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Forum: Environment Commission

Issue: Addressing the ecological effects of deep-sea mining in the Clarion Clipper Zone (CCZ)

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Introduction

Deep-sea mining in the Clarion-Clipperton Zone (CCZ), a 4.5 million km² region between Hawaii and Mexico, focuses on polymetallic nodules rich in manganese, nickel, copper, and cobalt. This mining in the global commons governed by the International Seabed Authority (ISA) under United Nations Convention on the Law of the Sea (UNCLOS) provides essential minerals for solar panels, wind turbines, and electric cars. Recent events, such as Nauru's 2021 notice that triggered the "two-year rule" for commercial mining and the ISA's 2025 decision to postpone regulations in the face of civil society protests and lawsuits from Pacific Island nations, highlight the urgency of finalizing a regulatory framework before deep-sea mining begins without proper oversight.

The CCZ holds 21 billion tonnes of nodules (potentially meeting global cobalt demand for 190 years) yet harbors 90% undiscovered species adapted to extreme 4,000-6,000m depths. Mining's sediment plumes (lasting months) and "blue carbon" disruption threaten millennia-old carbon sinks, potentially accelerating climate change. The damage is not localized; while a single collector vehicle directly disturbs 2 km² of seabed every hour, German 2022 trials revealed that the resulting sediment plumes spread biodiversity impacts as far as 20 km away.

Growing ecological risks to the Clarion-Clipperton Zone range from habitat destruction and sediment plumes upsetting marine ecosystems to mining-related toxic runoff and disruption of the carbon cycle. These dangers highlight the shortcomings of United Nations Convention on the Law Of the Sea (UNSCLOS) governance, put conservation measures like Area of Particular Environmental Interest (APEI) zones to the test, and emphasize the need to give ocean protection top priority despite the rising demand for minerals that power green technologies.

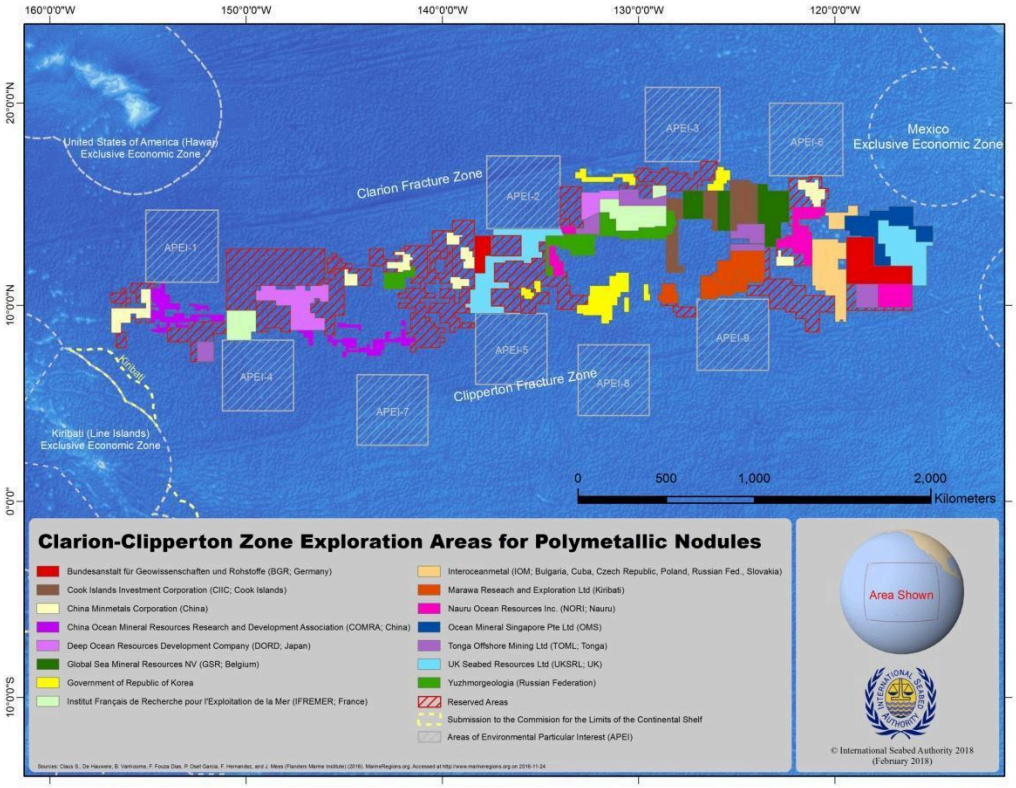

Figure #1. Clarion-Clipperton Zone Exploration Areas for Polymetallic Nodules. Source: International Seabed Authority, February 2018; https://isa.org.jm/deepdata-database/maps/

Key Terminology

Abyssal Plain

Extensive flat expanses of the deep seafloor located at depths of 4,000 to 6,000 meters comprise approximately 50% of Earth's surface. In the CCZ, these plains host slow-growing specialized species that are highly susceptible to disturbance from mining activities.

Area of Particular Environmental Interest (APEI)

The ISA has designated Areas of Particular Environmental Interest (APEIs) as protected zones within the Clarion-Clipperton Zone (CCZ), totaling 1.5 million km². These areas were established in 2012 as part of the CCZ environmental management plan to preserve

biodiversity hotspots and shield them from deep-sea mining impacts. Additional APEIs were approved in December 2021.

Blue Carbon

Carbon compounds captured, stored, and sequestered for centuries by coastal ecosystems such as mangroves, salt marshes, and seagrasses. These habitats act as natural buffers against climate change by trapping CO_2 at rates far exceeding terrestrial forests. CCZ disruption risks releasing ancient stores, worsening climate change.

Environmental Impact Assessment (EIA)

Mandatory pre-mining studies required to evaluate potential impacts on biodiversity, sediment plumes, and chemical risks associated with deep-sea extraction activities. Currently, significant gaps exist in their application to commercial-scale operations within the CCZ.

International Seabed Authority (ISA)

A Jamaica-based intergovernmental organization established by UNCLOS Part XI in 1994, tasked with regulating all mineral resource activities in the "Area" (seabed beyond national jurisdiction). Administers the "common heritage of mankind" principle by issuing exploration contracts, collecting royalties, and developing exploitation regulations.

Moratorium

A temporary suspension or ban on deep-sea mining activities in international waters, advocated by over 32 nations and environmental organizations to allow time for comprehensive environmental studies, development of regulations, and assessment of ecological risks in areas like the CCZ.

Plume Dispersion

Mud clouds of fine sediment particles resuspended by deep-sea mining collector vehicles. These turbid plumes extend over 20 kilometers from extraction sites and persist for weeks to months. They smother benthic organisms, reduce light penetration for

chemosynthetic ecosystems, and release heavy metals into surrounding waters, disrupting ecological connectivity across CCZ abyssal plains.

Polymetallic Nodules

Concentric mineral concretions, typically 4-10 cm in diameter, formed through slow precipitation of metals from seawater onto abyssal sediments over 1-10 million years. Composed primarily of manganese (27-30%), nickel (1.2-1.5%), copper (1.0-1.3%), and cobalt (0.2-0.3%), with trace rare earth elements. The Clarion-Clipperton Zone contains an estimated 21 billion dry tonnes, representing approximately 75% of global critical mineral reserves needed for low-carbon technologies.

Figure #2. A deep sea starfish between manganese nodules. (Picture: ROV Team, GEOMAR). Source: Meere Online; https://www.meere-online.de/en/topics/human-use-of-the-ocean/focus-deep-sea-mining

Two-Year Rule

UNCLOS clause allowing countries to start commercial mining if ISA lacks regulations within 2 years; Nauru (tiny Pacific island nation), seeking mining royalties, used it in 2021 to pressure ISA, sponsoring Canada's The Metals Company (delayed to 2026).

United Nations Convention on the Law of the Sea (UNCLOS)

The 1982 international treaty that establishes the legal framework for the International Seabed Authority (ISA) and governs all deep-sea mining activities in international waters.

Background

The target of deep-sea mining in the Clarion-Clipperton Zone (CCZ), which was found during the British expedition in 1872–1876, are polymetallic nodules at 4,000–6,000 meters. Following the oil crises of the 1970s, when U.S. consortia conducted trial dredges, interest grew. Seabed minerals are the "common heritage of mankind," according to the 1982 UNCLOS which established the International Seabed Authority (ISA) in 1994. 17 contractors currently own 1.3 million km² since China's first exploration contract was awarded in 2001; however, Nauru's 2021 "two-year rule" expedited regulations, which are still stalled despite mounting calls for a moratorium.

Economic Aspects

The CCZ hosts a 90 percent concentration of the world manganese in what are called nodules with large portions of nickel, copper, and cobalt, which are essential to batteries and renewables. One mine might produce $40-200 billion in 25 years, as the Global South is financed by the ISA royalties. However, recycling rates are below 1% and mass seafloor production would break down metal prices by up to 60 percent posing a threat to export profits in countries such as Chile and Zambia. Capital expenses are very high and returns are unpredictable which makes viability a challenge despite their stated emission being 90% less than that of land mines.

Political Aspects

ISA's 170 members are divided. China has nine contracts signifying early exploitation and more than 30 countries, such as France and Germany, endorse moratorium. The U.S., which is not under UNCLOS, will be licensing firms on its own, which might lead to fragmentation on governance. Pacific sponsors such as Nauru, Kiribati, Tonga and Cook Islands urge equitable terms, however North-South conflicts remain on the issue of benefit-sharing and environmental standards. ISA gridlock is a measure of geopolitical competition, as China and Russia oppose all strict protective measures to protect their strategic access to essential minerals.

Environmental Aspects

The CCZ harbors 5,000+ mostly endemic species reliant on nodules as habitat. Mining leads to disruption of sediments leading to the 90–98% death of large benthic life and sediment plumes traveling over 100km. Recovery may require centuries while noise and light is acting on migratory species. Models indicate that, despite the nine APEI protected zones, they are not able to maintain ecological connectivity across the CCZ.

Social Aspects

Deep-sea mining has the potential to provide 10,000-260,000 jobs and Sustainable Development Goals funding without providing any direct community benefits. Unlike terrestrial mines, it excludes indigenous voices and coastal stakeholders because decisions are made at the ISA by member states behind closed doors, with no formal mechanism for indigenous participation. Pacific Islander communities report being sidelined in decisions affecting their waters, facing short consultation periods and no requirement for free, prior and informed consent. Even when indigenous advocates attend ISA meetings, their recommendations have been dismissed. Equitable royalties and transparency could make seabed resources a pillar of sustainable development, but only if governance prioritizes ocean health over short-term economic gain.

Major Parties Involved

International Seabed Authority (ISA)

Under the UN Convention on the Law of the Sea (UNCLOS), the International Seabed Authority (ISA) was created to oversee deep-sea mining in regions outside of national borders. The seabed is the “common heritage of mankind” according to UNCLOS Article 136, and Article 145 assigns the ISA the responsibility of creating a balance between ecosystem preservation and resource exploitation. The ISA has not yet granted any commercial mining licenses; however, it is known that the Authority has already granted 31 exploration contracts. One important clause would be the “two-year rule,” which was implemented by Nauru in 2021 and mandates that the ISA completes regulations within two years of receiving notice from a sponsoring state. Non-parties like the United States disputing the legitimacy of UNCLOS complicate global governance.

China Ocean Mineral Resources Research and Development Association (COMRA)

China's COMRA was founded in 1990 with State Council approval and in 1991 it registered as a pioneer investor with the UN. The Association makes significant investments in mining technology and has five CCZ exploration contracts which is the most of any sponsor. By using its ISA influence to shape regulations and secure mineral supply chains that are essential for green industries, COMRA seeks Mining Code terms that support resource sovereignty and industrial security.

Pacific Island States (Nauru, Tonga, Kiribati, Cook Islands)

Although they sponsor CCZ projects for financial gain, Nauru, Tonga, Kiribati, and the Cook Islands encounter significant political and ecological opposition. While Tonga and the Cook Islands faced domestic criticism, Nauru's "two-year rule" in 2021 expedited ISA negotiations. These countries represent the trade-off between immediate benefits and long-term ocean health.

Environmental Coalitions

Environmental coalitions like the Deep Sea Conservation Coalition, World Wide Fund for Nature Pacific (WWF Pacific), and Pacific Network on Globalisation (PANG) campaign for a moratorium, highlighting sediment plumes, biodiversity loss, and data gaps. Through lobbying and research, they press for a precautionary global ban and greater accountability within the ISA.

United States

The U.S., not a UNCLOS party, seeks mineral access for security and clean energy. *Via* Executive Order 13955 (2020), it streamlined domestic permitting, enabling firms like TMC to bypass ISA. This approach risks eroding ISA legitimacy, prioritizing mineral independence over multilateral rules and potentially encouraging unilateral actions.

Timeline of Events

Date	Description/Note

1982	UNCLOS adopted at the Third UN Conference on the Law of the Sea, establishing the legal framework for deep-sea mining and the "common heritage of mankind" principle (Article 136).
1994	International Seabed Authority (ISA) formally established under UNCLOS to regulate mining in international waters.
2001	China's COMRA secures its first CCZ exploration contract with ISA, marking China's entry into deep-sea mineral extraction.
2006–2020	Accumulation of exploration contracts awarded by ISA: by 2010, approximately 10 contracts; by 2015, the total reaches approximately 20 active exploration licenses; by 2020, 28 exploration contracts are active in the CCZ.
June 28, 2020	U.S. President Trump issues Executive Order 13955, streamlining domestic permitting for deep-sea mining, enabling firms to bypass ISA processes.
July 9, 2021	Nauru invokes the "two-year rule" (Annex IV, Article 15 of UNCLOS), triggering a deadline for ISA to finalize exploitation regulations.
March 15, 2024	At the UN Environment Assembly (UNEA-6), environmental coalitions push for a global moratorium on deep-sea mining, citing biodiversity risks.
December 10, 2025	ISA holds a critical Mining Code session; negotiations stall over environmental standards and benefit-sharing.
Q2 2026	**Forecast**: ISA expected to release a revised draft of the Mining Code, incorporating feedback from member states and stakeholders. Debates focus on liability, monitoring, and protected areas.

Previous Attempts/Solutions

International Seabed Authority (ISA)-Led Regulatory Frameworks

The International Seabed Authority (ISA), created under UNCLOS, is the only body regulating deep-sea mining beyond national jurisdiction, which includes the CCZ. Its main initiatives

include exploration rules adopted in 2010–2012 setting basic contractor standards, however excluding CCZ nodules, which limits their relevance. Precautionary amendments in 2013 introduced environmental safeguards and non-commercial test limits, yet enforcement mechanisms remained relatively fragile, making them largely unenforceable. Draft exploitation regulations proposed in 2019 included governance, benefit-sharing, and monitoring measures, however political divisions stalled their adoption when member states clashed over royalty rates, environmental standards, and the distribution of revenues. Mining Code negotiations from 2016 to 2025 have similarly stalled over persistent debates on environmental impact assessments, financial terms, and compliance mechanisms, compounded by the 2021 "two-year rule" triggering that created additional time pressure without resolving underlying disagreements.

Triggering the "Two-Year Rule" (2021)

In 2021 Nauru invoked Annex IV Article 15 of UNCLOS requiring the ISA to finalize exploitation regulations within two years, therefore by July 2023. The goal was to accelerate rulemaking and enable mining. Unfortunately, the initiative was unsuccessful in achieving it as regulations were not finalized by the deadline. This solution exposed ISA's inability to meet deadlines, which weakened trust in its regulatory process and set a leverage for contractors to pressure the ISA *via* procedural mechanisms.

National and Regional Solutions

Multiple countries and regional bodies pursued domestic and cooperative approaches. Pacific Island States developed national frameworks for seabed minerals aiming for regional harmonization and capacity building through the EU-Secretariat of the Pacific Community Project from 2011 to 2016. This initiative was partially successful as frameworks were developed, however harmonization across the region still remains incomplete. The Cook Islands adopted a national regulatory framework in 2024 designed to balance economic interests with environmental safeguards, yet its success has been limited as well as while the framework was adopted, it has faced criticism for inadequate public consultation.

Civil Society and Multilateral Advocacy

Citing unresolved ecological risk, at least 32 nations and coalitions, including the Deep Sea Conservation Coalition, had demanded a halt to commercial mining by 2024. Political support for such a pause is still growing, even though no legally binding agreement has been reached. Although they have had varying degrees of success, advocates have pushed for stronger safeguards through forums such as the United Nations Environment Assembly (UNEA) and ISA sessions. Although they have increased awareness, they have not succeeded in moving ISA negotiations in the direction of more stringent regulations.

Potential Solutions

Vector 1: Precautionary Governance and Knowledge Building

A temporary five-year moratorium on commercial mining activities in the CCZ appears necessary looking at significant gaps in current scientific knowledge which includes an incomplete understanding of CCZ biodiversity, unknown species recovery rates after disturbance, and insufficient data on the cumulative impacts of mining operations. The ban would remain in place until two key conditions are met: independent peer reviews would confirm that mining can proceed with minimal ecosystem disruption, and the International Seabed Authority (ISA) would adopt environmental safeguards. This approach allows critical research, though it delays economic benefits for sponsoring states and might face opposition from mining-advancing nations. Its feasibility is estimated to be moderate as consensus requirements at the ISA make adoption without compromise complex.

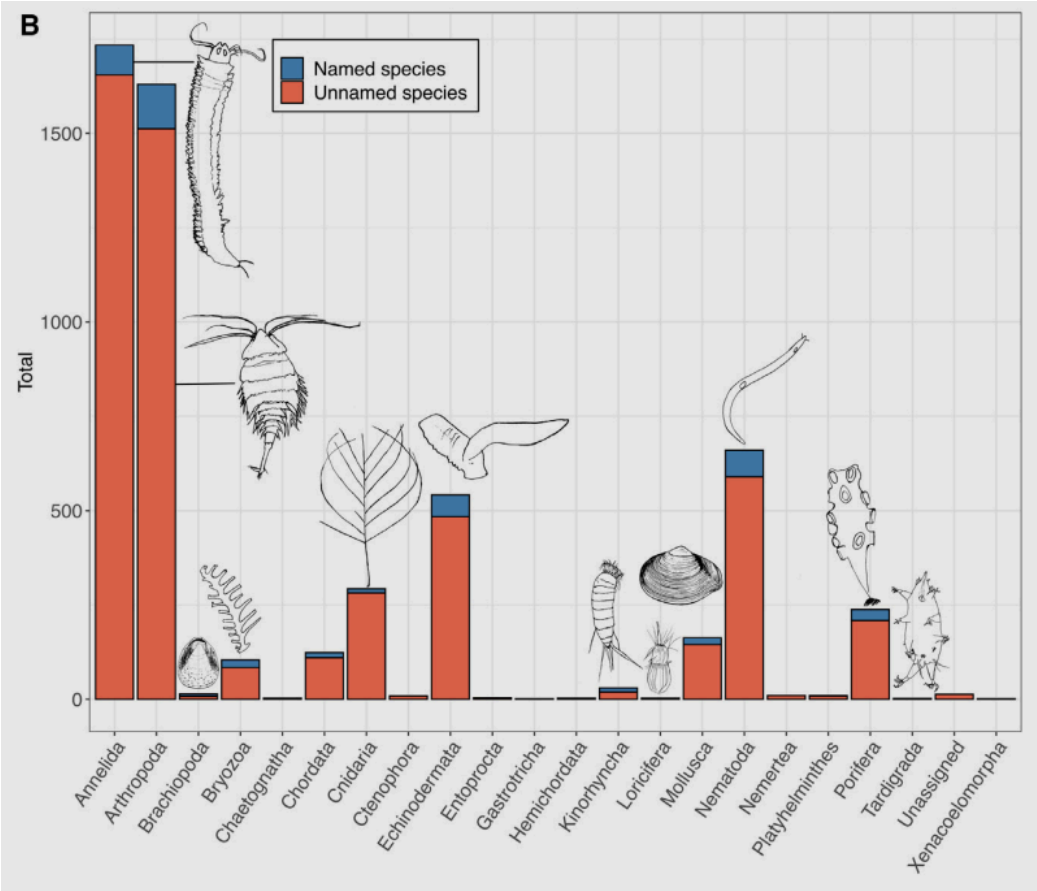

Figure #3. Proportion of species diversity in the Clarion Clipperton Zone (CCZ) that is undescribed. Source: "Current Biology", Volume 33, Issue 12, 19 June 2023; Article *How many metazoan species live in the world's largest mineral exploration region?* https://www.sciencedirect.com/science/article/pii/S0960982223005341#mmc2

To address knowledge gaps effectively, it is proposed to integrate advanced artificial intelligence into scientific research efforts. The AI system would perform habitat mapping, predictive impact modeling, and real-time anomaly detection. This integration would enable proactive ecosystem stewardship based on real-time evidence, which would accelerate data processing and reduce error, yet it would require significant funding and technical expertise. The feasibility is high, as the ISA can mandate contractor contributions and, moreover, similar technologies are already in development.

Vector 2: Ecosystem Protection and Spatial Planning

Hydrothermal vent fields, unique sponge and coral groups, and important migration paths would receive protection if APEIs were expanded to cover at least 40 to 50% of the CCZ area, going beyond the current 33%. Buffer zones of 100 km around all APEIs could improve protection by lessening the impacts of sediment plumes and other mining-related disturbances while keeping core habitats intact. Although this expansion might reduce the land available for mining or face pushback from contractor states, it could significantly enhance biodiversity conservation. Since ISA members need to agree and current contracts must be resigned, the likelihood of this solution being feasible appears to be low to moderate.

Measurable limits for managing noise pollution, controlling sediment plumes, and protecting biodiversity could be established outside of protected areas. Mandatory audits by independent experts, ongoing real-time monitoring, and transparent reporting of all incidents and compliance data are essential for enforcement. This would provide clear guidelines, encourage accountability, and allow for results-oriented management. However, such measures need technical skills, cooperation from contractors, and robust enforcement tools. While effective enforcement in the deep sea remains a technical challenge, the ISA could require compliance, and similar standards already exist in other industries, making this a moderately feasible option.

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