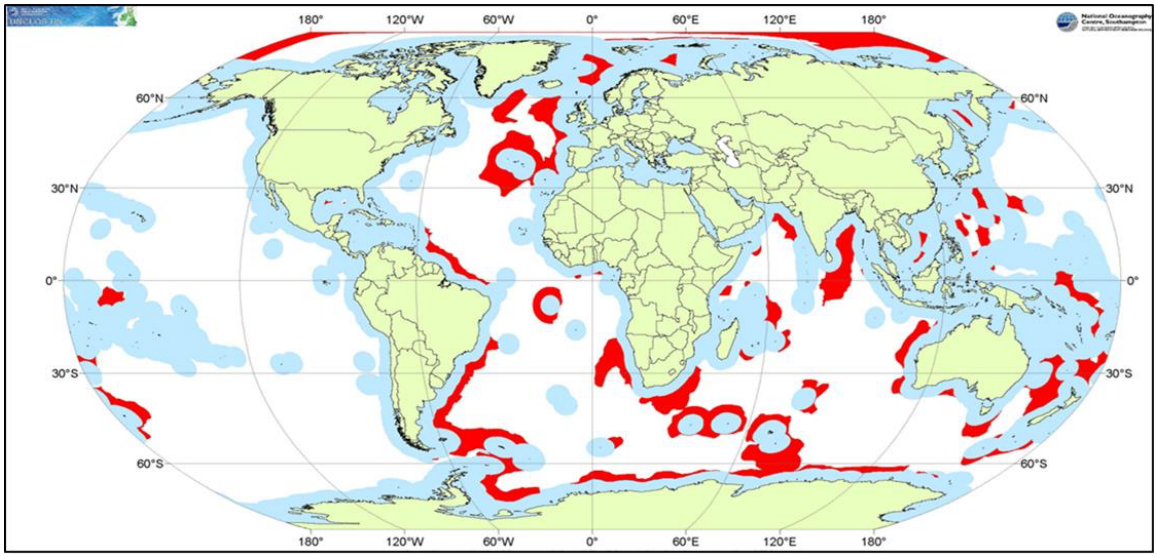


Figure 1: The Area

Salient Principles in UNCLOS Governing the Area

Singh included a list of UNCLOS articles which are relevant to the governance of the Area:

- **Art. 136:** The Area and its mineral resources are the common heritage of mankind.
- **Art. 137:** No claims or exercise of sovereignty or sovereign rights over the Area or its mineral resources. All rights in the mineral resources are vested in humanity as a whole, on whose behalf the ISA shall act in accordance with Part XI and the applicable RRPs adopted by the ISA.
- **Art. 138:** The conduct of States in relation to the Area shall be in accordance with Part XI.
- **Art. 139:** States can be held responsible under international law for any damage caused by the failure to carry out its responsibilities under Part XI.
- **Art. 140:** Activities in the Area shall be carried out for the benefit of mankind as a whole. Financial and other economic benefits derived from such activities shall be distributed equitably through an appropriate mechanism designed by the ISA.
- **Art. 141:** The Area shall be used exclusively for peaceful purposes.
- **Art. 143:** The conduct of marine scientific research in the Area shall be promoted.

- **Art. 145:** Necessary measures shall be taken to ensure the effective protection of the marine environment from the harmful effects of activities in the Area.
- **Art. 147:** Activities in the Area shall be carried out with reasonable regard for other activities in the marine environment and vice versa.
- **Art. 148:** The effective participation of developing States in activities in the Area shall be promoted.

The International Seabed Authority

The ISA is an autonomous international organization based in Kingston, Jamaica. It is run by its member states, which includes all parties to UNCLOS – 167 states and the EU. The ISA has a mandate over the mineral resources of the Area, the rights of which are "vested in mankind," with the ISA acting "on behalf of mankind as a whole." Its responsibilities include:

- Development of regulations for mineral exploration and exploitation;
- Considering and awarding mining contracts;
- Collecting payments from contractors;
- Facilitating equitable sharing of financial and other economic benefits derived from mining in the Area;
- Compensating developing countries that engage in terrestrial mining for adverse economic impacts;
- Ensuring the effective protection of the marine environment from the harmful effects of mining;
- Exercising control over contractors; and
- Promoting marine scientific research.

Institutional Structure of the ISA

The primary organs of the ISA are the Assembly, Council, and Secretariat. Its subsidiary organs are the Finance Committee and the Legal and Technical Commission. Two other organs were established under UNCLOS but

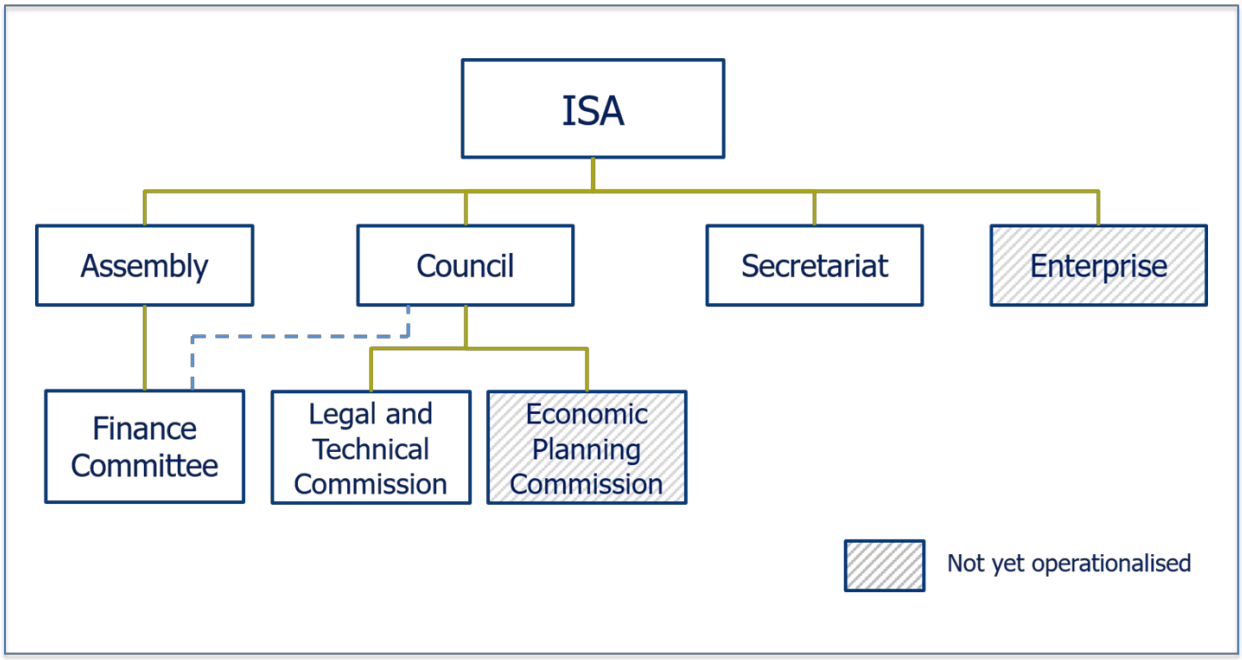


Figure 2: Institutional Structure of the ISA

have not yet been operationalized: the Enterprise and the Economic Planning Commission. The Enterprise was envisioned as a sort of mining arm of the ISA. Essentially, it was to be a contractor in its own right, carrying out mining activities on behalf of humankind. One of the compromises that allowed the 1994 agreement to pass involved postponing the operationalization of the Enterprise until a later date. However, in recent years, many states in the African group and American and Caribbean group have advocated for operationalization to happen soon.

The Economic and Planning Commission was planned under UNCLOS as a subsidiary expert body intended to carry out reviews of trends in the supply and prices of minerals. The 1994 agreement also postponed the operationalization of this commission until a later date; for the time being, the Legal and Technical Commission is carrying out its functions.

The Assembly is the supreme organ of the ISA, and includes representation from all 127 states party to UNCLOS and the EU. It approves mining regulations and adopts general policies for the ISA based on the recommendations of the Council.

The Council is the executive organ, and only consists of 36 states. These states are elected by the Assembly for terms of 4 years. The Council also acts as the decision-making organ, responsible for adopting and provisionally applying regulations and ISA-specific policies. It also considers and approves mining applications.

The Secretariat, led by the Secretary-General along with personnel and staff, is the administrative organ of the ISA. It is the permanent organ responsible for the day-to-day running of the organization. It is always operational, while the other organs only meet once or twice every year.

The Legal and Technical Commission (LTC) is a subsidiary organ, the members of which are nominated by state parties and elected by the Council to 5-year terms. For the current term, which lasts until the end of 2022, the LTC is comprised of 30 members. The LTC has significant environmental responsibilities, including:

- Formulating drafts of ISA rules, regulations, and procedures, particularly those related to exploration and exploitation;
- Reviewing applications for plans of work for activities in the Area (applications for mining exploration and exploitation) and submitting recommendations to the Council on whether or not to approve them;
- Preparing assessments of the environmental implications of activities in the Area; and
- Making recommendations to the Council relating to emergency orders and disapproval of exploitation areas.

Currently, the LTC is the subject of several major issues and concerns. The expertise of the commission is in question; at the moment, only a small minority of the 30 members have environmental or ecological expertise. The rest are geologists or lawyers. Moreover, some members of the commission are actively working for exploration contractors, presenting a potential conflict of interest. Transparency also remains an issue, since most LTC meetings take place behind closed doors. The extent to which the secretariat and external actors influence the commission is unclear. While the LTC produces a lot of recommendations, most of them do not contain much background information on how those recommendations are developed. The information and documents considered by the LTC are confidential and many of their recommendations are not long or comprehensive. Finally, the workload of the commission is very heavy compared to its capacity. Despite its considerable responsibilities, it works on a voluntary basis and only meets for a few weeks each year.

Current State-of-Affairs at the ISA

Several entities can apply for an exploration contract from the ISA, including any member state of UNCLOS and the Enterprise, once it is operationalized. State-owned enterprises or other private persons/mining companies may also submit an application to the ISA, but only with the sponsorship of an eligible member state. States can sponsor their own nationals or foreign nationals that are “effectively controlled” by them or their nationals

(UNCLOS Art. 139, 153, and Annex III, Art. 4(3)). Singh added in the Q&A session that countries can face repercussions for any guideline violations committed by contractors they have sponsored.

The ISA has been operational since 1994, and exploration of potential mining areas has been happening since 2000. Polymetallic nodule exploration guidelines were adopted in 2000 and revised in 2013; for sulfides, they were adopted in 2010; and for crusts, in 2012. A total of 31 exploration contracts have been awarded: 19 for nodules, 7 for sulfides, and 5 for crusts. No exploitation activities are occurring as of yet.

Exploitation is not yet happening because the draft exploitation regulations are still being developed. The LTC commenced work on these regulations in 2014. After going through several iterations, an advanced draft was presented to the Council for consideration. Text negotiations on this draft commenced at the Council in July 2019 and resumed in February 2020. Not much progress was made in those two meetings, and in the February 2020 meeting the Council decided to establish three informal working groups covering three different topics: the protection and preservation of the marine environment; inspection, compliance, and enforcement; and institutional matters. These three informal working groups were established in addition to an existing working group, which works on the financial terms of exploitation contracts. In the Q&A session, Singh noted that these working groups are designed to be open and inclusive to the participation of external stakeholders.

A set of standards and guidelines (S&Gs) are necessary to give effect to exploitation regulations. The development of these S&Gs has been ongoing in three phases. Phase 1 will be necessary prior to the adoption of the draft exploitation regulations; phase 2 will be necessary prior to the receipt of an application for a plan of work for exploitation; and phase 3 will be necessary before commercial mining activities can commence in the Area.

The Two-Year Rule

In June of 2021, Nauru, a small island state in the Pacific, invoked Section 1(15) of the 1994 agreement. This section is often referred to as the “two-year rule” because it requires the ISA Council to accelerate the development of exploitation regulations so that they can be adopted within two years. This deadline will be July 9, 2023. If the Council fails to finalize exploitation regulations by this date, it would still have to consider and decide upon any pending mining applications despite the absence of regulations.

Exploitation regulations must be adopted by consensus at the Council. Only one formal objection would cause a deadlock. The two-year rule was included in the 1994 agreement to address this situation. Its primary intention was to ensure that a small number of states cannot block progress at the Council. Singh emphasized that this rule was not intended for a situation where the Council has been acting promptly and all states are negotiating the regulations in good faith. The pandemic caused some delay to the process, but all parties to the Council are genuinely participating in negotiations. Their commitment to the process was reiterated at the ISA meetings in December of 2021.

Singh then shared some of his thoughts on the two-year rule and the variables that could alter how it is implemented. He noted that it is not an absolute deadline – Section 1(15)(c) notes that the exploitation regulations do not necessarily need to be complete by the deadline, although the Council will have to consider exploitation applications regardless. It can also be argued that the elaboration of the regulations and their entry into force do not need to be simultaneous. This is important in the context of the S&Gs. It is possible that the regulations will be complete before phases 1 and 2 of the S&Gs have been finalized. In this situation, the adoption of exploitation regulations could be delayed until S&Gs are also ready for adoption.

Additionally, the two-year deadline is inconsequential if no exploitation application is submitted. According to Singh, it may be a more pragmatic approach for the Council to enter into discussions to ensure that no application will be submitted until it has had sufficient time to complete the regulations. This would allow the delays caused by the pandemic to be fully accounted for.

Singh also said that if an application is submitted for consideration after the deadline, there is no requirement that the Council actually approve it. The words “consider and approve” are used in Section 1(15)(c); however,

other similarly-worded provisions in UNCLOS imply that the organ in question has the power to decide whether or not to approve the application. It is not definite that any application submitted will be approved. Applications need to have sufficient baseline information and assessments of the environmental implications of mining activities. If the information provided in an application is not satisfactory, then it may not be approved.

If the Council is unable to agree to a full, robust set of exploitation regulations, the two-year rule states that it could adopt a provisional, temporary set of regulations. One option, in these interim regulations, would be to adopt very strict environmental standards to account for remaining uncertainty about environmental impacts.

Singh listed six options for the ISA and Council to approach the invocation of the two-year rule:

- **Option 1:** Proceed to meet the prescribed deadline in 2023
- **Option 2:** Proceed notwithstanding by taking as much time as is needed to complete regulations (while also taking actions to make sure that no application is submitted)
- **Option 3:** Adopt a provisional (temporary) set of regulations for the time being and continue to work on developing a permanent rulebook for exploitation
- **Option 4:** Complete the regulations within the prescribed time but do not adopt them yet, or adopt them with conditions present in relation to their entry into force (such as tying it to the completion of the S&Gs to make sure they are adopted together)
- **Option 5:** Adopt a "precautionary pause" or moratorium on exploitation
- **Option 6:** Consider avenues for judicial recourse

The ISA Council's December 2021 Meeting

The ISA Council most recently met from December 6-10, 2021 in Kingston, Jamaica. At this meeting, the Council proposed a roadmap for meeting the 2023 deadline imposed by the two-year rule. After much debate, they agreed upon a schedule for 2022:

February: Webinar/information session on environmental matters in the exploitation regulations.

March 21 – April 1: First 2022 meeting of the Council. Commence/resume work through the four informal working groups and agree on how intersessional work will take place.

July 19 – 29: Another two weeks of Council meetings. Another agenda will be developed based on the progress that has been made to this point.

October 31 – November 11: A third Council meeting. Another agenda will be developed based on progress, including a schedule for 2023. This meeting will also include discussion of a "what if" scenario: if it has become apparent that the two-year deadline will be missed, this is when the Council will discuss what it can or should do.

The revised roadmap also reaffirms that, while it is necessary that the Council accelerate work on regulations, "nothing is agreed until everything is agreed." The exploitation regulations will be considered as a whole and adopted together.

The ISA's Environmental Responsibilities and Legal Duty to Act on Behalf of Humankind

Singh then shifted his focus specifically to the environmental responsibilities of the ISA. The protection of the marine environment, including the seabed, water column, and coastline, is a cornerstone of the regime governing the Area. UNCLOS and the 1994 agreement make it clear that these responsibilities are very important, and they entrust the ISA to develop this responsibility further. Article 145 of UNCLOS is the core provision for the protection of the marine environment:

Article 145: *Protection of the Marine Environment*

Necessary measures shall be taken in accordance with this Convention with respect to activities in the Area to ensure effective protection of the marine environment from harmful effects which may arise from such activities. To this end the Authority shall adopt appropriate rules, regulations and procedures for inter alia:

(a) The prevention, reduction and control of pollution and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment, particular attention being paid to the need for protection from harmful effects of such activities such as drilling, dredging, excavation, disposal of waste, construction and operation or maintenance of installations, pipelines and other devices related to such activities;

(b) The protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment.

Under UNCLOS, environmental protection is not just an aspiration, but a legal duty. Significant gaps in scientific knowledge about the environmental impacts of seabed mining still exist. Singh echoed a message from Levin's presentation: closing knowledge gaps is necessary to operationalize the precautionary principle.

The ISA still has a lot of work to do to accomplish this goal. Environmental thresholds for seabed mining impacts have not yet been determined, and what constitutes "harm to the marine environment" has yet to be defined. There are still ambiguities on environmental processes, including how much environmental baseline data is adequate; EIA/EIS processes; and the criteria upon which to assess exploitation applications. Some have called for a dedicated environmental and scientific subsidiary body to the Council, instead of delegating those responsibilities to the LTC. This body could work alongside the LTC and allow more external scientific expertise to be included.

Current financial models being used by the ISA are designed to attract investment, not to prioritize environmental protection. A number of delegations have already pointed out that the current models do not adequately take into account environmental considerations such as loss of biodiversity and natural capital. It has also been noted that they do not provide fair compensation to humankind as a whole – a relatively small number of people will profit financially from the mining of the seabed. It is also important to note that geological resource-related data is being treated as proprietary and kept strictly confidential. Despite the mineral resources on the seabed being defined as the common heritage of mankind, data about their abundance and value are not public.

In the Q&A session after his presentation, Singh acknowledged the argument that securing a reliable supply of metals from the sea floor could be wholly beneficial to humankind due to the possibility that they could support the energy transition and ease geopolitical tensions. However, he noted that this argument should not be made without proper consideration of environmental costs.

There are also unanswered questions about equity and fairness, related to benefit-sharing, the Enterprise, and compensation to developing countries that conduct land-based mining, as well as on sponsorship and effective control over and access to reserved areas. In the last 8-10 years there have been an increasing amount of exploration applications from companies that represent themselves as being based in one state which, in reality, are owned by a foreign company. The ISA has paid little attention to this practice. This is important because applicants who are sponsored by developing countries would have access to areas that are reserved specifically for them (called "reserved areas"). These areas hold minerals of significant value.

Calls for a Pause or Moratorium

Many external calls for a pause or moratorium on deep seabed mining have been addressed to the ISA, as well as through internal processes in individual member states. The most recent of these was in Guam, where in late 2021 the domestic legislature called for a moratorium and sent letters to the ISA in support of one. However, no state delegation has explicitly proposed a moratorium at an ISA session to date. A recent ISA report, commissioned by the Secretariat, seems to oppose the implementation of a moratorium:

> "From its inception, ISA has had a central role for civil society engagement in its processes [...]. NGOs have made valuable contributions to the framing of environmental regulations. Nevertheless, some are also simultaneously making a case outside ISA processes for a moratorium on deep-sea mining wherever it may occur. Many ISA Members who reach different conclusions on this issue, however, are currently shying away from engagement in the debate. [T]he failure of ISA's Members to engage with critics may hinder progress [...]."

The invocation of the two-year rule may increase momentum in favor of a moratorium. However, a major shift in the current attitude of most members of the Council would be necessary for one to be put into place.

Options to pursue a moratorium outside of the ISA could also be considered through bodies like the UN General Assembly, States Party to the Convention on the Law of the Sea, the UN Ocean Decade, the Convention on Biological Diversity, and the draft treaty on Marine Biodiversity in Areas Beyond National Jurisdiction (BBNJ). However, the extent of these bodies' influence to actually be able to impose a moratorium is unclear. Moreover, it is important that states not be allowed to take contradictory views on this issue in different fora.

Support for a moratorium has been more pronounced since the two-year rule was invoked. 622 marine science and policy experts from over 44 countries signed a letter with the following recommendation: "we strongly recommend that the transition to the exploitation of mineral resources be paused until sufficient and robust scientific information has been obtained to make informed decisions as to whether deep-sea mining can be authorized without significant damage to the marine environment and, if so, under what conditions."

At the IUCN World Conservation Congress in September of 2021, delegates voted overwhelmingly in support of a motion that calls for "Protection of deep-ocean ecosystems and biodiversity through a moratorium on seabed mining." The motion's conditions for mining to commence include establishing comprehensive knowledge of the risks of seabed mining to ensure that effective protection of the marine environment can be accomplished; implementing the precautionary principle, ecosystem approach, and polluter pays principle; ensuring the sustainable and responsible use and production of metals; and implementing transparent and inclusive ISA processes. 81 governments and government agencies voted in favor of the motion, along with 577 NGOs and civil society organizations.

A moratorium could take a variety of different forms, including a pause, a suspension, or a permanent ban on mining. The nature of any individual call will influence its viability: for example, a permanent ban might require an implementing agreement or an amendment to UNCLOS. For this reason, most calls to date are pertinent only to exploitation and include provisions that would allow mining if certain conditions are met. Under current moratorium proposals, exploration activities would be expected to continue, including the collection of baseline environmental data and closing of knowledge gaps.

Environmental duty and the duty to represent mankind as a whole are essential legal obligations of the ISA. UNCLOS allows mining to happen under certain conditions – it does not require mining to commence at all costs. Ultimately, state parties determine what direction the ISA will take and their decisions will be responsible for its actions over the coming years.

Conclusion

Counter to recent remarks from the Secretary-General of the ISA, a moratorium on seabed mining would not be "anti-international law." UNCLOS is a living instrument and is capable of evolution. Moratoria have precedent in other global regimes, including those governing Antarctic mineral resources, whaling, and ocean fertilization. To conform to international law, the international community (through the ISA) must ensure that preconditions under UNCLOS are met before mineral exploitation commences on the international seabed.

The protection of the marine environment is becoming a greater priority in the international community of late. In 2021, the UN Secretary-General emphasized that the ocean is currently facing unprecedented levels of threat and degradation due to human activities, and that urgent action is required to restore ocean health.

Singh closed with a quote from the ISA Secretary-General in 2018: “Environmental protection is front and center of the Authority’s responsibilities under the Convention. Seabed mineral exploitation cannot be permitted to proceed unless the Authority is satisfied that rigorous environmental safeguards are in place through globally applicable regulations that are binding upon member States.”

To view the PowerPoint associated with this presentation, click **here**.

Further reading cited by Singh in his presentation:

Singh P., “Legal Analysis of the Implications and Consequences of the Invocation of the ‘Two-year Rule’ at the International Seabed Authority” Forthcoming (2022).

Singh, P. “What Are the Next Steps for the International Seabed Authority after the Invocation of the ‘Two-year Rule’?” *International Journal of Marine and Coastal Law* 37 (2021). **Available here**.

Singh, P. “The two-year deadline to complete the ISA’s Mining Code: Key outstanding matters that still need to be resolved.” *Marine Policy* 134 (2021). **Available here.**

About the presenter: Pradeep Singh is a doctoral researcher at the University of Bremen and an independent legal consultant. He holds an LL.M degree from Harvard Law School, an LL.M. degree in Global Environment and Climate Change Law from the University of Edinburgh as a British Chevening scholar, and an LL.B. degree with first-class honours from the University of Malaya in his home country, Malaysia. Pradeep has published extensively on the topics within his expertise, which range from public international law, global environmental law and climate law, the law of the sea and ocean governance. He regularly attends and participates in meetings and events of the International Seabed Authority as an observer delegate for the Institute for Advanced Sustainability Studies. In his capacity as an independent consultant, Pradeep provides legal advice to several delegates and parties to international negotiations on technical matters pertaining to deep seabed mining as well as on the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction. Since November 2021, he is Deputy Chair for the Ocean Law specialist group at the IUCN's World Commission on Environmental Law.

Minerals Demand and the Renewable Energy Transition

Introduction

One of the most common arguments in favor of deep seabed mineral mining is that the copper, nickel, manganese, cobalt, and other minerals found on the deep seabed must be mined to manufacture EV batteries and other technologies for the clean energy transition. **Payal Sampat**, Mining Program Director at Earthworks, examined the various factors that will determine the mineral needs of the energy transition and proposed a path forward for securing those minerals responsibly.

Sampat began by describing the work of Earthworks. In 2019 they launched an initiative called "Making Clean Energy Clean, Just, & Equitable." The initiative aims to ensure that the transition to renewable energy sources is powered by responsibly and equitably sourced minerals that minimizes the need for new extraction and moves the mining industry toward more responsible practices. Their work informed the content of Sampat's presentation.

Opportunity for a Just and Equitable Transition

Sampat established that she and Earthworks as an organization support the transition to a future powered by renewables. She also established that they support a transition that is just and equitable, and that does not harm communities and the environment through increased mining impacts, whether terrestrial or marine.

The central goal of the clean energy transition is to replace the dirty, fossil fuel-based system that is currently in place. It is important that this transition happen in a manner that is cognizant of the mistakes of the previous system and consciously tries to prevent them from happening again. It will not be a simple process, and the urgency of the climate crisis has created pressure for it to happen rapidly. In this pressured environment, it can be easy to frame the energy transition in terms of false choices. In the past, there has been inadequate impetus to effectively mitigate harm to people and ecosystems as a result of the energy system. This impending shift is an opportunity to move toward a low-carbon economy, but also to reduce dependence on irresponsible mining practices. This will require early interventions and political willpower.

Why Mining is a Threat to Communities, Climate and Ecosystems

Terrestrial mining is highly impactful on communities, climate, and ecosystems. These are persistent issues with the industry. According to its proponents, seabed mining affords an opportunity to meet mineral needs without these harmful externalities. Sampat's presentation demonstrated why this is a false choice and demonstrated alternate paths toward a clean energy future that reduce community and ecosystem impacts from mining activities without mining the seabed.

Mining is often associated with human rights abuses, including forced displacement, armed and violent conflict, and pollution that causes environmental health impacts for workers and communities. These impacts have been disproportionately felt by indigenous people – to their rights, their livelihoods, and their lands. The majority of American mining proposals for metals like lithium, cobalt, and nickel are located within 35 miles of Native American reservations. Mines generate massive amounts of waste, impacting the quantity and quality of fresh water. In some instances, tailings disasters have even become deadly.

Mining and processing minerals are also very carbon-intensive activities. According to the UN Environment Program, the industry already accounts for 10% of global carbon emissions. This raises the question of whether it is logical to depend on new expansion of mining activities with the justification that they will assist with addressing the climate crisis.

Report: Responsible Minerals Sourcing for Renewable Energy

In recent years, there has been an uptick in new proposals for terrestrial mining projects in pristine ecosystems like the Bristol Bay watershed in Alaska, coastal regions of Indonesia, and the high Andean desert of Chile, as well as on the deep seabed. Given the potentially significant ecological impacts of these projects, it is worth analyzing to what degree they are necessary. What amount of minerals is actually needed for the renewable energy transition? This question was central to a 2019 report commissioned by Earthworks and produced by the Institute for Sustainable Futures at the University of Technology, Sydney. The report analyzes various scenarios for stabilizing the climate with warming at or below 1.5°C above preindustrial levels.

The report's evaluation includes 18 different metals that are used in clean energy technologies like wind, solar, and battery storage, including lithium, cobalt, nickel, manganese, and copper. Their research, in a similar vein to other reports from organizations like the World Bank and International Energy Agency, looked at different pathways toward accomplishing climate goals and their relative mineral intensity. In any scenario, there was an increase in mineral demand compared to current production.

Sampat listed the following key findings from this report:

- The energy transition will likely cause large demand increases for metals that have previously only been mined in small amounts. Renewable energy technologies, especially batteries for electric vehicles (EVs) will be responsible for a significant portion of these demand increases.
- The world is not yet locked into any one scenario for how the energy transition will unfold. There are decisions to be made which will impact the mineral intensity of the energy transition.
- Lithium, cobalt, and rare earth minerals are most likely to see the largest increases in production. The report listed percentage increases in the minimum and maximum production scenarios, in the context of the energy transition. The following minerals were identified as having the largest likely increases in production:
  - Cobalt: 679% - 1788% increase
  - Dysprosium: 406% - 640% increase
  - Lithium: 1565% - 8845% increase
  - Neodymium: 369% - 592% increase
  - Nickel: 119% - 313% increase
- Electric vehicles, primarily private electric vehicles, will be the main driver of demand for key metals.
- A combination of technical shifts, recycling, and increased efficiency in how minerals are used has the most potential to reduce demand.
- The extent to which private EVs, as opposed to public transit, are adopted will be important. This shift affords an opportunity for a shift in transportation modes, which would have a significant impact on mineral demand as well as equity in outcomes.

Report: Reducing New Mining for EV Battery Minerals

Earthworks commissioned a subsequent report from the Institute for Sustainable Futures, which was released in 2021, titled "Reducing New Mining for EV Battery Minerals." In this report, they sought to determine the options for securing minerals to meet upcoming increases in demand. Grounding their claims in credible research, they looked at the potential for secondary sources to displace the pressure for new mining.

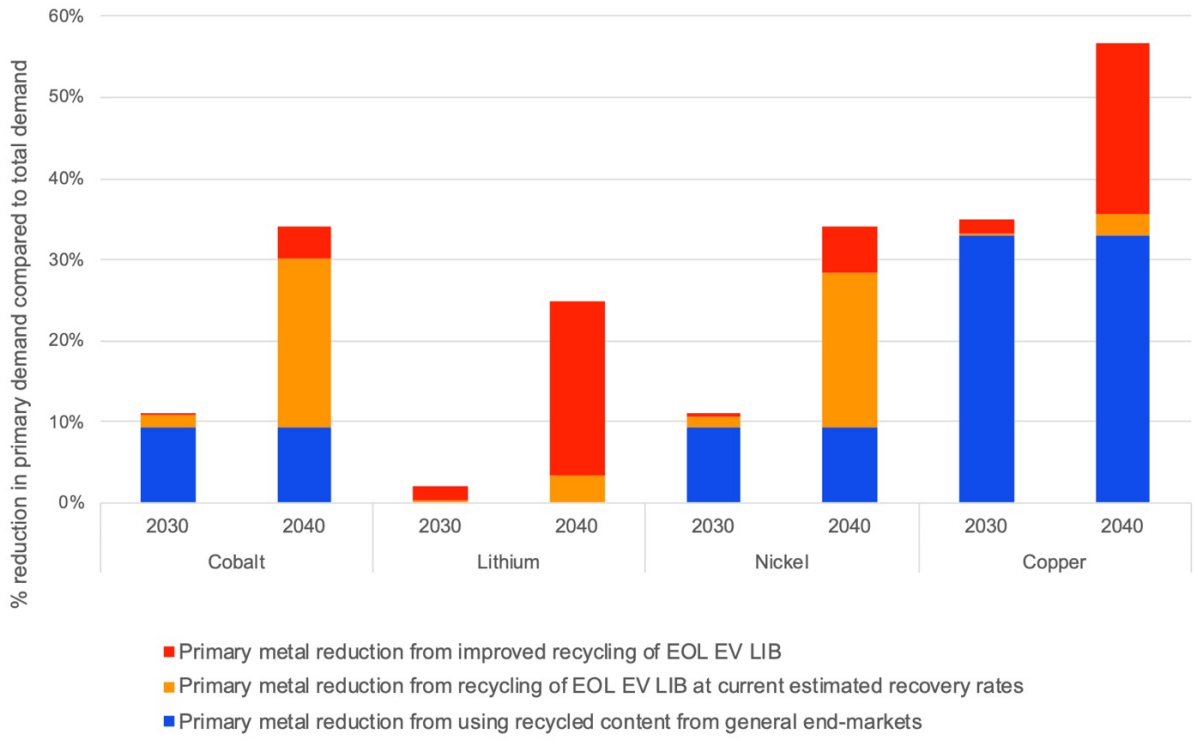


Figure 1: Impact of recycling on reducing primary metal demand

The key findings of this report are as follows:

- Recycling has the potential to reduce primary demand as a percentage of total demand in 2040, by approximately 25% for lithium, 35% for cobalt and nickel, and 55% for copper. This creates an opportunity to significantly reduce the demand for new mining.
  - In the Q&A session, Sampat added that these projections assume the continued use of current battery technologies with the mineral content being used today. Innovation may reduce the mineral needs of these technologies in the future, so these projections are likely conservative.
- For cobalt and nickel, most of the reduction in primary demand would come from the use of recycled metals from end-of-life electric vehicle lithium-ion batteries, assuming that recycling continues at current recovery rates (which are already relatively high).
- Recovery rates are expected to increase after the passage of the EU's EV battery regulations, which are expected to be voted on in March of 2022.
- There is significant potential to increase lithium recycling. At present, recycling rates for lithium are relatively low. Almost all the reduction in primary demand for lithium would come from the use of recycled metals from end-of-life lithium-ion batteries at an improved recovery rate.
- For copper, the use of recycled contents from general end-markets has the most potential impact on reducing primary demand, followed by the use of recycled metals from end-of-life electric vehicle lithium-ion batteries at an improved recovery rate.

There are also a variety of non-recycling options for reducing demand for lithium-ion batteries in EVs in general. One option is to extend battery lifetimes. Some manufacturers have proposed that 20-year battery lifetimes could be feasible, up from an estimated 8-15 years currently. Batteries could also be reused in "second-life"

applications like stationary storage for electricity grids, where batteries could be put to use for over a decade after being recovered from EVs.

Another option is a shift away from private car ownership. While car sharing schemes are a solution that is currently in practice, their widespread adoption is limited due to consumer preferences and a lack of policy support. Improved bike and public transit are also clear options to reduce private car use. Well-connected and incentivized electric buses and trains and the improved provision of bike infrastructure would reduce demand for private cars. However, these solutions are also currently limited by a lack of policy support.

Renewable Energy and Deep-Sea Mining: Supply, Demand, and Scenarios

In 2016, the Institute for Sustainable Futures conducted an analysis that specifically addressed the issues of mineral demand, the energy transition, and seabed mining. The report examined various scenarios for the mineral needs of the energy transition and possible implications for deep-sea mining. They summarized their results in the following paragraph:

> "A transition toward a 100% renewable energy supply can take place without deep-sea mining. Metal demand associated with the dominant renewable technologies evaluated in this report, even assuming very aggressive growth rates under the most ambitious future energy scenarios, do not require deep-sea mining activity. This is combined with a potential to increase recycling rates and sustained research and development into alternative technologies that reduce, or eliminate, the use of supply-constrained metals. The significant increase in production demands for neodymium and dysprosium, and the projected volumes of lithium and silver relative to current reserves suggests that these metals require special attention."

Levers for Change

Sampat concluded her presentation by describing levers for change to move toward a clean energy economy without irresponsible sourcing of minerals.

Boost Recycling and Minimize Toxicity

Boosting recycling and minimizing toxicity for a circular minerals system will help the energy transition occur without irresponsible mining activity. Policy interventions will be necessary to reach this goal. Currently, incentives and subsidies are vastly tilted in support of new extraction of minerals, even in developed countries like the United States. Policies like the new EU battery regulations that will receive a vote in March 2022 would encourage metals recovery and recycling and remove many of the barriers which currently incentivize new extraction. Policies aimed at extending product life and incentivizing the repurposing of batteries would also help accomplish this goal.

Recycling can also be facilitated through product take-back requirements, designing batteries for disassembly, and standardization of battery technologies. More than 50 different manufacturers are currently producing EVs. Recycling would be greatly facilitated if a standardized system were in place for battery takeback and recovery at the end of an EV's life.

As Sampat noted previously, it is essential to ensure that the new energy system does not repeat the mistakes of the old one. This means prioritizing the health and safety of workers and communities when planning recycling initiatives. While secondary production has a much lower footprint than new extraction, it is still toxic. Approaches to mineral recycling should guarantee that they will create no new sacrifice zones, ecosystem harm, or injustices.

It is also important to understand that R&D advances in battery technologies are resulting in substitutions and reductions of mineral content in clean energy technologies. Most projections for deep-sea and terrestrial mining assume that battery technologies, and therefore the mineral needs of battery manufacturing, will remain the same. This will not necessarily be the case – current battery R&D initiatives are seeking to replace cobalt and create batteries that are lighter and have much lower mineral content.

Demand-Side Shift in Consumption and Transportation

The projections of future mineral needs discussed in this presentation were produced in the context of a radical transformation of the energy system. At the moment, seabed mining proponents are discussing opening up an untouched area of the planet to mining. If this new frontier is being considered, it makes sense to consider other frontiers related to rethinking how people consume products and the transportation of goods and people. Prioritizing investments in electric-powered public transit can play a significant role in this, along with circular economy strategies that reduce battery demand and ensure second-life uses. In the Q&A session, Sampat confirmed that the degrowth movement could have an important role to play in this shift, allowing for the re-evaluation and reduction of mineral consumption needs to the extent possible.

It is also worth considering who is benefitting from the development and adoption of new energy technologies. Equity in access to these technologies is important. If the advantages and profits of the energy transition are accrued by a relatively small number of people in the global North, mining of new minerals is not necessarily benefitting all of humankind. If this outcome is to be avoided, equity in access to the benefits of clean energy and transit should be central to planning efforts.

Ensure Responsible Minerals Sourcing

Because new mineral needs of the energy transition cannot be met entirely by secondary sources, it is important to consider the path to conducting terrestrial mining more responsibly. Mineral mining in the U.S. is governed by the U.S. General Mining Law of 1872, a piece of legislation that is almost 150 years old. Mining companies in the U.S. and abroad are frequently exempt from environmental laws like the Clean Water Act.

Mining law reform is necessary to create legally binding regulations for the protection of human rights and the environment at the regional, state, national, and international level. Where the sourcing of new metals is necessary, operations should adhere to stringent environmental and human rights standards with independent, third-party assurance of compliance and civil society oversight.

Sampat identified the multi-stakeholder Initiative for Responsible Mining Assurance (IRMA) as a useful resource for assuring that new mining activities are conducted responsibly. IRMA articulates in a clear and detailed manner the environmental, human rights, social, transparency, reclamation, closure, and economic requirements for a mining operation with a much-reduced footprint. It also includes a requirement for third-party assurance to ensure accountability. Members of the initiative include mining companies, civil society organizations, frontline community members, trade unions, and the users of minerals like auto manufacturers and computer companies. In the Q&A session, Sampat added that IRMA is already operational, conducting audits and evaluating mining operations around the world. This articulation of responsible mining standards and system for oversight is a valuable tool for the creation of a more sustainable and humane mining industry that meets the needs of the renewable energy transition.

To view the PowerPoint associated with this presentation, click **here**.

Further reading cited by Sampat in her presentation:

Dominish, E., Florin, N. and Teske, S., 2019, *Responsible Minerals Sourcing for Renewable Energy.* Report prepared for Earthworks by the Institute for Sustainable Futures, University of Technology Sydney. **Available here.**

Dominish, E., Florin, N., Wakefield-Rann, R., (2021). *Reducing new mining for electric vehicle battery metals: responsible sourcing through demand reduction strategies and recycling.* Report prepared for Earthworks by the Institute for Sustainable Futures, University of Technology Sydney. **Available here.**

Teske, S., Florin, N., Dominish, E. and Giurco, D. (2016) *Renewable Energy and Deep Sea Mining: Supply, Demand and Scenarios.* Report prepared by ISF for J.M.Kaplan Fund, Oceans 5 and Synchronicity Earth, July 2016. **Available here.**

About the presenter: Payal Sampat is Mining Program Director at Earthworks, a nonprofit organization dedicated to protecting communities and the environment from the adverse impacts of mineral and energy development while promoting sustainable solutions. She leads Earthworks' efforts to reform mining practices through corporate and markets campaigns, policy reforms, and solidarity with frontline communities. She is the author of several publications on mining and a sustainable materials economy and is an NGO sector representative to the multi-sector Initiative for Responsible Mining Assurance.

She holds a BA in English from St Xavier's College, Bombay University and a Master's in International Environmental Policy and Planning from Tufts University.

IEA Report: The Role of Critical Minerals in Clean Energy Transitions

In 2021, the International Energy Agency (IEA) released a report entitled "The Role of Critical Minerals in Clean Energy Transitions." In this report, IEA presents a framework for securing the minerals necessary for the energy transition, similarly to the Institute for Sustainable Futures report "Responsible minerals sourcing for renewable energy" summarized by Sampat. These two reports together provide a comprehensive overview of how minerals can be secured for a clean energy future.

The IEA report was developed because, in a quick energy transition that effectively addresses the climate crisis, mineral demand will increase significantly because clean energy technologies tend to be far more mineral-intensive than their fossil fuel-burning counterparts. IEA estimates that the transition will require increasing mineral inputs to clean energy technologies by 4 to 6 times to meet climate goals. It acknowledges significant uncertainty – the extent to which new technologies and policy support are implemented will have a large impact on mineral intensity.

To meet this demand increase and improve security of mineral supplies, IEA proposes six key recommendations:

- Governments should send a clear signal about their climate ambitions to reduce uncertainty about the energy transition and spur diversified investment.
- Promote technology innovation to allow mineral substitution and unlock new supplies.
- Scale up recycling.
- Enhance supply chain resilience and market transparency.
- Promote higher environmental, social, and governance standards for the mining industry.
- Strengthen international collaboration between producers and consumers.

Similar to the Institute for Sustainable Futures analysis, the framework set out by the IEA in this report focuses largely on recycling, innovation, and making the mining industry more sustainable, socially responsible, and transparent. It does not include the deep seabed as a necessary source of new minerals for the energy transition. While it acknowledges that several key minerals can be found on the seabed, the report also recognizes the significant economic, technical, and environmental hurdles to retrieving them.

The IEA report can be found **here**.

U.S. State Department's Current Perspectives and Activities on Deep Seabed Mineral Mining

Introduction

The United States, which has not ratified the UN Convention on the Law of the Sea, participates in the International Seabed Authority (ISA) as an observer state. Regardless of its status, the U.S. has interest in seabed mining in international waters. **Gregory O'Brien**, Foreign Affairs Officer in the U.S. Department of State's Office of Ocean and Polar Affairs, explained the department's current perspectives on the issue. O'Brien organized his presentation into two sections: the U.S.'s general interest in seabed minerals, and its interests specifically related to the International Seabed Authority.

U.S. Interest in Seabed Minerals

In recent years, U.S. government agencies have been working to evaluate critical mineral needs. This involves identifying reliable sources of critical minerals and ensuring the security of supply chains. Soon after his inauguration, President Biden took steps to accomplish this goal by commissioning reports about the reliability of supply chains for four different types of resources. One of these resources was critical minerals.

This report, titled "Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth," released in June of 2021, addresses seabed minerals in a footnote:

> "Significant quantities of strategic and critical materials may be found on the seabed, but the industry to extract these resources remains nascent, given both technical challenges of mining in the marine environment and the potential for significant environmental harm. On the other hand, substantial portions of mineral exploration leases are held by foreign sources, providing not only a potential supply benefit, but also dual-use technology development associated with unmanned undersea vessels and hydrographic mapping. Though seabed resources may provide a significant future source of strategic and critical materials, they are not covered by this report."

In short, the U.S. views seabed minerals as a mid- to long-term option, not as an immediate source of new minerals. O'Brien noted that the U.S. is engaged in discussions with other countries about securing reliable sources of critical minerals. Those countries have typically reached similar conclusions. They view seabed mining has a nascent industry, one to watch and monitor, but not an immediate way to satisfy critical mineral needs.

U.S. Interest in the International Seabed Authority

Since the U.S. has not ratified the UN Convention on the Law of the Sea, it can only participate in ISA activities as an observer state. The U.S. has an interest in ISA activities, however, and was given an opportunity to rearticulate this interest at the ISA Council meeting in December 2021.

At the December meeting, the ISA's Legal and Technical Commission (LTC) recommended that four areas within the Clarion Clipperton Zone (CCZ) be added to a network of "Areas of Particular Environmental Interest" (APEIs), also known as protected areas. These areas would be added to nine existing APEIs which would not be subject to exploitation contracts through the ISA. This is significant for the U.S. because one of the new protected areas overlaps with an area that has been licensed to the Lockheed Martin Corporation under U.S. domestic law since the 1980s. The U.S. has two of these licenses active in the CCZ, and this was the first time in the history of the ISA that any action had affected either of them.

Since the U.S. is not a member of the ISA, the U.S.'s activities on the international seabed are governed by domestic law. The centerpiece of the U.S.'s approach to deep seabed mining in international waters is the Deep Seabed Hard Mineral Resources Act (DSHMRA), which was enacted by Congress in 1980. It was meant

to serve as a means to transition U.S. companies from mining activities licensed under domestic law to working under the regime envisioned in UNCLOS. O'Brien said that the U.S. still views the law in those terms – the current administration, like all administrations dating back to 1994, supports the U.S. joining UNCLOS and taking part in the international regime for seabed mining.

In the Q&A session following his presentation, O'Brien explained that U.S. companies face several challenges in the pursuit of domestic licenses for exploration and exploitation of minerals in areas of the seabed subject to ISA jurisdiction. Seabed mining requires a significant amount of investment capital, and investors want to be assured that the company has security of title to the exploration site for a defined number of years before they provide funds. Since the contracts held by Lockheed Martin were issued under U.S. domestic law, no other country is obligated to respect them. Without security of title or tenure, it is difficult to secure investment funding. While some people oppose the U.S. joining UNCLOS on the grounds that U.S. companies could conduct mining activity outside of its regulations, these uncertainties make that unlikely to happen. Companies that formerly held U.S. domestic contracts have largely moved on to pursuing contracts under the ISA instead.

O'Brien noted that, given the proposed establishment of these APEIs, it was important for the U.S. to express its continued interest in the two areas licensed to Lockheed Martin, as well as the continued work of the ISA, particularly its work to ensure effective protection of the marine environment. In response to the proposed APEI designation, the U.S. presented the following statement to the ISA, which O'Brien summarized:

> "Thank you, Mr. President. As this is the first opportunity for our delegation to speak, we congratulate you on your election as President and assure you of our delegation's support of your stewardship over the Council's work. We wish to thank the government of Jamaica and the Secretariat for facilitating these in-person meetings. We also wish to congratulate the LTC and in particular its chair for the impressive work done over the last two years under immensely challenging circumstances.
>
> The United States strongly supports measures, including the establishment of APEIs, for the protection of the unique flora and fauna and ecosystems of the deep-sea environment, and to develop a better understanding of those systems, their interdependencies, and their variability before beginning any development of these areas. This will be crucial for understanding the impact of any future extractive activities and ensuring their safety and best practices in any development.
>
> The United States notes the potential importance of deep seabed mining as a source of metals needed for renewable energy technologies. At the same time, we need to ensure effective protection of the marine environment.
>
> The United States for decades has advocated for a stable and internationally recognized framework for seabed mining that has protection of the marine environment as a core principle. It is essential that this regulatory framework provide effective protection for the marine environment from harmful effects which may arise from seabed mining activities, as required by the Convention. In this context, the ISA's consideration of APEIs to strengthen the Regional Environmental Management Plan for the Clarion-Clipperton Zone is appreciated.
>
> The U.S. Congress enacted legislation in 1980 to regulate the exploration and commercial activities of U.S. citizens in seabed areas through licenses and permits. Under this legislation, the United States issued a number of exploration licenses in the early 1980s, two of which continue to be periodically renewed under U.S. law. The United States notes that proposed APEI-13 overlaps in part with one of these two exploration licenses.
>
> The current and previous U.S. Administrations have had a long-standing interest in the United States becoming party to the Law of the Sea Convention and participating in the work of the Authority as a full member. If and when the United States joins the Convention, we would seek to better align the foregoing interests with decisions that may be taken here.
>
> We thank you for the opportunity to deliver this statement and thank you for your consideration."

The U.S. views access to and exploitation of seabed minerals as a long-term focus. It is not a party to the ISA and not a sponsor entity for exploration and exploitation contracts. However, in the long-term, the U.S. does aspire toward becoming a party to UNCLOS in order to participate more fully and actively in these activities. If and when that time comes, O'Brien said that the interests pursued under domestic law would align with the interests of the ISA.

At the end of the Q&A session, O'Brien addressed the recent resolution passed at the 2021 International Union for the Conservation of Nature (IUCN) World Conservation Congress which called for a moratorium on seabed mining. While the U.S. delegation participated actively in the Congress, it abstained from voting on that measure. The U.S. position is, fundamentally, that it supports a stable and internationally recognized framework for seabed mining in international waters. Embedded in that position is the need for effective protection of the marine environment from the harmful impacts of mining activities. While the U.S. did not vote for or against it, O'Brien said that this position is certainly not counter to the interests that are reflected in the resolution.

The U.S. statement at the December 2021 ISA Council meeting can be found **here**.

About the presenter: Gregory O'Brien is a Foreign Affairs Officer in the U.S. Department of State's Office of Ocean and Polar Affairs. He leads the United States' delegation to the International Seabed Authority.

Appendix: Conference Program

Friday, December 17, 2021

10:00 am - 10:05 am

Welcome and Opening Remarks

Robert Day
Executive Director
Renewable Natural Resources Foundation

Stephen Yaeger (moderator)
Program Manager
Renewable Natural Resources Foundation

10:05 am – 10:45 am

The Ecology of Deep Seabed Mineral Mining
As scientific understanding of ecology in the deep ocean has improved, it has become increasingly clear that deep seabed mineral mining would have serious impacts on ocean ecosystems. Moreover, current understanding of these ecosystems still has significant gaps that will require further research to understand completely. In this section, Lisa Levin will explain the state of the science regarding the ecosystems that would be impacted by seabed mining, including the gaps in current knowledge which limit our ability to fully evaluate mining risks.

Lisa Levin
Distinguished Professor of Biological Oceanography
Scripps Institution for Oceanography, University of California, San Diego
San Diego, California

PowerPoint Slides

10:45 am - 11:00 am

Questions and Discussion

11:00 am - 11:40 am

The International Seabed Authority and Current Issues in the Governance of Seabed Mining
The International Seabed Authority (ISA) is the intergovernmental body tasked with regulating and organizing all mining activity in international waters. One of its core responsibilities is to craft the regulations for the exploitation of seabed minerals. The country of Nauru recently invoked the ISA's "two-year rule," which will allow it to apply for an exploitation permit in the summer of 2023. This effectively puts a deadline on the completion of the mining rulebook. Proponents of this action argue that allowing seabed mining to commence as quickly as possible is necessary to facilitate the global transition to clean energy. Pradeep Singh will discuss the implementation of the two-year rule and the reasoning for it, as well as updates from December's ISA session in Kingston, Jamaica. He will then discuss potential paths forward, including the viability of a

moratorium, the implementation of the two-year rule, and the completion of the mining code.

Pradeep Singh
Research Associate
Institute for Advanced Sustainability Studies
Potsdam, Germany

PowerPoint Slides

11:40 am - 11:55 am **Questions and Discussion**

11:55 am - 12:35 pm **The Mineral Needs of the Clean Energy Transition: Do We Need to Mine the Seabed?**
Proponents of deep seabed mineral mining often argue that it is necessary to satisfy the mineral requirements of the clean energy transition. However, there is considerable uncertainty surrounding these mineral needs and whether recycling and terrestrial mining alone will have the capacity to satisfy them. Payal Sampat will discuss these uncertainties, as well as efforts to promote recycling, make terrestrial mining more sustainable and humane, and reduce the mineral requirements of the transition to a more sustainable economy.

Payal Sampat
Mining Program Director
Earthworks
San Francisco, California

PowerPoint Slides

12:35 pm - 12:50 pm **Questions and Discussion**

12:50 pm - 1:30 pm **U.S. State Department's Current Perspectives and Activities on DSMM**

Gregory O'Brien
Foreign Affairs Officer
Office of Ocean and Polar Affairs
U.S. Department of State
Washington, DC

1:30 pm - 1:45 pm **Questions and Discussion**

1:45 pm - 1:55 pm **Closing Remarks**

Robert Day
Executive Director
Renewable Natural Resources Foundation

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